User Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio Release 12.6(2)

First Published: 2023-04-28

Last Modified: 2023-04-28

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 527-0883

THE SPECIFICATIONS AND INFORMATION REGARDING THE PRODUCTS IN THIS MANUAL ARE SUBJECT TO CHANGE WITHOUT NOTICE. ALL STATEMENTS, INFORMATION, AND RECOMMENDATIONS IN THIS MANUAL ARE BELIEVED TO BE ACCURATE BUT ARE PRESENTED WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED. USERS MUST TAKE FULL RESPONSIBILITY FOR THEIR APPLICATION OF ANY PRODUCTS.

THE SOFTWARE LICENSE AND LIMITED WARRANTY FOR THE ACCOMPANYING PRODUCT ARE SET FORTH IN THE INFORMATION PACKET THAT SHIPPED WITH THE PRODUCT AND ARE INCORPORATED HEREIN BY THIS REFERENCE. IF YOU ARE UNABLE TO LOCATE THE SOFTWARE LICENSE OR LIMITED WARRANTY, CONTACT YOUR CISCO REPRESENTATIVE FOR A COPY.

The Cisco implementation of TCP header compression is an adaptation of a program developed by the University of California, Berkeley (UCB) as part of UCB's public domain version of the UNIX operating system. All rights reserved. Copyright © 1981, Regents of the University of California.

NOTWITHSTANDING ANY OTHER WARRANTY HEREIN, ALL DOCUMENT FILES AND SOFTWARE OF THESE SUPPLIERS ARE PROVIDED “AS IS" WITH ALL FAULTS. CISCO AND THE ABOVE-NAMED SUPPLIERS DISCLAIM ALL WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING, WITHOUT LIMITATION, THOSE OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT OR ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

IN NO EVENT SHALL CISCO OR ITS SUPPLIERS BE LIABLE FOR ANY INDIRECT, SPECIAL, CONSEQUENTIAL, OR INCIDENTAL DAMAGES, INCLUDING, WITHOUT LIMITATION, LOST PROFITS OR LOSS OR DAMAGE TO DATA ARISING OUT OF THE USE OR INABILITY TO USE THIS MANUAL, EVEN IF CISCO OR ITS SUPPLIERS HAVE BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

Any Internet Protocol (IP) addresses and phone numbers used in this document are not intended to be actual addresses and phone numbers. Any examples, command display output, network topology diagrams, and other figures included in the document are shown for illustrative purposes only. Any use of actual IP addresses or phone numbers in illustrative content is unintentional and coincidental.

All printed copies and duplicate soft copies of this document are considered uncontrolled. See the current online version for the latest version.

Cisco has more than 200 offices worldwide. Addresses and phone numbers are listed on the Cisco website at www.cisco.com/go/offices.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: https://www.cisco.com/c/en/us/about/legal/trademarks.html. Third-party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1721R)

© 1994–2023 Cisco Systems, Inc. All rights reserved.

CONTENTS

PREFACE

Preface ix

Change History ix

About this Guide ix

Audience ix

Related Documents x

Communications, Services, and Additional Information x

Documentation Feedback x

CHAPTER 1

Introduction 1

VoiceXML Overview 1

VRU Technologies Limitations 1

VRU Development Simplification with VoiceXML 1

Key Business Benefits of VoiceXML 2

VoiceXML Use 3

VoiceXML Development Challenges 3

Unified CVP Solution 3

Call Studio 3

VXML Server 4

Unified CVP Elements 5

Voice Elements 6

VoiceXML Insert Elements 7

Decision Elements 8

Action Elements 8

Flag Elements 9

Modular Application 9

Subflows 10

Unified CVP Call Studio Introduction 11
Preferences 11
Builder for Call Studio 13
Project Introduction 13
Create Call Studio Project 13
Create Subflow 22
Refactor Call Flows 24
Call Stack History View 25
Variables View 25
Modify Data Variables in the Variables View 26
Import Call Studio Applications 26
Export Call Studio Applications 26
Online Help 27

CHAPTER 2 Cisco Unified CVP VoiceXML Components 29
Components 29
Variables 30
Global Data 30
Application Data 31
Session Data 31
Element Data 31
Component Accessibility 32
APIs 33
Configurable Elements 34
Standard Action and Decision Elements 34
Dynamic Element Configurations 35
Start / End of Call Actions 35
Event Handling 35
Say It Smart Plugins 36
Start and End of Application Actions 37
Loggers 37
On Error Notification 38
Unified CVP XML Decisions in Detail 38
<call_data> 41

<data> 42
<user_info> 42
<general_date_time> 43
<caller_activity> 43
<historical_data> 44
XML Decision Example1 45
XML Decision Example2 46
XML Decision Example3 47
VoiceXML Insert Elements 49
Insert Element Restrictions 50
Insert Element Inputs 50
Insert Element Outputs 53
Root Document 54
Example of Insert Elements 55

CHAPTER 3 **Administration** 57
Introduction to VXML Server Administration 57
JMX Management Interface 57
Administration Scripts 58
System Information Page 59
Administration Information 60
Application and System Status 60
VXML Server Information 61
VXML Gateway Adapter 63
Configuration Updates 64
VXML Server Configuration Options 65
Application Configuration Options 67
Administration Functions 68
Graceful Administration Activity 68
Applications Update 68
Applications Suspension 70
Applications Addition 73
Applications Removal 73
Common Classes Update 75

Global and Application Data Function 75
Administrator Log Access 77
Administration Function Reference 77
VXML Server Metrics 78

CHAPTER 4 **User Management** 83
Deployment 83
Database Design 84
Applications 84
User Data 85
Historical Data 86

CHAPTER 5 **VXML Server Logging** 89
Loggers 89
Global Loggers 90
Global Call Logger 90
Global Error Logger 91
Global Administration History Logger 95
Application Loggers 95
Application Activity Logger 96
Application Error Logger 107
Application Administration History Logger 110
Application Debug Logger 111
Correlating Unified CVP Call Server Logs with VXML Server Logs 112

CHAPTER 6 **VXML Server Configuration** 113
Global Configuration File 113
Setup Options 113

CHAPTER 7 **JavaScript Utilities** 117
JSONPath Expression 117
XPath Expression 117
Date Validation 118
Time Validation 119

CHAPTER 8 **Web Service Integration** 121

SOAP Service 121

Web Services Element 121

Rest Service 121

Rest_Client Element 121

Ignore Certificate Validation 122

Import Certificate in Call Studio for Debug Mode 122

Import Certificate in VXML Server 122

Create One-Way Communication Between VXML and REST Server 123

Create Two-Way Communication Between VXML and REST Server 124

XPath Expression 124

JSONPath Expression 125

CHAPTER 9 **Standalone Application Builder** 127

Standalone Application Builder Introduction 127

Script Processing 128

Script Output 128

User Level Access Control for Call Studio 129

Steps for the Administrator 129

Steps for the User 129

APPENDIX A **Substitution Tag Reference** 131

APPENDIX B **Directory Structure** 137

Glossary of Terms ?

Preface

- Change History, on page ix
- About this Guide, on page ix
- Audience, on page ix
- Related Documents, on page x
- Communications, Services, and Additional Information, on page x
- Documentation Feedback, on page x

Change History

This table lists changes made to this guide. Most recent changes appear at the top.

Change	See	Date
Initial Release of Document for Release 12.6(2)		April 2023
Initial Release of Document for Release 12.6(2) ES09		November 2023
Added Remote URL settings update for Call Studio project	See **Introduction** > **Unified CVP Call Studio Introduction** > **Create Call Studio project** procedure.	

About this Guide

This document describes the various components that can exist on Cisco Unified CVP VXML Server, administering the VXML Server, and VXML Server logging.

Audience

This design guide is intended for the system architects, designers, engineers, and Cisco channel partners who want to apply best design practices for the Cisco Unified Customer Voice Portal (CVP).

This document assumes that you are already familiar with basic contact center terms and concepts.

Related Documents

Note Planning your Unified CVP solution is an important part of the process in setting up Unified CVP. Read *Solution Design Guide for Cisco Unified Contact Center Enterprise* before you configure Unified CVP solution.

Unified CVP provides the following documentation:

- *Solution Design Guide for Cisco Unified Contact Center Enterprise*
- *Configuration Guide for Cisco Unified Customer Voice Portal*
- *Element Specifications for Cisco Unified CVP VXML Server and Cisco Unified Call Studio*
- *Installation and Upgrade Guide for Cisco Unified Customer Voice Portal*
- *Port Utilization Guide for Cisco Unified Contact Center Solutions*
- *Reporting Guide for Cisco Unified Customer Voice Portal*

For additional information about Unified ICM, refer to the *Cisco web site listing Unified ICM documentation.*

Communications, Services, and Additional Information

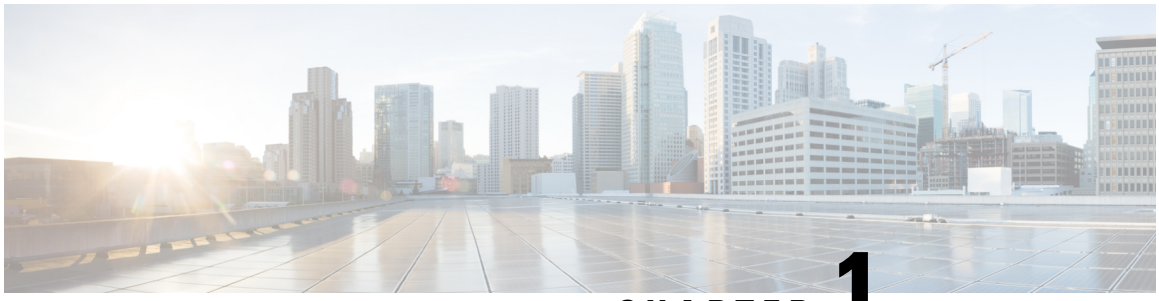
- To receive timely, relevant information from Cisco, sign up at Cisco Profile Manager.
- To get the business impact you're looking for with the technologies that matter, visit Cisco Services.
- To submit a service request, visit Cisco Support.
- To discover and browse secure, validated enterprise-class apps, products, solutions and services, visit Cisco Marketplace.
- To obtain general networking, training, and certification titles, visit Cisco Press.
- To find warranty information for a specific product or product family, access Cisco Warranty Finder.

Cisco Bug Search Tool

Cisco Bug Search Tool (BST) is a web-based tool that acts as a gateway to the Cisco bug tracking system that maintains a comprehensive list of defects and vulnerabilities in Cisco products and software. BST provides you with detailed defect information about your products and software.

Documentation Feedback

Provide your comments about this document to: mailto:contactcenterproducts_docfeedback@cisco.com.



CHAPTER 1

Introduction

- VoiceXML Overview, on page 1
- Unified CVP Solution, on page 3
- Unified CVP Call Studio Introduction, on page 11

VoiceXML Overview

Since its introduction, VoiceXML has become the standard technology for deploying automated phone systems. The overview of traditional technologies used to develop interactive voice response systems is given to understand the acceptance of VoiceXML by enterprises, carriers, and technology vendors.

VRU Technologies Limitations

Conventional VRU solutions are not speech enabled, and upgrading to speech recognition on a traditional VRU platform is difficult. These VRU solutions do not allow the choice and flexibility necessary to meet the increasing demands of fast, quality service and a consistent experience across phone and web contact channels. These limitations of conventional VRU solutions are overcome by implementing VoiceXML as one-size-fits-all VRU solution because VoiceXML is flexible and powerful.

VRU Development Simplification with VoiceXML

VoiceXML is a programming language that was created to simplify the development of VRU systems and other voice applications. Based on the Worldwide Web Consortium's (W3C's) Extensible Markup Language (XML), VoiceXML was established as a standard in 1999 by the VoiceXML Forum, an industry organization founded by AT&T, IBM, Lucent and Motorola. Today, many hundreds of companies support VoiceXML and use it to develop applications.

VoiceXML utilizes the same networking infrastructure, HTTP communications, and markup language programming model. VoiceXML has features to control audio output, audio input, presentation logic, call flow, telephony connections, and event handling for errors. It serves as a standard for the development of powerful speech-driven interactive applications accessible from any phone.

Key Business Benefits of VoiceXML

A VoiceXML-based VRU provides options when creating, deploying, and maintaining automated customer service applications. By providing the standards-based feature of VoiceXML, organizations are obtaining a number of benefits including:

- **Portability**—VoiceXML eliminates the need to purchase a proprietary, special purpose platform to provide automated customer service. The standards-based feature of VoiceXML allows VRU applications to run on any VoiceXML platform, eliminating customer bound. A VoiceXML-based VRU offers businesses a choice in application providers and allows applications to move between platforms with minimal effort.
- **Flexible application development and deployment**—VoiceXML enables freedom of choice in VRU application creation and modification. Because it is similar to HTML, development of VRU applications with VoiceXML is simple and does not require specialized knowledge of proprietary telephony systems. VoiceXML also is widely available to the development community so enterprises can choose between many competing vendors to find an application that meets their business needs. Increased application choice also means that businesses are not tied to the timeframe of a single application provider and can modify their VRU based on their own organizational priorities.
- **Extensive integration capability**—VRU applications written in VoiceXML can integrate with and use existing business applications and data, which extends the capabilities of core business systems already in use. A VoiceXML-based VRU can integrate with any enterprise application that supports standard communication and data access protocols. By leveraging the capabilities of existing legacy and web systems to deliver better voice services, organizations can consider their VRU like their enterprise applications and fulfill business demands with an integrated customer-facing solution.

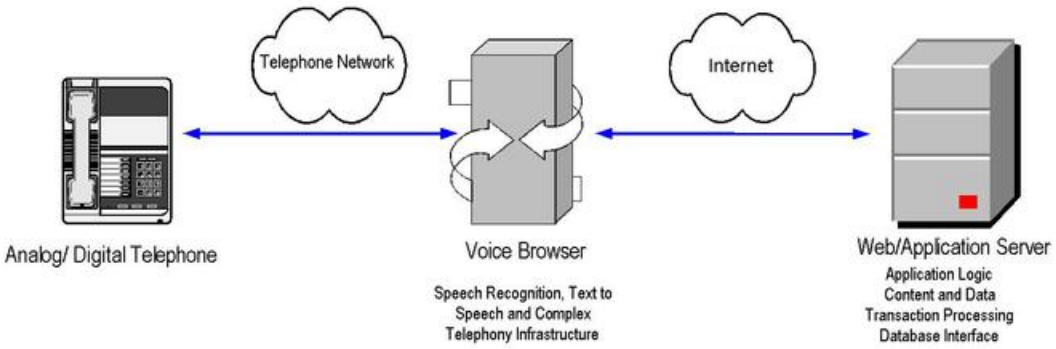
  The wide array of options available allows businesses to maximize existing resources to deliver better service at lower cost.
- **Reduced total cost of ownership**—The options offered by a VoiceXML-based VRU reduces the total cost of ownership in several key areas:
  - **Speech capability is standard**—The VoiceXML architecture directly supports integration with speech recognition, which makes a VoiceXML-based VRU a cost- effective alternative to retrofitting a traditional VRU for speech. Incorporating speech into an VRU solution increases call completion, lowering the average cost per call.
  - **Lower hardware and maintenance costs**—VoiceXML applications run on commonly available hardware and software, enabling businesses to save money by using equipment that they already own instead of purchasing special purpose hardware. Additionally, businesses can use the same team that handles existing enterprise maintenance to maintain VRU applications written in VoiceXML.
  - **Affordable scaling**— In a VoiceXML-based VRU model, application logic resides on a web/application server and is separate from telephony equipment. Businesses can save money by purchasing capacity for regular day-to-day needs and outsourcing seasonal demand to a network provider.
  - **Applications for every budget**—Competition between VoiceXML application developers provides a variety of VRU solutions for budgets of all sizes. Businesses pay only for necessary application features.

VoiceXML Use

VoiceXML is designed to leverage web infrastructure. VoiceXML is analogous to HTML, which is a standard for creating web sites. The development of voice applications using VoiceXML is simple and straightforward. Because the complexities of voice applications development are hidden from developers, they can focus on business logic and call flow design rather than complex platform and infrastructure details.

With VoiceXML, callers interact with the voice application over the phone using a voice browser. The voice browser is analogous to a graphical web browser, such as Microsoft's Internet Explorer. Instead of interpreting HTML as a web browser does, the voice browser interprets VoiceXML and allows callers to access information and services using their voice and a telephone.

Figure 1: VoiceXML Platform Architecture



The primary components of the VoiceXML platform architecture are the telephone, voice browser, and application server. The voice browser, a platform that interprets VoiceXML, manages the dialog between the application and the caller by sending requests to the application server. Based on data, content, and business logic, the application server creates a VoiceXML document dynamically or uses a static VoiceXML document that it sends back to the voice browser as a response.

VoiceXML Development Challenges

Unified CVP Solution

To address the challenges, Unified CVP provides a complete solution for rapidly conceiving, creating, and deploying dynamic VoiceXML 2.0 compliant applications. In order to understand how to use Unified CVP to build dynamic voice applications, you need to understand the components of the system and how they work. This section presents a high-level overview of all the components of Unified CVP software.

Unified CVP consists of three main components: Cisco Unified Call Studio (Call Studio), VXML Server, and Unified CVP Elements. Each of these components is discussed in further detail in this section.

Call Studio

Call Studio is a development platform for the creation of voice applications. Call Studio provides a framework on which the host of Unified CVP and third-party tools appear with a robust, consistent interface for voice

application designers and developers to use. Call Studio provides a true control panel for developing all aspects of a voice application; each function is implemented as a plug-in to the Call Studio platform.

The most important plug-in for Call Studio is Builder for Call Studio (or Builder), the component that Cisco built to provide a drag-and-drop graphical user interface (GUI) for the rapid creation of advanced voice applications.

Builder for Call Studio provides:

- **Intuitive Interface**: Using a process similar to flowcharting software, the application developer can use Builder for Call Studio to create an application, define its call flow, and configure it to the exact specifications required.
- **Design and build at the same time**: Builder for Call Studio acts as a design tool as well as a building tool, allowing the developer to rapidly try different application call flows and then test them out immediately.
- **No technical details required**: Builder for Call Studio requires little to no technical knowledge of Java, VoiceXML, or other markup languages. For the first time, the bulk of a voice application can be designed and built by voice application design specialists, not technical specialists.
- **Rapid application development**: By using Builder for Call Studio, developers can dramatically shorten deployment times. Application development time is reduced by as much as 90 percent over the generation and management of flat VoiceXML files.

You can access Call Studio documentation by accessing the Help menu in Call Studio. This guide, however, includes a brief introduction to Call Studio in the Call Studio Introduction section in this chapter.

VXML Server

VXML Server is a powerful J2EE- and J2SE-compliant run-time engine. VXML Server provides:

- **Robust back-end integration**: VXML Server runs in a J2SE and J2EE framework, giving the developer access to the full collection of middleware and data adapters currently available for those environments. Additionally, the Java application server provides a robust, extensible environment for system integration and data access and manipulation.
- **Session management**: Call and user data are maintained by VXML Server so that information captured from the caller (or environment data such as the caller's number or the dialed number) can be easily accessed during the call for use in business rules.
- **Dynamic applications**: Content and application logic are determined at runtime based on rules ranging from simple to the most complex business rules. Almost all details about an application can be determined at runtime.
- **System Management**: VXML Server provides a full suite of administration tools from managing individual voice applications without affecting users calling into them to configurable logging of caller activity for analytical purposes.
- **User Management**: VXML Server includes a lightweight customer data management system for applications where more robust data are not already available. The user management system allows dynamic applications to personalize the call experience depending on the caller.

VXML Server capabilities listed above are discussed in further detail in Administration, User Management, and VXML Server Logging sections.

Unified CVP Elements

The Unified CVP Elements are a collection of prebuilt, fully tested building blocks to speed application development

- **Browser compatibility**: Unified CVP's library of voice elements produce VoiceXML supporting the industry's leading voice browsers. They output dynamically generated VoiceXML 2.0 compliant code that has been thoroughly tested with each browser.
- **Reusable functionality**: Unified CVP Elements encloses the parts of a voice application, from capturing and validating a credit card to interfacing with a database. Unified CVP Elements greatly reduce the complexity of voice applications by managing low-level details.
- **Configurable content**: Unified CVP Elements can be configured by the developer to customize their output specifically to address the needs of the voice application. Prebuilt configurations using proven dialog design techniques are provided to further speed the development of professional grade voice applications.

In Unified CVP, there are five different building block types, or elements, that are used to construct any voice application: voice elements, VoiceXML insert elements, decision elements, action elements, and flag elements. VXML Server combines these elements with three additional concepts hotlinks, hotevents, and application transfers, to represent a voice application.

The building blocks that make up an application are referred to as elements. In Unified CVP, elements are defined as:

- A distinct component of a voice application call flow whose actions affect the experience of the caller.

Many elements in Unified CVP share several characteristics such as the maintenance of element data and session data, the concept of an exit state, and customizability.

Element and Session Data

Much like variables in programming, elements in a voice application share data with each other. Some elements capture data and require storage for this data. Other elements act upon the data or modify it. These variables are the fuction for elements to communicate with each other. The data comes in two forms: element data and session data.

- **Element data**: Variables that exist only within the element itself, can be accessed by other elements, but can only be changed by the element that created them.
- **Session data**: Variables that can be created and changed by any element as well as some other non-element components.

Exit States

Each element in an application's call flow can be considered to be a black box that accepts an input and performs an action. There may be multiple results to the actions taken by the element. In order to retain the modularity of the system, the consequences of these results are external to the element. Like a flowchart, each action result is linked to another element by the application designer. The results are called exit states. Each element must have at least one exit state and frequently has many. The use of multiple exit states creates a branched call flow.

Customizability

Most elements require some manner of customization to perform specific tasks in a complex voice application. Customization is accomplished through three different functions supported by Unified CVP: a fixed

configuration for the element, a Java API to dynamically configure prebuilt elements or to define new ones, and an API accessed with XML-data delivered over HTTP.

- **Fixed configuration**: Provides a static file containing the element configuration so that each time the element is visited in the call flow it acts the same. Even in dynamic voice applications, not every component need be dynamic; many parts actually do not need to change.
- **Java API**: Used for dynamic customization and is a high performance solution because all actions are run by compiled Java code. The one drawback to this approach is that it requires developers to have at least some Java knowledge, though the Java required for interfacing with the API is basic
- **XML-over-HTTP (or XML API for short)**: Provides developers with the ability to use any programming language for the customization of elements. The only requirement is the use of a system that can return XML based on an HTTP request made by VXML Server. The advantages of this approach include: a larger array of programming language choices; the ability to physically isolate business logic and data from the voice presentation layer; and the use of XML, which is commonly used and easy to learn. The main disadvantage of this approach is the potential for HTTP connection problems, such as slow or lost connections. Additionally, the performance of this approach does not typically perform as well as compiled Java because XML must be parsed at runtime in both VXML Server and the external system.

Note HTTPs is not supported with XML-over-HTTP.

Voice Elements

Almost all voice applications must use a number of dialogs with the caller, playing audio files, interpreting speech utterances, capturing data entered by the user, and so on. The more these dialogs can be contained in discrete components, the more they can be reused in a single application or across multiple applications.

These dialog components are covered in *voice elements*.

- **Voice Element**—A reusable, VoiceXML-producing dialog with a fixed or dynamically produced configuration.

Voice elements are used to assemble the VoiceXML sent to the voice browser. Each voice element constitutes a discrete section of a call, such as making a recording, capturing a number, transferring a call, and so on. These pre-built components can then be reused throughout the call flow wherever needed.

Voice elements are built using the Unified CVP Voice Foundation Classes (VFCs), which produce VoiceXML compatible with multiple voice browsers (see the *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio* for more on the VFCs and constructing custom voice elements).

Voice elements are complete dialogs in that they can encompass just a single action or an entire interaction with the caller. Depending on its function, a voice element can contain almost as much dialog as a small application. However, because of the pre-built nature of voice elements, application designers do not need to worry about their complexity. Each voice element is simply a *black box* which can be treated as a single object. As a result, by combining many voice elements, a complex call flow can be reduced significantly.

Each voice element defines the exit states it can return and the designer must map each exit state to another call flow component to handle all its consequences. To fully configure voice elements, developers must specify values for four components: settings, VoiceXML properties, audio groups, and variables.

- **Settings**—Used to store information that affects how the voice element performs. For example, a setting describes what phone number to transfer to or the length of audio input recording. A voice element can have many or few settings, depending on its complexity and its level of customization.
- **VoiceXML properties**—Equivalent to the properties outlined in the VoiceXML specification, and are used to modify voice element behavior by directly inserting data into the VoiceXML that each element produces. For example, the length of time the voice element waits before encountering a noinput event can be changed by setting a VoiceXML property. Available properties correspond directly to those listed in the VoiceXML specification and voice browser specification. The designer should understand the consequences of modifying these properties.
- **Audio Groups**—Nearly all voice elements involve the use of audio assets, whether in the form of prerecorded audio files or text-to-speech (TTS) phrases. An audio group encapsulates the audio that the application plays when reaching a certain point in the voice element call flow. For example, an audio group might perform the function of asking a question, giving an answer, playing an error message, and so on. An audio group may contain any number of audio items. Audio items are defined as prerecorded audio files, TTS phrases, or information that conforms to a specified format to be read to the user (such as a date or currency value). Each audio item in an audio group is played in the order they appear in the audio group.
- **Variables**—As described in the previous section, allow voice elements to set or use element or session data. Many voice elements use element data to store information captured from a caller, though voice element configurations can also define additional variables.

A voice element's configuration can be either fixed or dynamic.

- **Fixed configurations**—XML files containing the desired settings, VoiceXML properties, audio groups, and variables that are then loaded by VXML Server. The same configuration is applied each time the voice element is called.
- **Dynamic configuration**—The configuration of some voice elements can only be determined at runtime. In these cases a dynamic configuration is used. As described previously, the Java API and XML API can be used to create dynamic configurations.

For a complete list of the voice elements included in Unified CVP, refer to Element Specifications for Cisco Unified CVP VXML Server and Unified Call Studio.

VoiceXML Insert Elements

There are certain situations in a voice application where a developer may want to include prewritten VoiceXML into their Unified CVP application. The developer may want fine-level control over a specific voice function at the VoiceXML tag level without getting involved with constructing a custom configurable element in Java. Additionally, the developer may want to integrate VoiceXML content that has already be created and tested into a Unified CVP application.

These situations are handled by a *VoiceXML insert element*.

- **VoiceXML Insert Element**—A custom element built in VoiceXML providing direct control of lower-level voice dialog at the price of decreased flexibility.

VoiceXML insert elements contain VoiceXML code that the developer makes available as the content of a VoiceXML `<subdialog>`. The content can be in the form of static VoiceXML files, JSP templates, or even dynamically generated by a separate application server. A framework is provided to allow seamless integration of VoiceXML insert elements with the rest of the call flow.

The use of VoiceXML insert elements can cause the following results:

- the loss of being able to seamlessly switch between different voice browsers
- some greater processing overhead involved with integration with the rest of the call flow
- the added complexity of dealing with VoiceXML itself rather than creating an application with easy-to-use configurable elements

VoiceXML insert elements can have as many exit states as the developer requires, with a minimum of one.

Decision Elements

Even the simplest voice applications require some level of decision making throughout the call flow.

- **Decision Element**—Comprise business logic that make decisions with at least two exit states.

A decision element is like a traffic cop, redirecting the flow of callers according to built-in business rules. Examples of business rules include decisions such as whether to play an ad to a caller, which of five different payment plans should be offered to the caller, or whether to transfer a caller to an agent or end the call.

The results of a decision element are represented as exit states. Although many decisions are boolean in nature, (for example, has the caller registered? is the caller new to the application?), decision elements can have as many exit states as desired, as long as at least two are specified.

The configuration for a configurable decision contains two components: settings and variables. Additionally, the Java class that defines the configurable decision sets the exit states it can return and the designer must map each exit state to another call flow component to handle all its consequences.

Action Elements

Many voice applications require actions to occur behind the scenes at some point in the call. In these cases, the action does not produce VoiceXML (and thus has no audible effect on the call) or perform some action that branches the call flow (like a decision). Instead the action makes a calculation, interfaces with a backend system such as a database or legacy system, stores data to a file or notifies an outside system of a specific event.

All of these processes are built into *action elements*.

- **Action Element**—Comprises business logic that performs tasks not affecting the call flow (that is, has only one exit state).

An action element can be thought of as a way to insert custom code directly in the call flow of a voice application. An example of an action element might be one that retrieves and stores the current stock market price. Another example might be a mortgage rate calculator that stores the rate after using information entered by the caller. A standard Unified CVP installation bundles some prebuilt action elements to simplify commonly needed tasks such as sending e-mails and accessing databases.

Since action elements do not affect the call flow, they will always have a single exit state.

The configuration for a configurable action contains two components: settings and variables.

Flag Elements

Flag elements provides a mechanism that analyze the activities of callers to determine the part of an application that is most popular, ambiguous , and difficult to find. To do these analyses, the developer need to know when the callers reach a certain point in the application call flow. This check can also be done within the call itself, by changing its behavior dynamically if a caller visited a part of the application previously.

- **Flag Element**—Records when a caller reached a certain point in the call flow.

Flag elements can be seen as *beacons*, which are triggered when a caller visits a part of the call flow. The application designer can place these flag elements in parts of the call flow that need to be tracked. When the flag is tripped, the application log is updated so that post-call analysis can determine which calls reached that flag. The flag trigger is also stored within the call data so an application can make decisions based on flags triggered by the caller.

Flag elements have a single exit state and do not affect the call flow whatsoever.

Modular Application

There are many scenarios where a set of smaller applications works better than a single monolithic application. The desire to split up applications into smaller parts centers on reuse - encapsulating a single function in an application and then using it in multiple applications can save time and effort. Additionally updating a single application is much simpler than updating multiple applications with the same change. VXML Server provides two different ways to foster modular application, each with its own unique features.

Application Transfers

There may be instances where a caller in one application wants to visit or *transfer to* another standalone application. This is accomplished with an *application transfer*.

- **Application Transfer**—A transfer from one voice application to another running on the same instance of VXML Server, simulating a new phone call.

Application transfers do not require telephony routing; they are a server-side simulation of a new call to another application running on the same instance of VXML Server. The caller is not aware that they are visiting a new application, but VXML Server treats it as if it were a separate call with separate logging, administration, and so on. Data captured in the source application can be sent to the destination application (even Java objects) to avoid asking for the same information multiple times in a phone call.

A situation that could utilize application transfers would be a voice portal whose main menu dispatches the caller to various independent applications depending on the caller's choice.

An application transfer is meant to satisfy the need for one independent, standalone application wishes to move the call to another independent standalone application that can also take calls directly. Since an application transfer is used to progress a call from one application to another, it has no exit states.

Subdialogs

There are instances where an application is less independent and really encapsulates some function that multiple applications wish to share. This can be achieved by using a *subdialog*.

- **Subdialog**— A visit to another VXML Server application or other voice application defined in a VoiceXML subdialog context that acts as a voice *service*.

Unlike application transfers that are separate but independent applications, subdialogs are *sub-applications* that an application can visit to handle some reusable functionality and then return back to the source application. It can also take as input application data (though not Java objects) and can also return data for use in the source application. Subdialogs also do not have the restriction that they be deployed on the same instance of VXML Server, they can be hosted anywhere accessible via a URL and does not even need to be a VXML Server application at all.

The VXML Server subdialog is similar to the VoiceXML Insert element but without the requirement to understand VoiceXML. VoiceXML Insert elements are also much more integrated with the rest of the application to be considered an element alternative where a subdialog truly sends control to the subdialog application. For example, hotlinks and hotevents in the source application do not work in the subdialog application where they do in a VoiceXML Insert element.

A situation that could utilize a subdialog would be a third party that develops a sophisticated voice-based authentication system that other applications can use to validate callers. That company exposes their service as a VoiceXML subdialog that takes specific inputs and returns information on the identity of the caller. Any application that wishes to use the service will then use the subdialog element to visit this application.

To use a subdialog, several special elements are needed in the source and subdialog applications. Visiting a subdialog from a source application requires that it use a *Subdialog Invoke* element.

- **Subdialog Invoke**—An element used by an application to initiate a visit to a subdialog using http or https.

The Subdialog Invoke element will be treated by the application as an element but will be the gateway to the subdialog. This element handles the inputs and outputs of the subdialog application. While the subdialog application is handling the call, the source application is dormant waiting for the subdialog to return. The Subdialog Invoke element has a single exit state that is followed when the subdialog application returns.

If a VXML Server application is to act as the subdialog, it uses two different elements: the *Subdialog Start* and the *Subdialog Return* elements.

- **Subdialog Start**—An element used by a VXML Server subdialog application at the start of the call flow to import all variables passed by the source application.
- **Subdialog Return**—An element used by a VXML Server subdialog application when the subdialog is complete to return data to the source application.

These elements must be used as the *endpoints* of a subdialog application. The Subdialog Start must be the first element in the application from which the rest of the call flow emerges. The Subdialog Return must be the final element in the call flow (to be used instead of the *Hang Up* element). An application that does not use these elements can only handle calls made directly to it and cannot be visited by another application as a subdialog.

Subflows

Subflows are developed in an application as independent modules. Each subflow has a resource and an associated folder to save the subflow information under Call Studio project. Call Studio uses Callflow Editor to open both main call flow and subflows. Subflows are created from the Call Studio Navigator view. Subflows are saved under the subflow folder as pages. Each page contains its associated element configuration. When a new subflow is created from the navigator, a default subflow with a Subflow Start element is created in workspace and opened in the editor. Subflow can be completed by adding additional call flow elements. When the subflow is saved, subflow is saved under the subflow folder in pages. Each page contains element configuration for that page.

Subflows has the following elements:

- **Subflow Start Element**: Subflow Start Element is the entry point of the subflow. Subflow processing starts at Subflow Start Element.
- **Subflow Return Element**: Subflow Return element is the exit point for the subflow processing. When the subflow return is reached, subflow is exited.
- **Call Subflow Element**: Call Subflow Element is used for calling a subflow. Call Subflow element passes the flow control to the Subflow Start element and regains the control when the Subflow Return element is processed. A subflow can be called any number of times in an application.

Unified CVP Call Studio Introduction

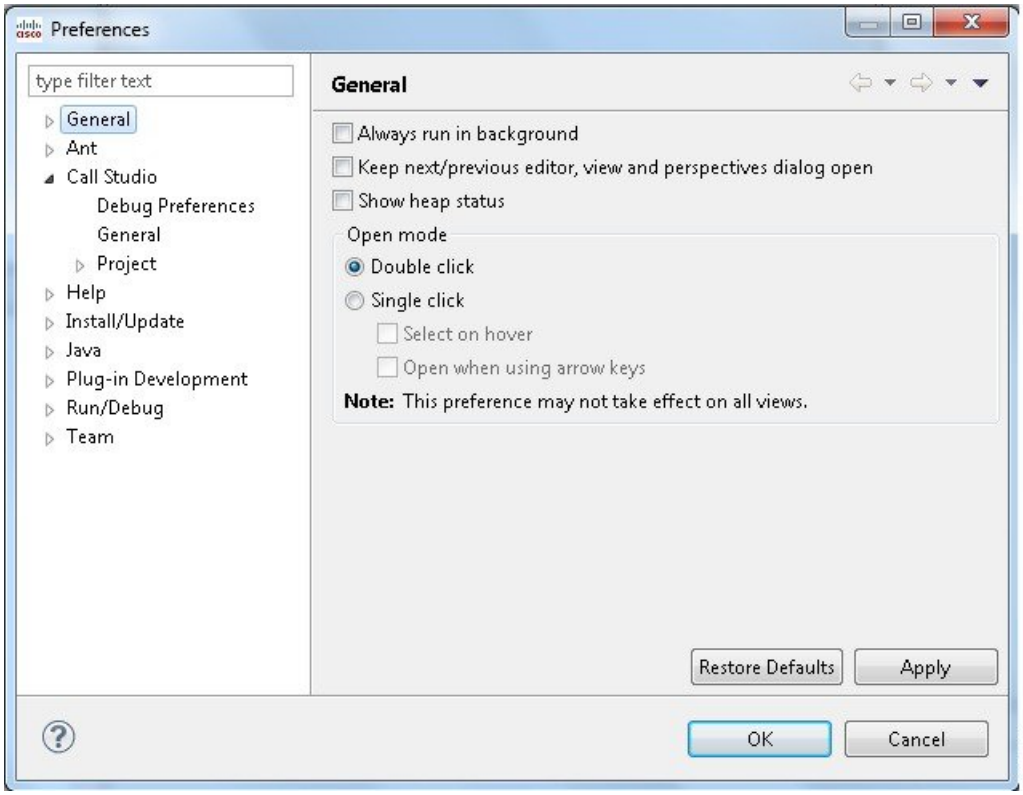
Call Studio is a platform for creating, managing, and deploying sophisticated voice applications. Call Studio is developed using the Eclipse framework, though no knowledge of Eclipse is necessary to work with Call Studio. Call Studio acts as a container in which features - called plug-ins - are encapsulated. It includes plug-ins for voice application development, Java programming, and many other features provided by Eclipse.

This section provides a brief introduction on how to license Call Studio, its preferences, creating a new project, and how to access online help. Refer to the online help for much more detailed information on Call Studio.

Preferences

The Preferences for Call Studio can be set by choosing **Window** > **Preferences** from the menu bar. Most of the settings listed here apply to the Eclipse platform; however, those listed under Call Studio are specifically intended for Call Studio. If modifications are made to any of these settings, we recommend that Call Studio be restarted so that the new settings can take effect.

Figure 1: Setting Preferences in Call Studio



The General window includes the following options:

- **Expand elements in Elements View**—This setting controls whether elements in the Elements view appear fully expanded or collapsed (the default).
- **Expand call flow elements in Outline View**—This setting controls whether call flow elements in the Outline view appear fully expanded (the default) or collapsed.

Starting from Release 11.5 the following fields have been introduced under **Preferences** > **Call Studio** > **Debug Preferences**.

- **Proxy URL**— Enter the Proxy URL for Context Service network traffic.
- **Timeout**—This setting controls the waiting period of the client for a response from Context Service. It can be set between 1200 and 5000.
- **Test connection**— This button shows the validity of connection data through the Proxy URL.

Note For more information refer to *Configure Context Service Connection Data in Call Studio* section in *Administration Guide for Cisco Unified Customer Voice Portal* at https://www.cisco.com/c/en/us/support/customer-collaboration/unified-customer-voice-portal/tsd-products-support-series-home.html.

Builder for Call Studio

Builder for Call Studio is a graphical user interface for creating and managing voice applications for deployment on VXML Server. VXML Server is the runtime framework for Unified CVP voice applications.

A complete dynamic voice application can be constructed within Builder, including call flow and audio elements. The philosophy behind Builder is to provide an intuitive, easy-to-use tool for building complex voice applications.

The conception and design of voice applications make use of flowcharts to represent the application call flow. Because flowcharts outline actions, not the processes behind these actions, they are an effective tool for representing the overall logic of the call flow. The flowcharting process is useful for mapping all the permutations of a call to ensure that all possible outcomes are handled appropriately. The schematic nature of flowcharts also make it easier for call flow designers to see where callers can get lost or stuck as well as how the call flow can be improved.

Builder works as a flowcharting program tailored specifically for building voice applications. Most of the familiar features of a flowcharting tool are present in Builder, with a palette of shapes that can be dragged and dropped onto a workspace and labeled, lines connecting those shapes, multiple pages, and more.

Project Introduction

A Call Studio project contains all of the resources required to build and deploy voice applications that run on VXML Server.

The `callflow` folder contains the XML files that make up that application's call flow and element configurations. The `app.callflow` file opens the Callflow Editor and graphically represents the call flow based on the information found in these files. Every time the application is saved, these files are updated.

The `deploy` folder contains any extra resources required for deployment; for example, local custom elements and Say It Smart plug-ins.

The `subflow` folder contains of all the XML files related to subflows. Each subflow has a folder inside the subflow folder, and it will contain the files related to subflow.

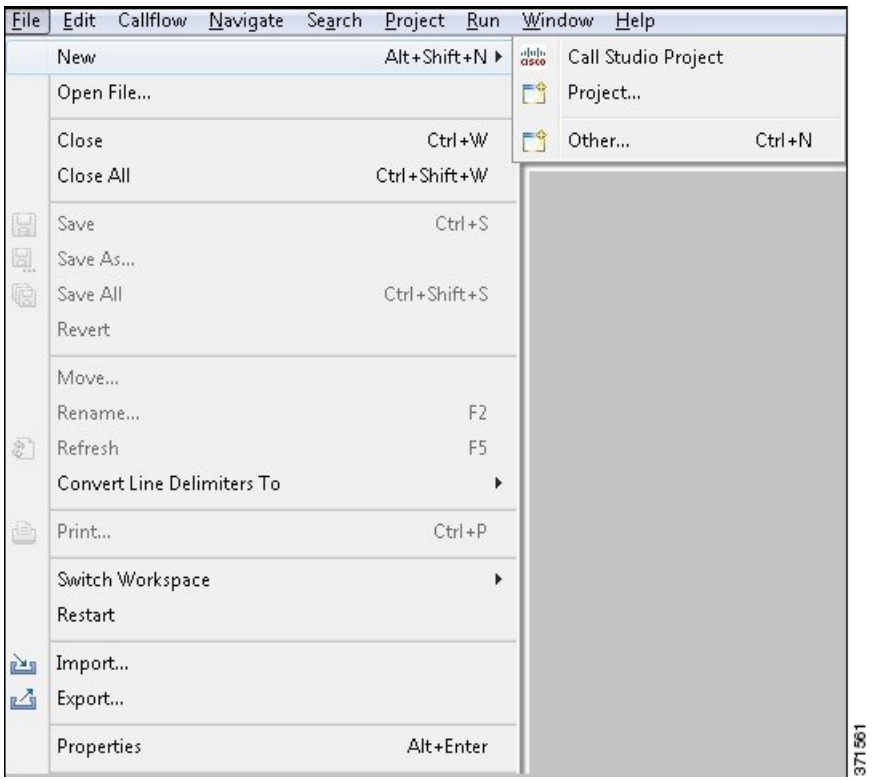
The app.callflow and .subflow file open the Callflow Editor and recreate the call flow based on the information found in the XML files in the callflow and subflow folder. Every time the application is saved, these files are updated.

Create Call Studio Project

Procedure

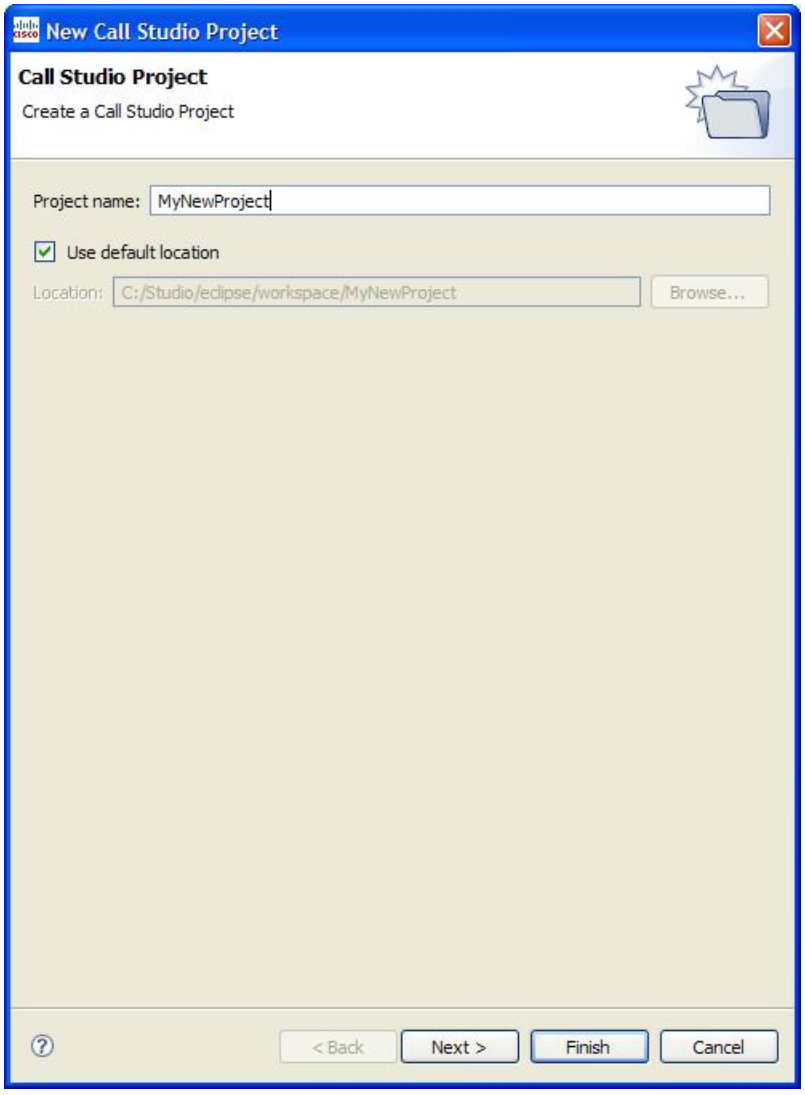
Step 1 From within the Call Studio program, click **File** > **New** > **Call Studio Project**.

Figure 2: Create a new Call Studio project



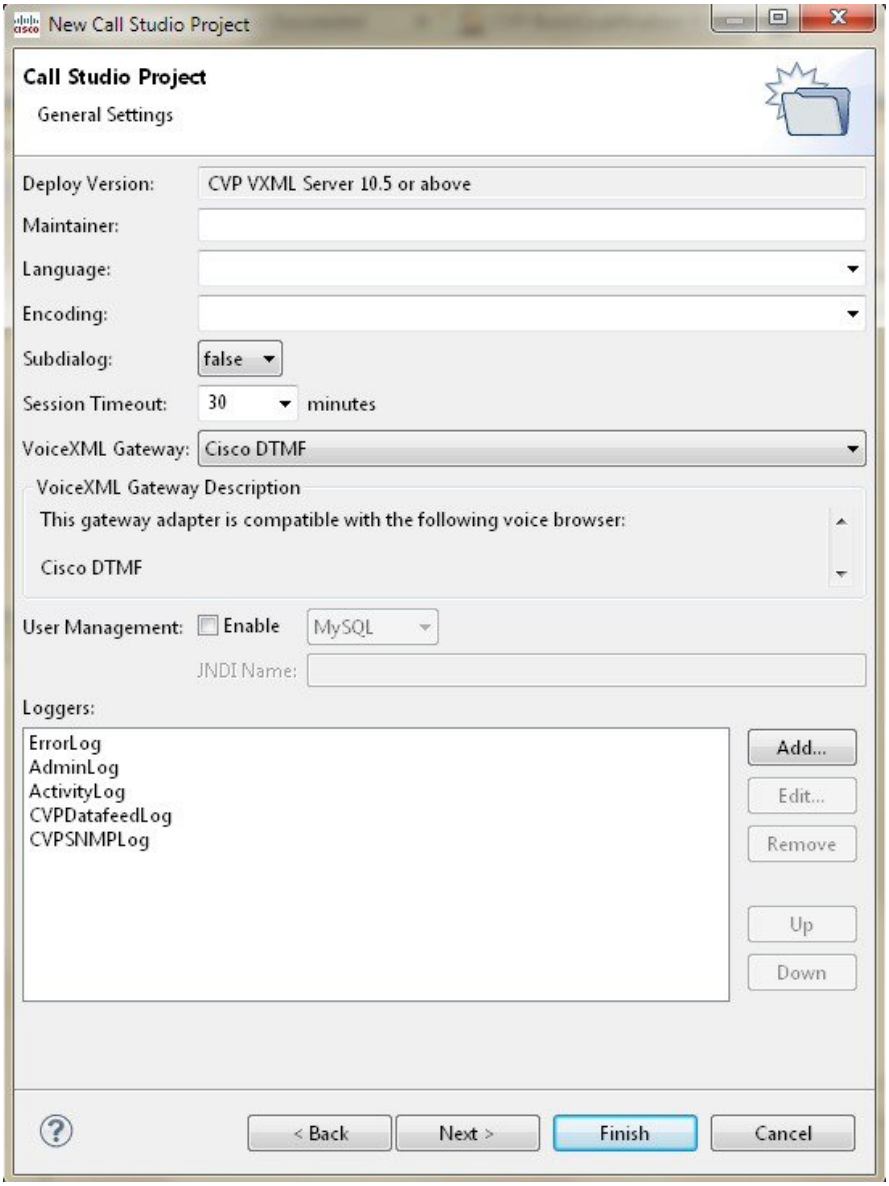
Step 2 Enter a name for the new Call Studio project and click **Next**. Leave the **Use default** location checked to create the new project in the default workspace directory.

Figure 3: Name the Call Studio Project



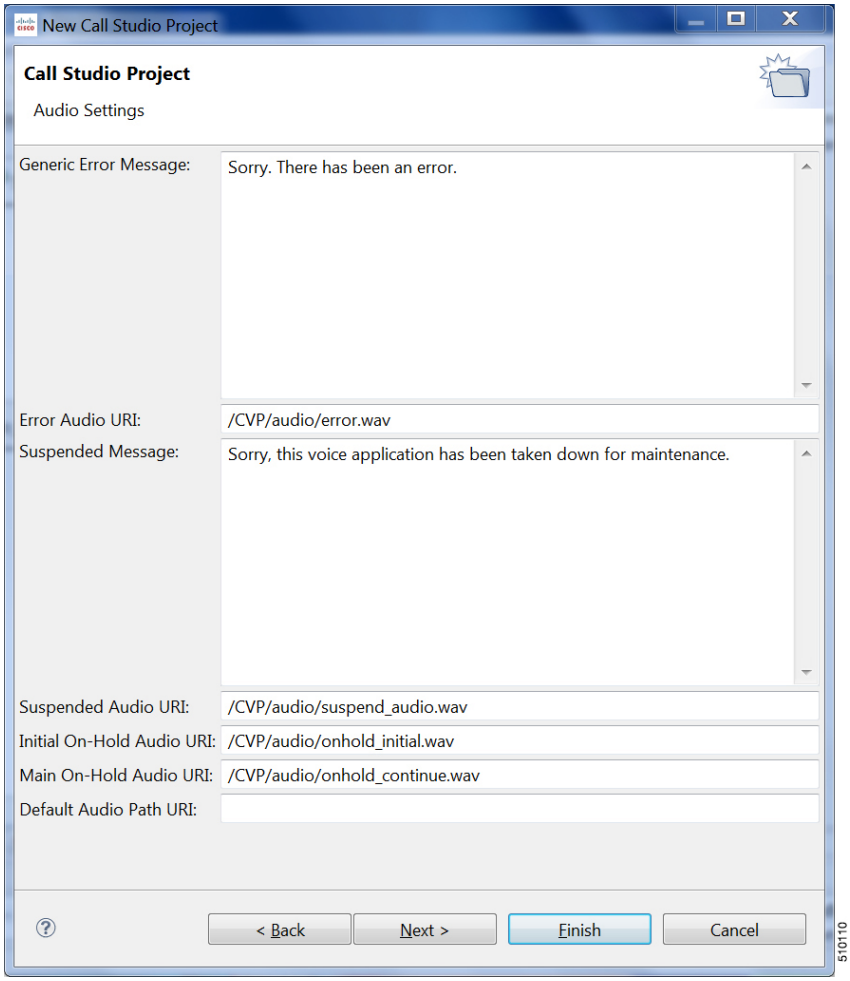
Step 3 Enter the General Settings for the new Call Studio Project and click **Next**. You can always change General Settings later.

Figure 4: Call Studio General Settings for new project



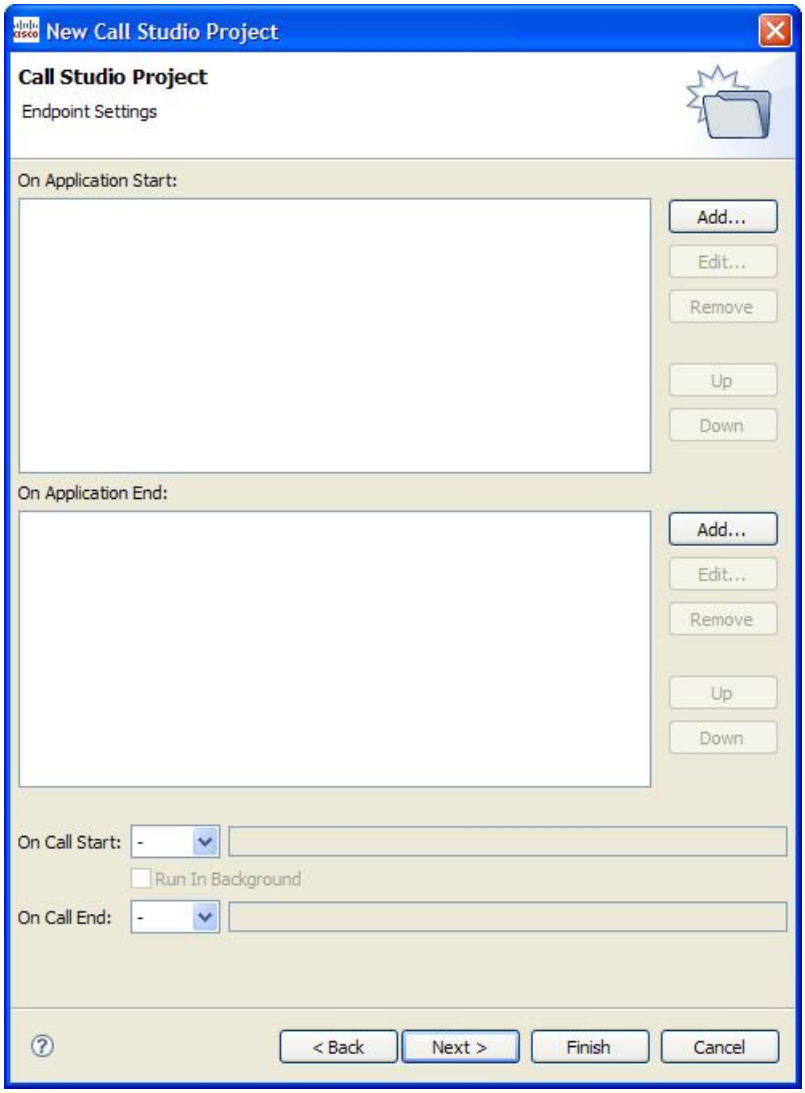
Step 4 Enter the Audio Settings for the new Call Studio Project and click **Next**. You can always change the Audio Settings later.

Figure 5: Call Studio Audio Settings for new project



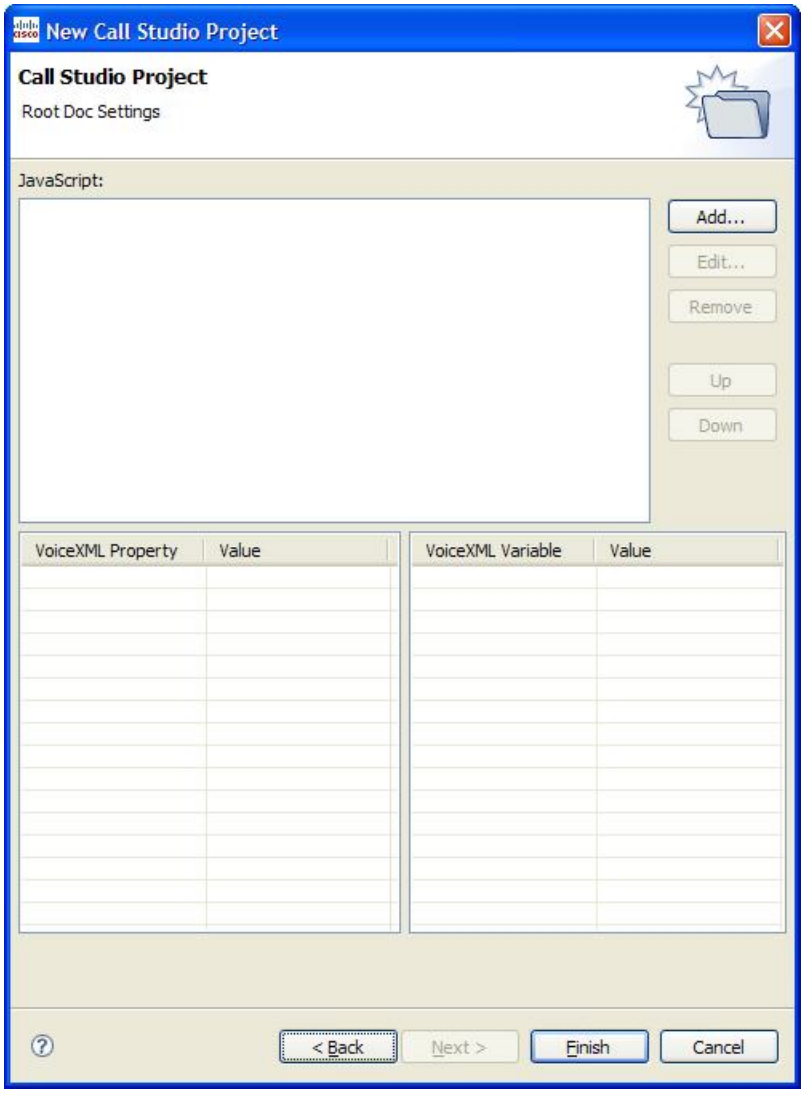
Step 5 Enter the Endpoint Settings for the new Call Studio Project and click **Next**. You can always change Endpoint Settings later.

Figure 6: New project Endpoint Settings



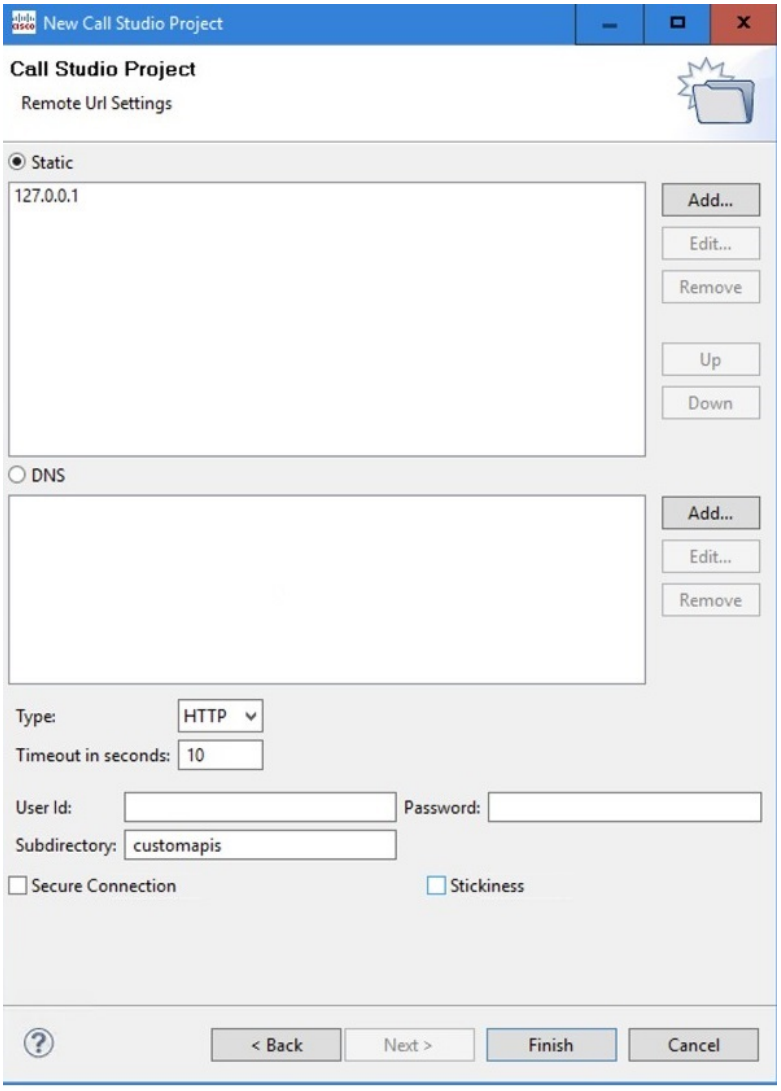
Step 6 Enter the Root Doc Settings for the new Call Studio Project and click **Next**. You can always change the Root Doc Settings later.

Figure 7: Root Doc Settings for new project



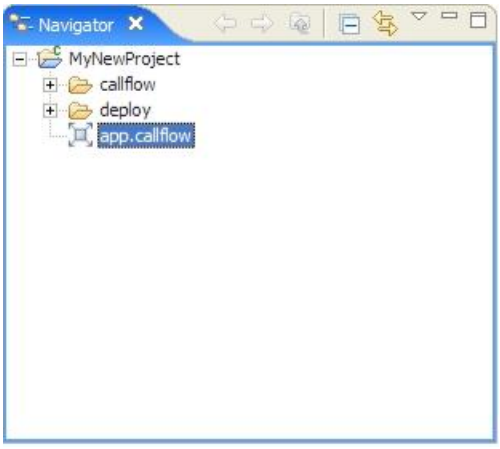
Step 7 Enter the Remote URL Settings for the new Call Studio Project and click **Finish**. You can always change Remote URL Settings later.

Figure 8: Remote Url Settings for new project



The new Call Studio Project displays in the Navigator tab.

Figure 9: New project showing in Navigator tab



The new application's call flow automatically opens in the call flow editor.

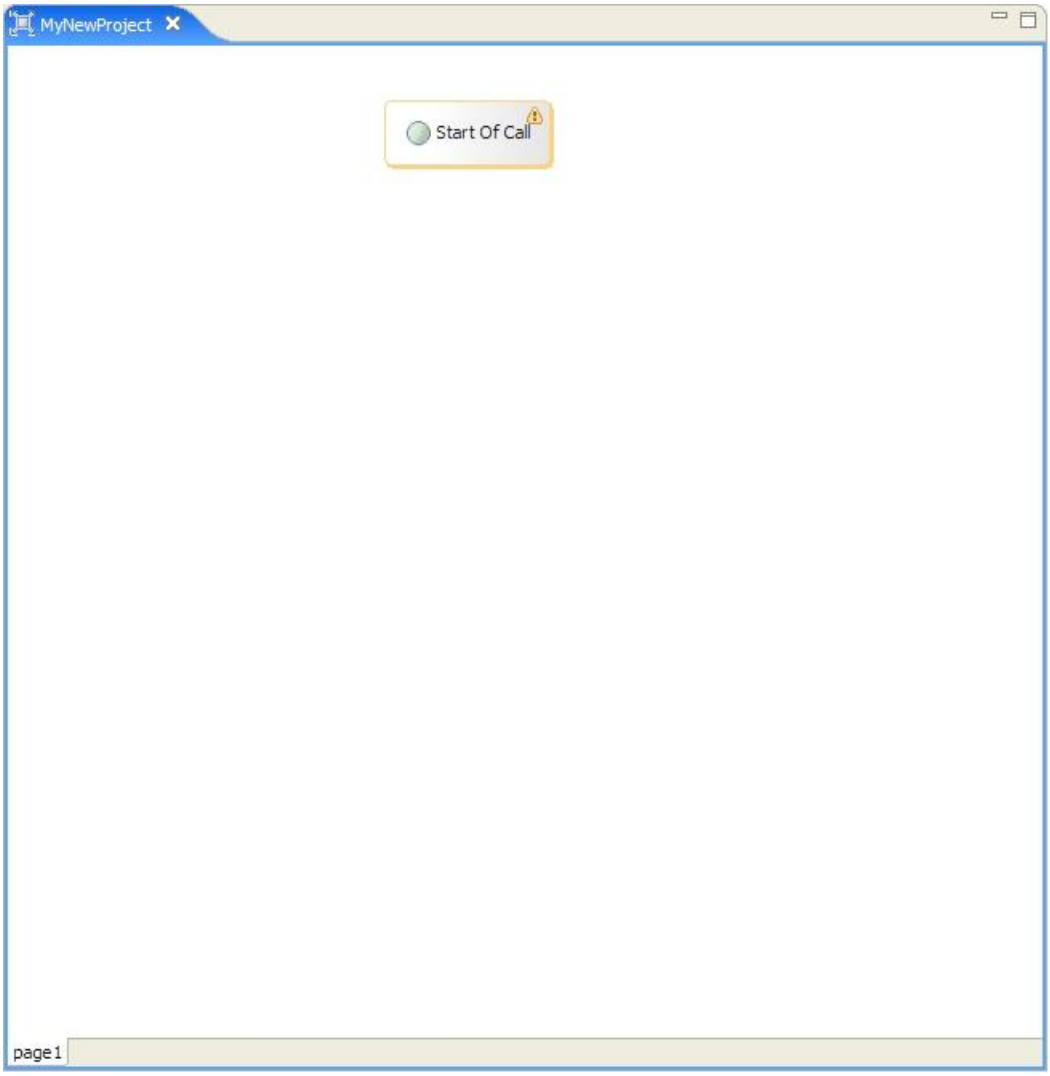
Note
You can move the Call Studio elements by one pixel with in the call flow editor by using the following keyboard shortcut.

- To move left, press Ctrl+Alt+H
- To move right, press Ctrl+Alt+J
- To move up, press Ctrl+Alt+K
- To move down, press Ctrl+Alt+L

You can also select multiple elements and move them by using the same keyboard shortcut.

For the x-coordinate and y-coordinate of a selected element, see the left side of the status bar. If multiple elements are selected, then the coordinates of the left-most element are displayed.

Figure 10: New project automatically started in call flow editor

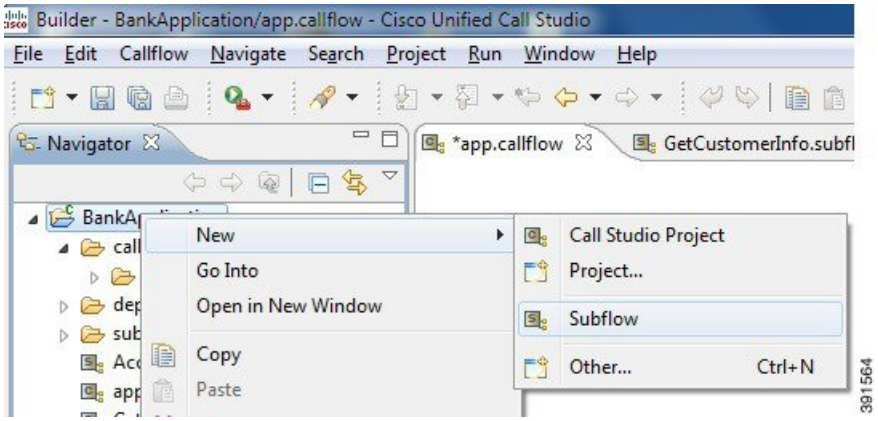


Create Subflow

Procedure

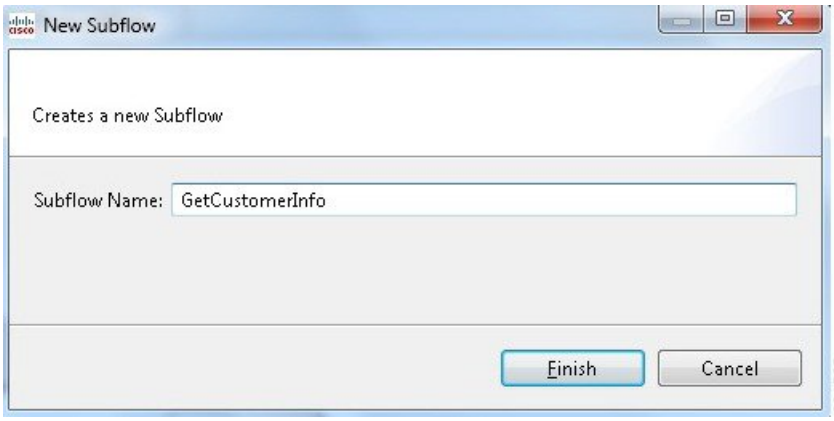
Step 1 From within the Call Studio program, choose **File** > **New** > **Subflow**.

Figure 11: Create Subflow



Step 2 Enter a name for the new Subflow.

Figure 12: Name the Subflow



Step 3 Click **Finish**.
A new subflow is created with the Subflow Start element in the work space.

Figure 13: New Subflow Created

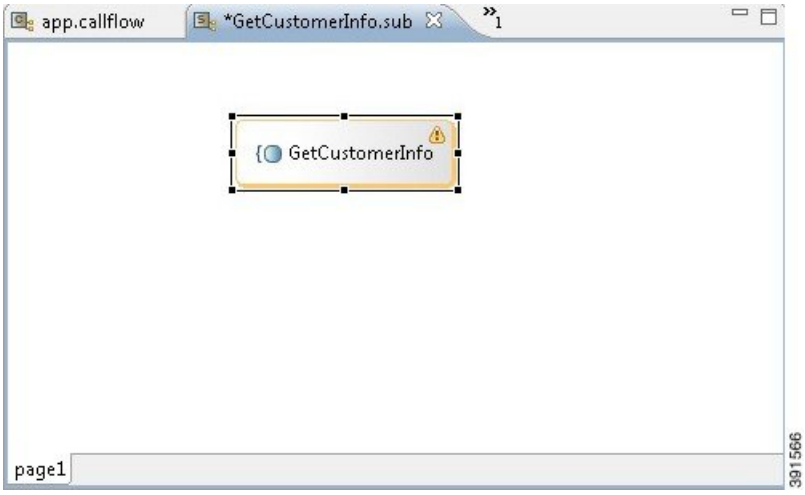
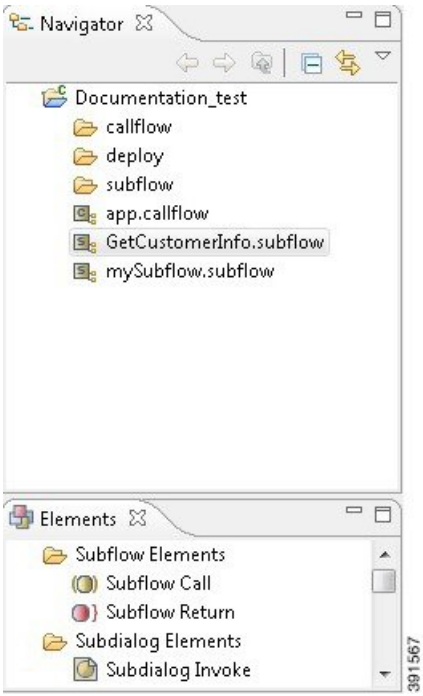


Figure 14: Subflow Folder Created



Refactor Call Flows

Operations such as conversion of main flow to subflow, subflow to mainflow, and moving subflows from one application to another application requires manual process.

Convert Main Flow to Subflow

Procedure

Step 1 Create a subflow with an appropriate name.

Step 2 Copy the elements in the main flow and paste them in the subflow.

Step 3 Add the subflow call element to invoke the converted subflow.
The main flow in the project will still exist; however, the application logic will be migrated to the newly created subflow.

Note
These steps can be used to function a large application to smaller subflows and remove duplicated call flow logic.

Copy Subflows

Procedure

Step 1 Find the resource location. Right-click on an application, select properties from the menu, and then select the resource location of the application where the subflow exists.
The properties window shows the resource location.

Step 2 Go to the resource location and right-click to copy the subflow file that needs to be copied to the target application. (Example, AccountVerification.subflow)

Step 3 Right-click to paste at the resource location of the target application.

Step 4 After pasting the subflow, copy and paste the class files, libraries, and media files from the source application to the target application.

Call Stack History View

This is a new view in Cisco Unified Call Studio. The information that previously appeared in the **Variables** view now appears in a new view called the **Call Stack History** view. The **Call Stack History** view displays information about the variables that are associated with the stack frame that you selected in the **Debug** view. Click an element in the **Editor** view to view the corresponding data variables in the **Call Stack History** view. In addition, Java objects can be expanded to show the fields. The data variables that are displayed in the **Call Stack History** view can be edited.

Variables View

You can modify data-variable values directly from the **Variables** view, while you debug a call flow. Click a particular element in the **Editor** view to see the name and value of the corresponding data variables in the **Variables** view. The **Variables** view allows you to modify data-variable values for elements in both the main flow and subflow.

Modify Data Variables in the Variables View

Procedure

Step 1 Click on an element in the Editor view to view the corresponding data variable values in the Variables view.

Step 2 Select the data value and modify the value directly from the value pane or right click on the data variable and select **Change Value** to modify the value**.**

Note
The updated data values are valid only for the current debugging session for one single call session.

Import Call Studio Applications

Procedure

Step 1 Select **File** > **Import** > **General** > **Existing Projects into Workspace** and click **Next**.

Step 2 Select the **Select root directory** radio button, and browse to the location where you want to import the Call Studio application.

Step 3 In the **Projects** section, select the following radio buttons:

- **Search for nested projects**
- **Copy projects into workspace**

Step 4 Click **Finish**.

Step 5 Click **Yes To All** when prompted.

Export Call Studio Applications

To export call studio applications:

Procedure

Step 1 Select **File** > **Export** > **General** > **General** > **File System**

Step 2 In the **Export resources to the local file system** section, click the **Select ALL** button to select all the projects.

Step 3 In the **To directory** field, browse to the directory you want to move the call studio application.

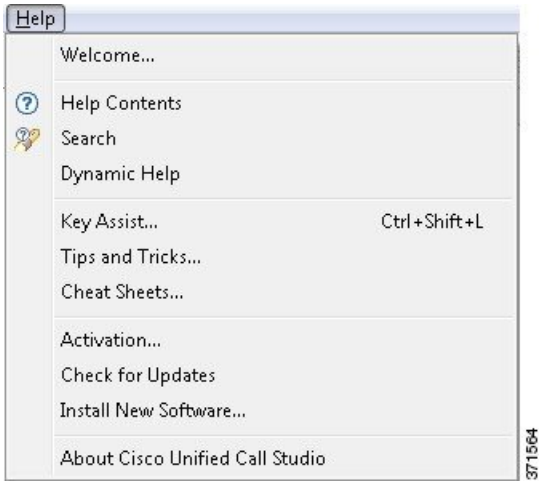
Step 4 In the **Options** section, do not change the default selections.

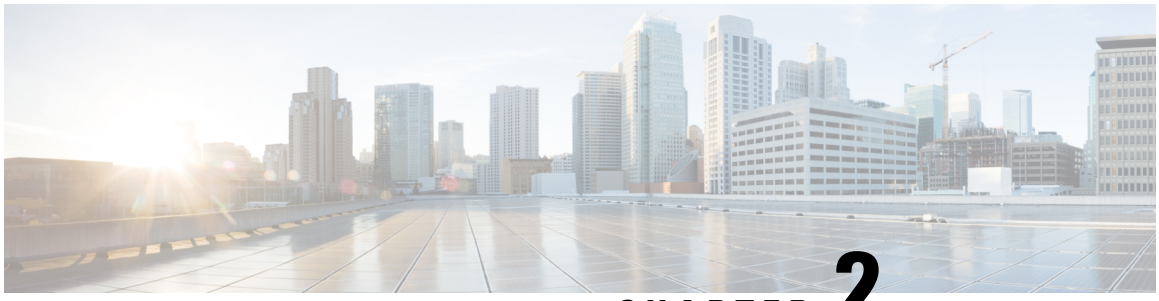
Step 5 Click **Finish**.

Online Help

Detailed descriptions of all Call Studio features, element types, and functionalities can be found in Call Studio's online help. This comprehensive online help can be accessed by choosing the **Help** > **Help Contents** menu option.

Figure 15: Call Studio Online Help Access





CHAPTER 2

Cisco Unified CVP VoiceXML Components

Some VXML Server components require detailed description on how to use them properly, especially when their functionality requires or is extended by programming. You might be able to create a voice application entirely dependent on fixed data, but most dynamic applications require some programming.

The non-developer user needs to be aware of these components and the functions they serve. The application designer needa to understand in what situations various components are required so that a comprehensive specification can be given to a developer responsible for building these components.

This chapter describes these components in more detail, and the typical situations where they would be used. It also describes the Unified CVP concepts used to develop and use the components. The Programming Guide for Cisco Unified CVP VXML Server and Unified Call Studio describes the components that require programming and describes the process of constructing and deploying them. The *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio* provides a comprehensive description of the information that this chapter introduces.

- Components, on page 29
- Variables, on page 30
- APIs, on page 33
- Configurable Elements, on page 34
- Standard Action and Decision Elements, on page 34
- Dynamic Element Configurations, on page 35
- Start / End of Call Actions, on page 35
- Event Handling, on page 35
- Say It Smart Plugins, on page 36
- Start and End of Application Actions, on page 37
- Loggers, on page 37
- On Error Notification, on page 38
- Unified CVP XML Decisions in Detail, on page 38
- VoiceXML Insert Elements, on page 49

Components

The following components are described in this chapter:

- **Built With Programming**—These components require some programming effort.
- **Call-Specific**—These components are built to be used within individual calls.

- **Custom Configurable Elements**—A developer might want to create their own reusable, configurable elements to supplement the elements that Unified CVP provides.
- **Standard Action and Decision Elements**—For situations where unique, application-specific functionality is needed, which does not require the flexibility and complexity of configurable elements.
- **Dynamic Element Configurations**—For situations where the configuration for a configurable element can only be determined at runtime.
- **Start and End of Call Action**—To perform tasks before each call begins and after each call ends.
- **Hotevents**—To specify the VoiceXML to run when a certain VoiceXML event occurs.
- **Say It Smart Plugins**—To play back additional formatted data or to extend existing Say It Smart behavior.

- **VXML Server-Specific**—These components are built to run on VXML Server as a whole and do not apply to a specific call.
  - **Start and End of Application Actions**—To perform tasks when a Unified CVP voice application is loaded and shuts down.
  - **Loggers**—Plug-ins designed to listen to events that occur within calls to an application and log or report them.
  - **On Error Notification**—To perform tasks if an error causes the phone call to end prematurely.
- **Built Without Programming**—These components do not require high-level programming effort to construct.
  - **XML Decisions**—Unified CVP provides an XML format for writing simple decisions without programming. The exact XML format is detailed in this chapter.
  - **VoiceXML Insert Elements**—This element is used in situations where the developer wants to incorporate custom VoiceXML content into a Unified CVP application. This chapter provides guidelines for building a VoiceXML insert element.

Variables

Unified CVP offers variables as a method for components to share data with each other, in these four forms: global data, application data, session data and element data.

Global Data

A global data variable is globally accessible and modifiable from all calls to all applications. Global data is given a single namespace within VXML Server that is shared across all calls to all applications. If a component changes global data, that change is immediately available to all calls for all applications. Global data can hold any data, including a Java object. The lifetime of global data is the lifetime of VXML Server. Global data is reset if the application server is restarted or the VXML Server web application archive (WAR) is restarted.

Global data typically is used to store static information that needs to be available to all components, no matter which application they reside in. For example, the holiday schedule of a company that applies to all applications for that company.

Application Data

An application data variable is accessible and modifiable from all calls to a particular application. Application data variables from one application cannot be seen by components in another application. Each application is given its own namespace to store application data. If a component changes application data, that change is immediately available to all other calls to the application. Application data can hold any data, including a Java object. The lifetime of application data is the lifetime of the application. Application data would be reset if the application were updated and would be deleted if the application were released.

Application data is typically used to store application-specific information that does not change on a per call basis and is to be available to all calls (for example, the location of a database to use for the application).

Session Data

Session data variables are accessible and modifiable from a single call session. Session data variables in one call cannot be accessed by components handling another call. Each session has its own session data namespace; session data set by one component will overwrite existing session data that has the same name. Session data can hold any data, including a Java data structure. The lifetime of session data is the lifetime of the session or the call. When the call ends, the session data is deleted.

Any component accessed within a call session, including elements, can create, modify, and delete session data. Session data can be created automatically by the system in two ways:

- If the voice browser passes additional arguments to VXML Server when the call is first received, these additional arguments will be added as session data with the arguments' name or value pairs translated to the session data name and value (both as `String` types). For example, if the voice browser calls the URL:

  ```
  http://myserver.com/CVP/Server?audium_application=MyApp&SomeData=1234
  ```

  This session will create session data named SomeData with a value of 1234 in every call session of the application MyApp that starts through this URL.

- If a Unified CVP voice application performs an application transfer to another application and the developer has chosen to pass data from the source application to the destination application, then this data will appear as session data in the destination application (the data is renamed before it is passed to the destination application). Refer to the Call Studio documentation for more information on application transfers.

Element Data

Element data variables are accessible from a single call session and modifiable from a single element within that call session. As the name suggests, element data can only be created by elements (excluding start and end of call events, the global error handler, hotevents, and XML decisions). Dynamic configurations are technically part of an element since they are responsible for configuring an element, so they can also create element data. Only the element that created an element data variable can modify or delete it, though it can be read by all other components. Due to the fact that the variable belongs to the element, the variable namespace is contained within the element, meaning two elements can define element data with the same name without

interfering with each other. To uniquely identify an element data variable, both the name of the element and the name of the variable must be used. Like session data, the lifetime of session data is the lifetime of the session or the call. When the call ends, the element data is deleted.

Component Accessibility

The following table lists each component and its ability to get and set global, application, session, and element data.

	Global Data		Application Data		Session Data		Element Data	
Component	**Get**	**Set**	**Get**	**Set**	**Get**	**Set**	**Get**	**Set**
Configurable Elements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Standard Elements	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dynamic Configurations	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start and End of Call Actions	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hotevents	No	No	No	No	No	No	No	No
Say It Smart Plugins	No	No	No	No	No	No	No	No
Start and End of Applications Actions	Yes	Yes	Yes	Yes	No	No	No	No
Loggers	Yes	No	Yes	No	Yes	No	Yes	No
On Error Notification	No	No	No	No	Yes	No	No	No
XML Decisions	No	No	No	No	No	No	No	No
VoiceXML Insert Elements	No	No	No	No	Yes	Yes	Yes	Yes

Note Hotevents, which are VoiceXML code appearing in the root document, do not have access to any server-side information.

Note A Say It Smart plug-in's purpose is to convert a value into a list of audio files, so it does not need to access server-side information.

Note A Logger's only responsibility is to report or log data and has access to all variables types but cannot set them.

Note On Error Notification classes are given the session data that existed at the time the error occurred.

APIs

To facilitate the development of components requiring programming effort, Unified CVP provides two application programming interfaces (APIs) for developers to use. The first is a Java API. The second API involves the use of XML sent through HTTP, which allows components to be built using programming languages other than Java. Some more complex and tightly integrated components can be built only through the Java API, though in most other aspects, the two APIs are functionally identical. The APIs themselves and the process of building components using either API is fully detailed in the Javadocs published with the software and in the *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio*. The two components that do not require the use of high-level programming, XML decisions, and VoiceXML insert elements are fully explained in this document.

The APIs are used to interface with VXML Server in order to retrieve data or change information. The API provided to each component has slightly different functionality reflecting each component's unique abilities. The following abilities are provided by the API that is common to most components used within a call flow:

- Getting call information such as the ANI, DNIS, call start time, application name, and so on.
- Getting or setting global data, application data, element data, or session data.
- Getting information about the application's settings such as the default audio path, voice browser, and so on.
- Setting the maintainer and default audio path. Changing the maintainer allows multiple people to maintain different parts of a single application. Changing the default audio path allows an application to change the persona or even language of the audio at any time during the call.
- Sending a custom event to all application loggers .

The following table shows which APIs can be used to construct the various components listed.

VXML Server Component	Build with Java API	Build Using XML-over-HTTP API	VoiceXML Knowledge Suggested
Configurable Action and Decision Elements	Yes	No	No
Configurable Voice Elements	Yes	No	Yes
Standard Elements	Yes	Yes	No
Dynamic Element Configurations	Yes	Yes	No
Start or End of Call Actions	Yes	Yes	No
Hotevents	Yes	No	Yes
Say It Smart Plugins	Yes	No	No

Start and End of Application Actions	Yes	No	No
Loggers	Yes	No	No
On Error Notification	Yes	No	No
XML Decisions	N/A	N/A	N/A
VoiceXML Insert Elements	N/A	N/A	Yes

Configurable Elements

Most of the elements in a typical Unified CVP application are prebuilt, reusable elements whose configurations are customized by the application designer. Using a configurable element in a call flow requires no programming or VoiceXML expertise, and because they can encapsulate a lot of functionality, the element greatly simplifies and speeds up the application building process. VXML Server includes dozens of elements that perform common tasks such as collecting a phone number or sending e-mail. A need may exist, however, for an element with functionality not available in the default installation. Additionally, while Unified CVP elements have been designed with configurations that are as flexible as possible, there may be situations where a desired configuration is not supported or is difficult to implement.

To address these issues, a developer can construct custom configurable elements that, once built, can be used and reused. The developer can design the element to possess as large or as small a configuration as desired, depending on how flexible it needs to be. Once deployed, custom elements appear in Builder for Call Studio in the Element Pane and are configured in the same way as Unified CVP Elements.

Due to the level of integration with the Unified CVP software required, only the Java API provides the means for building configurable elements. Using this API, configurable action, decision, and voice elements can be built. Because voice elements are responsible for producing VoiceXML, they use an additional Java API, the Voice Foundation Classes (VFCs). The VFCs are used to abstract the differences between the various voice browsers supported by Unified CVP. The VFCs follow a design that parallels VoiceXML itself, and only a developer familiar with VoiceXML and the process of a voice browser interpreting VoiceXML will be fully suited to use the VFCs to build voice elements.

The *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio* describes the process of building configurable elements including detailing the VFC API for building voice elements.

Standard Action and Decision Elements

Unlike configurable action or decision elements, a standard action or decision element is designed more as a one-off as they satisfy an application-specific purpose. As a result, standard action and decision elements do not require configurations.

There are many situations where a programming effort is required to perform some task specific to an application. Because the task is very specialized, preexisting reusable elements are too general to perform the effort. There would not be an advantage to building a configurable element for this purpose because there is little chance it would be needed anywhere but in this application. The developer would use a standard action or decision element to perform just this task. If the task applies to multiple situations, the developer most likely would put in the extra effort to construct a configurable, reusable element.

Unified CVP provides a means of defining standard decision elements without programming by writing an XML document directly within Builder for Call Studio. Consider format should be investigated when you want simple or moderately complex standard decision elements, and be able to revert to the programming API if the built-in format proves to be insufficient. The XML format that the Builder for Call Studio user interface produces for standard decision elements is described later in this chapter.

Dynamic Element Configurations

Each configurable voice, action, and decision element used in an application must have a configuration. Usually, the configuration will be fixed and functions the same for every caller that visits it. In these situations, the designer using Builder for Call Studio creates this configuration in the Configuration Pane. This configuration is saved as an XML file when the application is deployed.

There are situations, when a configuration for an element depends on information known only at runtime; it is considered to be dynamic. An example would be to configure the Unified CVP audio voice element to play a greeting message depending on the time of the day. The application know only at runtime the exact calling time and then what greeting message to play.

To produce dynamic configurations, programming is required. Dynamic element configurations are responsible for taking a base configuration (a partial configuration created in the Builder for Call Studio), adding to it or changing it depending on the application business logic, and returning the desired element configuration to VXML Server.

Start / End of Call Actions

Unified CVP provides functions to run some code when a phone call is received for a particular application or when the call ends. The end of a call is defined as either a end of call by the caller, a disconnection by the system, a move from one Unified CVP application to another Unified CVP application, or other rarer ways for the call to end such as a blind transfer or session timeout.

The purpose of the start of call action typically is to set up dynamic information that is used throughout the call, for example, the current price of a stock or information about the caller identified by their ANI in some situations. The end of call action typically is used to export information about the call to external systems, perform call flow history traces, or run other tasks that require information on what occurred within the call.

The start of call action is given the special ability to change the voice browser of the call. This change applies to the current call only, and allows for a truly dynamic application. By allowing the voice browser to change, the application can be deployed on multiple voice browsers at once and use a simple DNIS check to output VoiceXML compatible with the appropriate browser. This task can only be done in the start of call action because the call technically has not started when this action occurs.

The end of call action is given the special ability to produce a final VoiceXML page to send to the browser. Even though the caller is no longer connected to the browser by the time the end of call action is run, some voice browsers will allow for the interpretation of a VoiceXML page sent back in response to a request triggered by a disconnect or hang-up event. Typically this page will perform final logging tasks on the browser.

Event Handling

Event Handlers

Events and exceptions occurring in a Call Studio application can be handled by event handlers defined in the applications. To configure Event Handler on an element, you must add an event handler to the element configuration. The following events types are supported by Call Studio:

- VXML Event
- Custom Exception
- Local HotEvent
- Java Exception

Event Handlers can be placed at several levels in a call flow:

- **Element Level**

  VXML Events and Java Exceptions encountered during the processing of an element can be caught at the element level.

- **Subflow Start Element Level**

  Event Handlers placed at Subflow Start element level will be active during the processing of that particular sub flow. Subflow Start level event handlers can be used to handle events that are not handled at the element level.

- **Subflow Call Element Level**

  Event Handlers attached to the Subflow Call element can be used to handle events that are not handled inside a sub flow.

- **Start of Call Element Level**

  Event handlers attached to the Start of Call element act as global event handlers for the application. Any event not handled at the levels described above can be handled at this level. All Hot Links defined in the application act as event handlers at the Start of Call element level. Events escaped from attached event handlers and Hot Events can be trapped by the Error element defined in the application.

  Events generated inside a call flow will be propagated through the Subflow hierarchy until the Start of Call element. Event handler at a lower level has precedence over the event handlers at a higher level. Properties of the event trapped by the event handler can be extracted from the session variable lastException.

Note In addition to VXML Event and Java Exception, event handlers can be configured for Custom Exception and Local Hot Link at the levels described above. However, all event types are not applicable for all elements. Refer to the Element Specifications for Cisco Unified CVP VXML Server and Cisco Unified Call Studio for more details.

Say It Smart Plugins

In VXML Server, developers can create their own Say It Smart plugins. Similar to custom elements, Say it Smart plugins are prebuilt Java classes that when deployed in the Builder for Call Studio can be used as a

new Say It Smart type. As with custom elements, the level of integration required with the Unified CVP software restricts the creation of Say It Smart plugins to the Java API.

Custom Say It Smart plug-ins can be constructed to read back formatted data not handled by Unified CVP Say It Smart plug-ins, such as spelling playback or reading the name of an airport from its three-digit code. Plug-ins can also be created to extend the functionality of existing plug-ins, such as adding new output formats to play the information in another language. For example, a plug-in can define a new output format for the Unified CVP Date Say It Smart plug-in that reads back dates in Spanish.

Refer to the Programming Guide for Cisco Unified CVP VXML Server and Unified Call Studio for a full description of the process of building custom Say It Smart plug-ins.

Start and End of Application Actions

Unified CVP provides functions to run some code when an application is launched or shut down. A start of application action is run when the VXML Server web application archive (WAR) starts up (which occurs when the application server first starts up or the application server reloads the WAR), or the application is updated. An end of application action is run when the application is updated, released, or the web application is shut down (which occurs if the application server reloads or shuts down the web application or the application server itself is shut down).

The start of application action typically sets up global data or application data that is accessed by components within the call flow. Because global and application data's lifetime is the lifetime of the application, and they can contain Java objects, the start of the application action can set up persistent database connections or other communications to external systems that remain connected while the application is running.

Note If an error occurs within the start of the application class, the application deployment will continue unchanged. The designer can specify that an error in a particular start of application class stop the application deployment, if the class performs mandatory tasks that are necessary for the application to run correctly.

The end of application action cleans up any data, database connections, and so on, that are no longer needed once the application is shut down.

Note The end of application action is called even when the application is updated because the update may have changed the data that is needed by the application.

Every application deployed on VXML Server has the ability to define any number of start and end of application actions that are run in the order in which they appear in the application settings.

Loggers

The act of logging information about callers to the system is performed by loggers. An application can reference any number of loggers that *listen* for logging events that occur. These events range from events triggered by a call, such as a caller entering an element or activating a hotlink to administration events such as an application being updated to errors that may have been encountered. Loggers can take the information on these events

and use them as they want. Typically the logger stores that information somewhere such as a log file, database, or reporting system.

VXML Server includes default loggers that store the information obtained from logging events to parseable text log files. A logger might be required with functionality not available in the default installation or a logger that takes the same data and stores it using a different method.

To address these issues, a developer can construct custom loggers that listen for logger events and report them in their own way. The developer can design the logger to use a configuration to customize how the logger functions, depending on how flexible it needs to be. Due to the level of integration with the Unified CVP software required, only the Java API provides the method for building loggers.

Refer to VXML Server Logging in the section entitled *Application Loggers* for descriptions of the loggers included with VXML Server. Refer to the Programming Guide for Cisco Unified CVP VXML Server and Unified Call Studio for a description of the process of building custom loggers.

For additional information on Unified CVP VXML Server Logs, see *Configuring Unified CVP Logging and Event Notification* in the Configuration and Administration Guide for Cisco Unified Customer Voice Portal.

On Error Notification

When errors occur on the VXML Server, the application-specific error voice element decides how to handle the caller. If specified, the on error notification Java class can be configured to be activated when an error occurs. The class is given information about the application and some basic call information to allow the developer to specify the action accordingly. The developer can write this class to perform any function.

The most common purpose for the on error notification class is to perform a custom notification, which indicates at runtime that an error occurred. This notification might involve paging an administrator or integrating with a third-party trouble ticket and notification process. Since the notification usually involves an administrator whose responsibility is the entire VXML Server, the Java class, once specified, applies to any error that prematurely ends a call on any Unified CVP application.

Note This class is used for notification purposes; it does not allow the call to recover from the error.

Note There is no XML API equivalent for the on error notification; if done at all, it must be written in Java.

Unified CVP XML Decisions in Detail

Many commercial applications with decisions driven by business logic use an external rules engine to codify the definition of rules. These rule engines help describe the definition of a rule and then manage the process of making decisions based on the current criteria. VXML Server bundles a rule engine in the standard installation and provides an XML data format for defining decision elements within the framework of a voice application. The XML format is simple enough for an application designer to enter within Builder for Call Studio without requiring separate programming resources.

The main feature of a rule is one or more expressions. An expression is a statement that evaluates to a true or false. In most cases, there are two parts (called terms) to an expression with an operator in between. The terms

are defined by VXML Server to represent all of the most common items necessary to base decisions on in a voice application such as telephony data, element or session data, times and dates, caller activity, user information, and so on. The operators depend on the data being compared. For example, numbers can be compared for equality or greater than or less than while strings can be compared for equality or if it contains something. One type of expression breaks this format: an *exists* expression that itself evaluates to a true or false and does not need anything to compare it to.

Examples:

- Has this caller called before?
- Does the system have a social security number for the user?

Each of these conditions checks for the existence of something that is itself a complete expression.

One or more of these expressions are combined to yield one exit state of the decision element. Multiple expressions can be combined using ands or ors, though not a combination. For example, if the ANI begins with 212 OR if the ANI begins with 646 then return the exit state ‘Manhattan’.

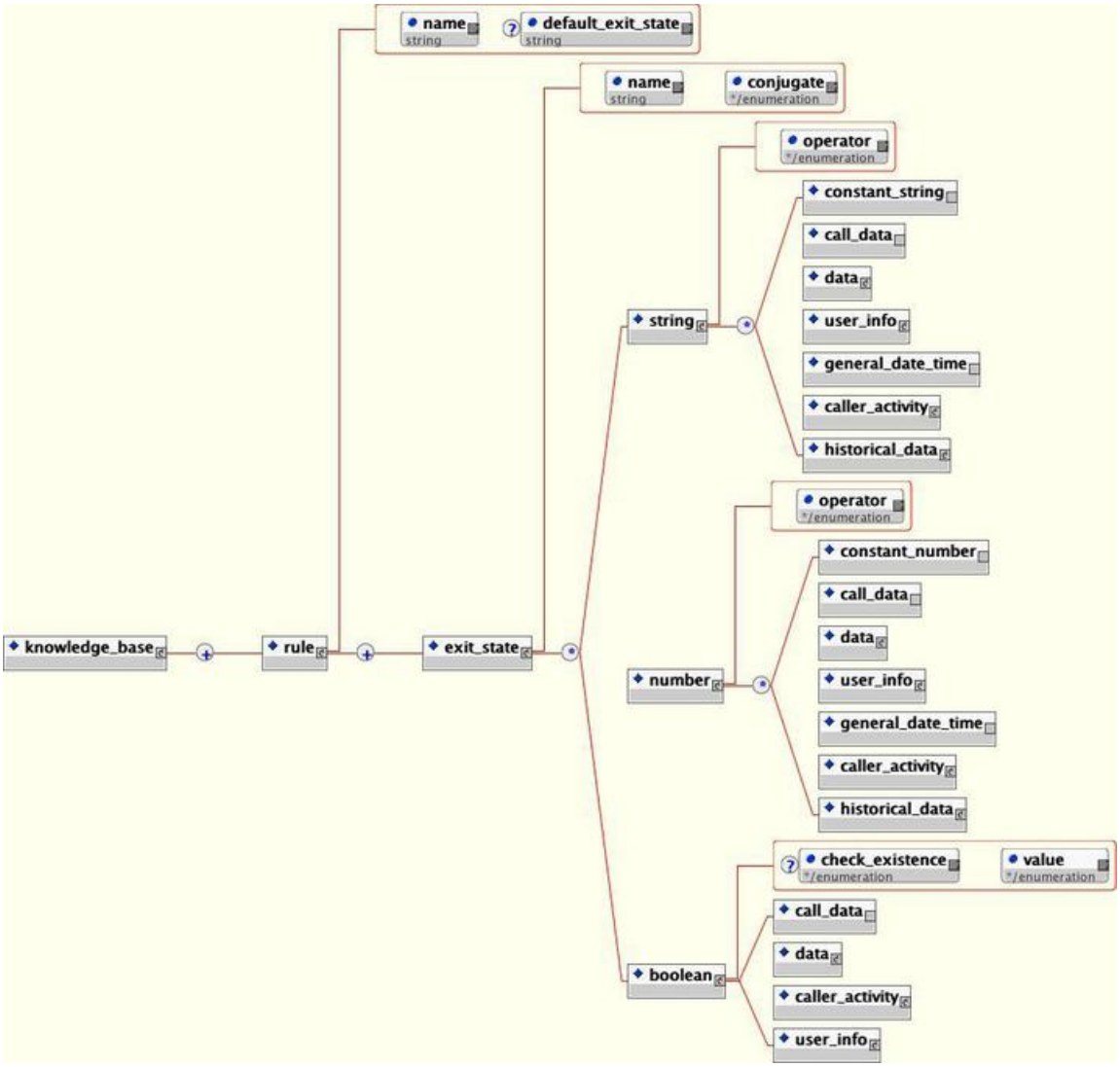
If a combination of ands and ors is desired, multiple expressions that return the same exit state would be used. For example, if the ANI begins with 212 and the user is a gold or platinum customer, then return the exit state ‘discount’ would **not** work as a single rule because the discount would be given to callers with a 212 area code who are gold customers and all platinum customers (there is no way to set precedence).

This would have to be expressed as two rules with the same exit state:

1. If the ANI begins with 212 AND the user is a gold customer, return the exit state discount.
2. If the ANI begins with 212 AND the user is a platinum customer, return the exit state discount.

It is possible to define an exit state that returns when all other exit states fail to apply, called the default exit state. When not specified, all possible cases must be caught by the defined rules. For example, if a rule checks if a number is greater than 5, there should be another rule checking if the number is less than or equal to 5, unless the default exit state is defined. One can even create a set of rules that start from being restrictive, searching for only very specific matches, to progressively less restrictive since the first rule to be true will yield an exit state and no more rules are tested.

Figure 16: Example of Tags for Defining a Decision



The knowledge_base example in the preceding figure shows the main tags of the XML file format for defining a decision. The elements in this XML document are:

- **rule**—This tag names the rule for the decision. There can only be one `<rule>` tag in the document. The tag contains any number of exit states that make up the decision. The optional `default_exit_state` attribute lists the exit state to return if no other exit states apply (essentially an else exit state).
- **exit_state**—This tag encapsulates the expressions that when true, return a particular exit state. The `name` attribute must refer to the same value chosen when the decision element was defined in the Builder for Call Studio. The `conjugate` attribute can be either *and* or *or*. If the exit state contains only one expression the conjugate attribute is ignored. The content of the `<exit_state>` tag is the type of data to be compared, each type containing different kinds of data. There can be any number of children to the `<exit_state>` tag, each representing another expression linked with the conjugate.
- **string**—This tag represents an expression comparing strings. The `operator` attribute can be *contains*, *not_contains*, *ends_with*, *not_ends_with*, *equal*, *not_equal*, *starts_with*, and *not_starts_with*. There can

be only two children to the <string> tag, representing the two terms of the expression. If there are fewer than two, an error will occur. If more, the extra ones are ignored. The content can be tags representing a constant string entered by the developer, data about the call, session and element data, user information, date and time information, the activity of the caller, and historical activity of the user. These tags are fully defined in the following sections.

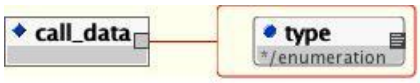
- **number**—This tag represents an expression comparing numbers. The operator attribute can be equal, not_equal, greater, greater_equal, less, and less_equal. There can be only two children to the <number> tag, representing the two terms of the expression. If there are fewer than two, an error will occur. If more, the extra ones will be ignored. The content can be tags representing a constant number entered by the developer, data about the call, session and element data, user information, date and time information, the activity of the caller, and historical activity of the user. These tags are fully defined in the following sections.
- **boolean**—This tag represents an expression which evaluates to a boolean result, requiring only a single term. If the check_existence attribute is yes, and the value attribute is true, it is checking if the data defined by the child tag exists. If check_existence is yes, and value is false, it is checking if the data defined by the child tag does *not* exist. If check_existence is no, the value attribute is used to compare the data defined by the child tag with either true or false. True means the expression is true if the data defined by the child tag evaluates to true. The child tags are a smaller subset of those allowed in <string> and <number>: data about the call, session and element data, user information, or the activity of the caller (each of these is fully defined in the following sections). When testing if the child tag's value is true or false, it must be able to evaluate to a Boolean value. If it cannot, the decision will act as if the rule did not activate.
- **constant_string / constant_number**—These tags store string and number data in the value attribute. The number can be any integer or floating-point number.

Note The number can also be treated as a string. For example, if 1234 starts with 12.

The following sections explain the contents of the individual tags found within the <string>, <number> and <boolean> tags.

<call_data>

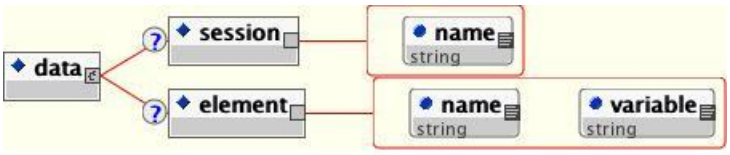
Figure 17: call_data Tag



The call_data Tag figure shows the term that represents information about the current call. The type attribute can be ani, dnis, uui, iidigits, source, appname, duration, language, or encoding. The ANI, DNIS, UUI, and IIDIGITS will be NA if it is not sent by the telephony provider. Source is the name of the application that transferred to this application or null if this application was the first to be called. Duration is the duration of the call up to this point in seconds.

<data>

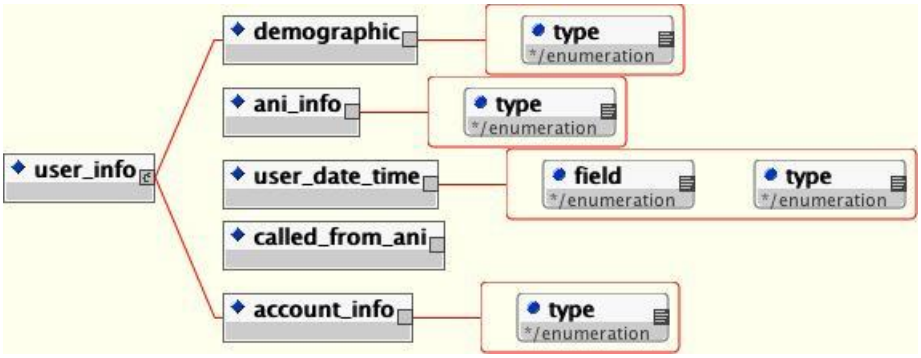
Figure 18: data Tag



The <data> Tag figure shows the term that represents session or element data. The `<session>` tag refers to session data with its name in the `name` attribute. The `<element>` tag refers to element data with the name of the element in the `name` attribute and the name of the variable in the `variable` attribute.

<user_info>

Figure 19: user_info Tag



The <user_info Tag figure shows the term that represents user information.

Note If the application has not been configured to use the user management system, and the call was not associated with a specific UID, using this term will cause an error.

Only one piece of user information can be returned per tag.

The possible user information to be compared is:

- **demographic**—This tag refers to the user's demographic information. The `type` attribute can be name, zipcode, birthday, gender, ssn, country, language, custom1, custom2, custom3, or custom4.
- **ani_info**—This tag refers to the various phone numbers associated with the user account. If the `type` attribute is first, the first number in the list of numbers is returned. This is returned if there was only one number associated with an account. If the attribute is num_diff the total number of different phone numbers associated with the account is returned.
- um_diff

  user_date_time—This tag refers to date information related to the user account. The `type` attribute indicates which user-related date to access and the `field` attribute is used to choose which part of the date to return. `Type` can be last_modified (indicating the last time the account was modified), creation

(indicating the time the account was created), and last_call (indicating the last time the user called). `Field` can be hour_of_day (which returns an integer from 0 to 23), minute (which returns an integer from 0 to 59), day_of_month (which returns an integer from 1 to 31), month (which returns an integer from 1 to 12), day_of_week (which returns an integer from 1 to 7 where 1 is Sunday), or year (which returns the 4 digit year).

- **called_from_ani**—This tag returns *true* if the caller has previously called from the current phone number, *false* if not.
- **account_info**—This tag refers to the user's account information. The `type` attribute can be pin, account_number, or external_uid.

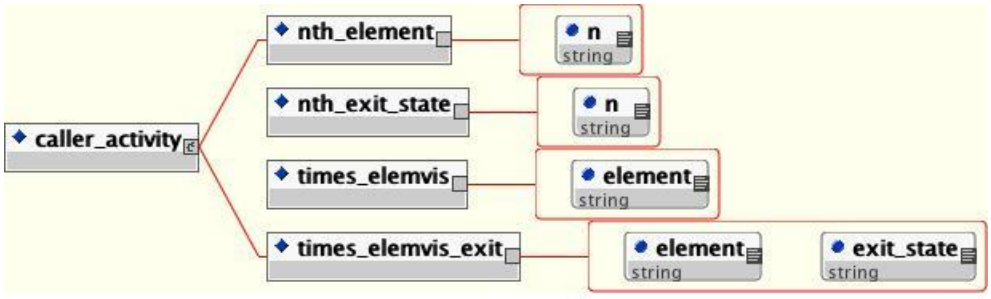
<general_date_time>

Figure 20: general_date_time Tag

The general_date_time> Tag figure shows the term that represents general date information. The `type` attribute indicates which date to access and the `field` attribute is used to choose which part of the date to return. `Type` can be current (indicating the current date/time) or call_start (indicating the time the call began). `Field` can be hour_of_day (which returns an integer from 0 to 23), minute (which returns an integer from 0 to 59), day_of_month (which returns an integer from 1 to 31), month (which returns an integer from 1 to 12), day_of_week (which returns an integer from 1 to 7 where 1 is Sunday), or year (which returns the 4 digit year).

<caller_activity>

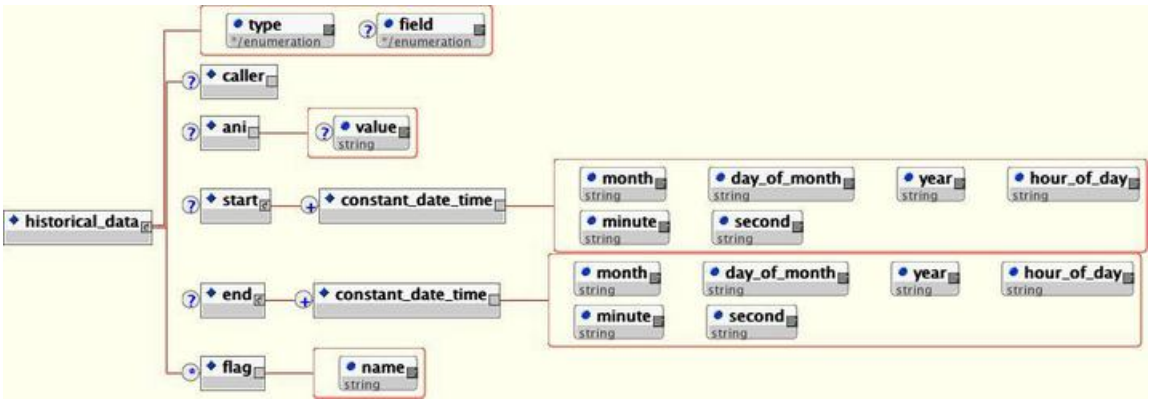
Figure 21: caller_activity Tag



The <caller_activity> Tag figure shows the term that represents the activity of the caller in the current call. The `<nth_element>` tag returns the nth element visited by the caller where the attribute `n` is the number (starting at 1). The `<nth_exit_state>` tag returns the exit state of the nth element visited by the caller where the attribute `n` is the number (starting at 1). The `<times_elemvis>` tag returns the number of times the caller visited the element whose name is given in the `element` attribute. The `<times_elemvis_exit>` tag returns the number of times the caller visited the element whose name is given in the attribute `element`, which returned an exit state whose name is given in the `exit_state` attribute.

<historical_data>

Figure 22: <historical_data> Tag



The <historical_data> Tag figure shows the term that represents the historical activity of the user associated with the call on the current application.

Note If the application has not been configured with a user management database, using this term will cause an error.

The `type` attribute determines what kind of value is returned. A value of num means that the value returned is the number of calls matching the criteria defined by the children tags. A value of last_date_time means that the value returned is the last date/time a call was received matching the criteria defined by the children tags. A value of first_date_time returns the first date/time a call was received that matched the criteria.

The `field` attribute is used if the `type` attribute is first_date_time or last_date_time and indicates which part of the date to compare. `Field` can be hour_of_day (which returns an integer from 0 to 23), minute (which returns an integer from 0 to 59), day_of_month (which returns an integer from 1 to 31), month (which returns an integer from 1 to 12), day_of_week (which returns an integer from 1 to 7 where 1 is Sunday), or year (which returns the 4 digit year). The children tags are used to turn on various criteria to add to the search.

The different search criteria are:

- **caller**—If this tag appears, the search looks for calls made by the current caller only. If it does not appear, it will search all calls made by all callers.

Note If the call was not associated with a specific UID, an error will occur if this tag is used.

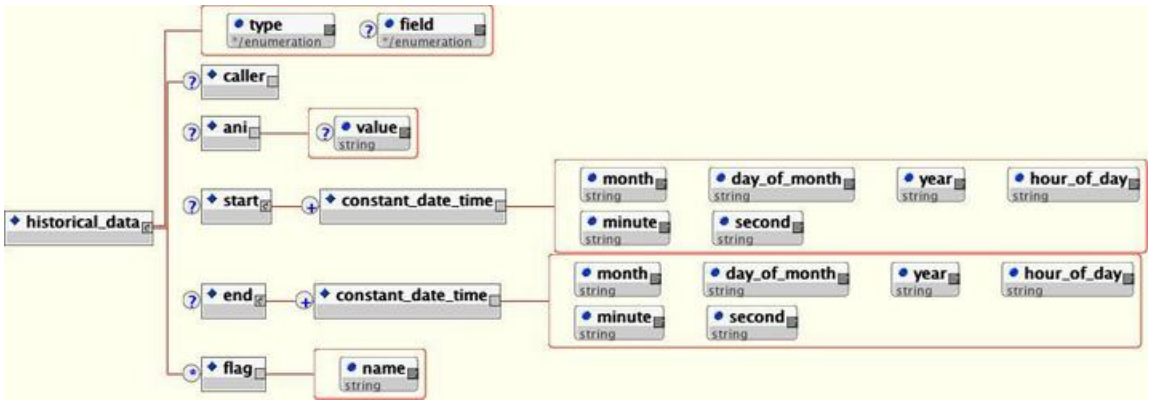
- **ani**—If this tag appears, the search looks for calls made by the ANI specified in the `value` attribute. If the `value` attribute is not included, the ANI of the current caller is used.
- **start**—If this tag appears, the search looks for calls whose start date/time are between two times specified by successive `<constant_date_time>` children tags. The attributes of `<constant_date_time>` define the specific date to use. The `month` attribute must be an integer from 1 to 12. The `day_of_month` attribute must be an integer from 1 to 31. The `year` attribute must be a four digit integer. The `hour_of_day` attribute

must be an integer from 0 to 23. The `minute` attribute must be an integer from 0 to 59. The `second` attribute must be an integer from 0 to 59.

- **end**—If this tag appears, the search looks for calls whose end date/time are between two times specified by successive `<constant_date_time>` children tags. See `<start>` (the previous bullet) for the description of the `<constant_date_time>` tag.
- **flag**—If this tag appears, the search looks for calls where a flag with the name given in the `name` attribute was triggered.

XML Decision Example1

Figure 23: <historical_data> Tag



The <historical_data> Tag figure shows the term that represents the historical activity of the user associated with the call on the current application.

Note If the application has not been configured with a user management database, using this term will cause an error.

The `type` attribute determines what kind of value is returned. A value of num means that the value returned is the number of calls matching the criteria defined by the children tags. A value of last_date_time means that the value returned is the last date/time a call was received matching the criteria defined by the children tags. A value of first_date_time returns the first date/time a call was received that matched the criteria.

The `field` attribute is used if the `type` attribute is first_date_time or last_date_time and indicates which part of the date to compare. `Field` can be hour_of_day (which returns an integer from 0 to 23), minute (which returns an integer from 0 to 59), day_of_month (which returns an integer from 1 to 31), month (which returns an integer from 1 to 12), day_of_week (which returns an integer from 1 to 7 where 1 is Sunday), or year (which returns the 4 digit year). The children tags are used to turn on various criteria to add to the search.

The different search criteria are:

- **caller**—If this tag appears, the search looks for calls made by the current caller only. If it does not appear, it will search all calls made by all callers.

Note If the call was not associated with a specific UID, an error will occur if this tag is used.

- **ani**—If this tag appears, the search looks for calls made by the ANI specified in the `value` attribute. If the `value` attribute is not included, the ANI of the current caller is used.
- **start**—If this tag appears, the search looks for calls whose start date/time are between two times specified by successive `<constant_date_time>` children tags. The attributes of `<constant_date_time>` define the specific date to use. The `month` attribute must be an integer from 1 to 12. The `day_of_month` attribute must be an integer from 1 to 31. The `year` attribute must be a four digit integer. The `hour_of_day` attribute must be an integer from 0 to 23. The `minute` attribute must be an integer from 0 to 59. The `second` attribute must be an integer from 0 to 59.
- **end**—If this tag appears, the search looks for calls whose end date/time are between two times specified by successive `<constant_date_time>` children tags. See `<start>` (the previous bullet) for the description of the `<constant_date_time>` tag.
- **flag**—If this tag appears, the search looks for calls where a flag with the name given in the `name` attribute was triggered.

XML Decision Example2

An application named Example2 randomly chooses two letters of the alphabet. The letters are chosen by an action element named *GetRandomLetter* and stored in element data named *letter1* and *letter2*.

A decision element named *IsCallerAWinner* would be needed which has three exit states:

- For a user whose name begins with either letter.
- For users whose name does not begin with the letters.
- For users whose name is not in the records (this could be an error or could prompt the application to ask the user to register on the website).

Even if the application assumes that all users will have their names on file, it is advisable to add this third exit state be sure. In this example, the default exit state is set to when the users do not match.

The rules of *IsCallerAWinner* decision element are:

Rule Number	Expression	Exit State
1	The caller's name begins with the value stored in the element *GetRandomLetter* with the variable name *letter1* or begins with the value stored in the element *GetRandomLetter* with the variable name *letter2*.	is a winner
2	The caller's name does not begin with the value stored in the element *GetRandomLetter* with the variable name *letter1* and does not begin with the value stored in the element *GetRandomLetter* with the variable name *letter2*.	not a winner
3	The caller's name does not exist.	no name

The Unified CVP decision element XML file is named *IsCallerAWinner* and will be saved in `%CVP_HOME%\VXMLServer\applications\Example2\data\misc`.

The XML file content will be:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE knowledge_base SYSTEM "../../../../dtds/DecisionKnowledgeBase.dtd">
<knowledge_base>
   <rule name="NameStartsWith" default_exit_state="not a winner">
      <exit_state name="no name" conjugate="and">
         <boolean value="false" check_existence="yes">
            <user_info>
               <demographic type="name"/>
            </user_info>
         </boolean>
      </exit_state>
      <exit_state name="is a winner" conjugate="or">
         <string operator="starts_with">
            <user_info>
               <demographic type="name"/>
            </user_info>
            <data>
               <element name="GetRandomLetter" variable="letter1"/>
            </data>
         </string>
         <string operator="starts_with">
            <user_info>
               <demographic type="name"/>
            </user_info>
            <data>
               <element name="GetRandomLetter" variable="letter2"/>
            </data>
         </string>
      </exit_state>
  </rule>
</knowledge_base>
```

Note The *no name* exit state is listed first. This is because before we try to analyze the user's name, we have to first know that it exists. We check if the name *does not exist* first and if it fails, it means that the name exists and we can continue.

Note The second exit state must check if the name begins with the first *or* second letter but the last exit state must check if the name does not begin with the first *and* second letter.

XML Decision Example3

An application named Example3 is designed to trigger a flag named *account menu* when a caller chooses to manage their account. As of June 15, 2004, the menu options were changed for the account menu. We want to tell people the options have changed, but only if know they have visited that part of the application before June 15. If not, there is no reason to say anything because the caller is experiencing this for the first time. A decision element is needed that distinguishes between those to play the changed audio to from those who should encounter the menu ordinarily. The rule must deal with the day, month, and the year, making sure that callers from previous years and future years are handled correctly as well. Because the current state of the

XML format does not allow date comparisons, a way must be determined to make this restriction. The solution is to use multiple rules which progressively get more restrictive in a process-of-elimination method. Because all conditions are to be handled, the rule must include those who do not hear the changed message using the same scheme (there is no need to use the default exit state).

The rules of *account menu* decision element are:

Rule Number	Expression	Exit State
1	The year the last time the caller triggered the flag *account menu* is earlier than 2004.	play changed
2	The year the last time the caller triggered the flag *account menu* is later than 2004.	normal
Note At this time, if the above two rules were not triggered, the caller triggered the flag in the year 2004.		
3	The month of the year the last time the caller triggered the flag *account menu* is less than 6.	play changed
4	The month of the year the last time the caller triggered the flag *account menu* is greater than 6	normal
Note At this time, if the above two rules were not triggered, the caller triggered the flag in June 2002.		
5	The day of the month the last time the caller triggered the flag *account menu* is less than or equal to 15.	play changed
6	The day of the month the last time the caller triggered the flag *account menu* is greater than 15.	normal

The Unified CVP decision element XML file is named *DoesCallerNeedMenuChanges* and will be saved in `%CVP_HOME%\VXMLServer\applications\Example3\data\misc`.

The content of the XML file will be:

```
<?xml version="1.0" encoding="ISO-8859-1"?>
<!DOCTYPE knowledge_base SYSTEM "../../../../dtds/DecisionKnowledgeBase.dtd">
<knowledge_base>
   <rule name="NewMessageTest">
      <exit_state name="play changed" conjugate="and">
         <number operator="less">
             <historical_data type="last_date_time" field="year">
                <caller/>
                <flag name="account menu"/>
             </historical_data>
             <constant_number value="2004"/>
         </number>
      </exit_state>
      <exit_state name="normal" conjugate="and">
         <number operator="greater ">
             <historical_data type="last_date_time" field="year">
                <caller/>
```

```
                <flag name="account menu"/>
            </historical_data>
            <constant_number value="2002"/>
        </number>
    </exit_state>
    <exit_state name="play changed" conjugate="and">
        <number operator="less">
            <historical_data type="last_date_time" field="month">
                <caller/>
                <flag name="account menu"/>
            </historical_data>
            <constant_number value="6"/>
        </number>
    </exit_state>
    <exit_state name="normal" conjugate="and">
        <number operator="greater">
            <historical_data type="last_date_time" field="month">
                <caller/>
                <flag name="account menu"/>
            </historical_data>
            <constant_number value="6"/>
        </number>
    </exit_state>
    <exit_state name="play changed" conjugate="and">
        <number operator="less_equal">
            <historical_data type="last_date_time" field="day_of_month">
                <caller/>
                <flag name="account menu"/>
            </historical_data>
            <constant_number value="15"/>
        </number>
    </exit_state>
    <exit_state name="normal" conjugate="and">
        <number operator="greater">
            <historical_data type="last_date_time" field="month">
                <caller/>
                <flag name="account menu"/>
            </historical_data>
            <constant_number value="6"/>
        </number>
    </exit_state>
  </rule>
</knowledge_base>
```

VoiceXML Insert Elements

There are certain situations in a voice application where a developer may want to include prewritten VoiceXML into their Unified CVP application. The developer may want fine-level control over a specific voice function at the VoiceXML tag level without getting involved with constructing a custom configurable element in Java. Additionally, the developer may want to integrate VoiceXML content that has already be created and tested into a Unified CVP application.

These situations are handled by a *VoiceXML insert element*.

- **VoiceXML Insert Element**—A custom element built in VoiceXML providing direct control of lower-level voice dialog at the price of decreased flexibility.

VoiceXML insert elements contain VoiceXML code that the developer makes available as the content of a VoiceXML `<subdialog>`. The content can be in the form of static VoiceXML files, JSP templates, or even

dynamically generated by a separate application server. A framework is provided to allow seamless integration of VoiceXML insert elements with the rest of the call flow.

The use of VoiceXML insert elements can cause the following results:

- the loss of being able to seamlessly switch between different voice browsers
- some greater processing overhead involved with integration with the rest of the call flow
- the added complexity of dealing with VoiceXML itself rather than creating an application with easy-to-use configurable elements

VoiceXML insert elements can have as many exit states as the developer requires, with a minimum of one.

Insert Element Restrictions

The following restrictions apply to a VoiceXML insert element. An insert element conforming to these restrictions will be assured full integration with the Unified CVP application. These restrictions will be clarified later.

- The insert element cannot define its own root document, a root document generated by VXML Server must be used.
- The variables to return to VXML Server, including the exit state, must conform to a strict naming convention.
- When using the `<return>` tag, Unified CVP-specified arguments must be returned along with the custom variables.

Note Use a VoiceXML insert element only in a top-level subdialog. You cannot use a VoiceXML Insert element in a nested subdialog.

Insert Element Inputs

As with any element in the application, an insert element needs to be able to access information about the call such as element and session data, call data (such as the ANI), and even information found in the user management database if the application is configured to use one. Generally, this information is available in the Java or XML API. Because an insert element is written in VoiceXML, this information must be made available for the insert element to use from within the VoiceXML.

Unified CVP achieves this by creating VoiceXML variables in the root document containing all the desired information. The variable names conform to a naming convention so that the Insert element developer can refer to them appropriately. This is one reason why Unified CVP requires the use of the VXML Server-generated root document.

In order to reduce the number of variables appearing in the root document, the application designer is given the option of choosing which input groups are passed to the insert element. Additionally, the designer can individually choose which element and session data to pass. By minimizing the inputs to only the data required by the insert element, the overhead involved in using an Insert element is minimized.

These are the input types:

- **Telephony**—This information deals with telephony data. The inputs start with audium_telephony_.
  - **audium_telephony_ani**—The phone number of the caller or NA if not sent.
  - **audium_telephony_dnis**—The DNIS or NA if not sent.
  - **audium_telephony_iidigits**—The IIDIGITS or NA if not sent.
  - **audium_telephony_uui**—The UUI or NA if not sent.
  - **audium_telephony_area_code**—The area code of the caller's phone number. Will not appear if the ANI is NA.
  - **audium_telephony_exchange**—The exchange. Will not appear if the ANI is NA.
- **Call**—This information deals with the call. The inputs start with audium_call_.
  - **audium_call_session_id**—The session ID.
  - **audium_call_source**—The name of the application which transferred to this one. Will not appear if this application is the first application in the call.
  - **audium_call_start**—The start time of the call in the format "DAY MNAME MONTH HH:MM:SS ZONE YEAR" where DAY is the abbreviated day of the week (for example, Wed), MNAME is the abbreviated name of the month (for example, Jun), HH is the hour (in military time), MM is the minute, SS is the seconds, ZONE is the time zone (for example, EDT), and YEAR is the four-digit year.
  - **audium_call_application**—The name of the current application.
- **History**—This information provides the history of elements visited so far in the call. The inputs start with audium_history_.
  - **audium_history**—This entire content of the element history (including exit states) is contained in this variable. The format is [ELEMENT]:[EXITSTATE]|..|[ELEMENT]:[EXITSTATE] where ELEMENT is the name of the element and EXITSTATE is the name of the exit state of this element. The order of the element/exit state pairs is consistent with the order in which they were visited. This will not appear if this insert element is the first element in the call.
- **Data**—This is the element and session data created so far in the call.
  - **audium_[ELEMENT]_[VARNAME]**—The element variable where ELEMENT is the name of the element and VARNAME is the name of the variable.

Note Both the element and variable names will have all spaces replaced with underscores. There may be no instances of this input if no element variables exist when this insert element is visited. For example, the variable audium_MyElement_the_value is element data named he value from the element MyElement.

  - **audium_session_[VARNAME]**—This is a session variable whose name is VARNAME.

Note The variable name will have all spaces replaced with underscores. The value is expressed as a string even if the type is not a string (the `toString()` method of the Java class is called). There may be no instances of this input if no session variables exist when this insert element is visited.

- **User Data**—This element information associated with the caller. It will only appear if the application has associated the call with a UID and a user management database has been set up for this application. The data will appear in the input exactly as in the database. The inputs start with user_.
  - **user_uid**—The UID of the user.
  - **user_account_number**—The account number of the user.
  - **user_account_pin**—The PIN of the user.
  - **user_demographics_name**—The name of the user.
  - **user_demographics_birthday**—The birthday of the user.
  - **user_demographics_zip_code**—The zip code of the user.
  - **user_demographics_gender**—The gender of the user.
  - **user_demographics_social_security**—The social security number of the user.
  - **user_demographics_country**—The country of the user.
  - **user_demographics_language**—The language of the user.
  - **user_demographics_custom1**—The value of the first custom column.
  - **user_demographics_custom2**—The value of the second custom column.
  - **user_demographics_custom3**—The value of the third custom column.
  - **user_demographics_custom4**—The value of the fourth custom column.
  - **user_account_external_uid**—The external UID of the user.
  - **user_account_created**—The date the account was created in the format. The value is in the format "DAY MNAME MONTH HH:MM:SS ZONE YEAR".
  - **user_account_modified**—The date the last time the account was modified. The value is in the format "DAY MNAME MONTH HH:MM:SS ZONE YEAR".
- **User By ANI**—Historical information about the phone number of the caller with regards to this application. It will only appear if a user management database has been set up for this application. The inputs start with user_by_ani_.
  - **user_by_ani_num_calls**—The number of calls made by this phone number.
  - **user_by_ani_last_call**—The last call made by the phone number. Will not appear if there were no calls made by this phone number in the past.

Insert Element Outputs

As with any element, VoiceXML insert elements can create element and session data, set the UID of the user to associate with the call, send custom logging events, and can return one of a set of exit states. As with voice elements, insert elements can have internal logging of caller activity and have global hotlinks and hotevents activated while the caller is visiting the Insert element. All of these actions involve variable data set within the Insert element and returned to VXML Server. These are crucial in order to properly integrate with the rest of the elements in the application.

These are the return arguments:

- **audium_exit_state** - The exit state of this VoiceXML insert element. The value of this variable must be exactly as chosen in the Builder for Call Studio when defining the insert element.
- **element_log_[VARNAME] / element_nolog_[VARNAME]** - These create new element data for this VoiceXML insert element whose name is VARNAME and which either sends a logging event to log the element data value or not, respectively. The data type will be assumed to be a string. The variable name cannot include spaces.
- **session_[VARNAME]** - This creates a new session variable whose name is VARNAME. The data type is assumed to be a string. The variable name cannot include spaces. If the variable name already exists, the old value will be replaced with this one. If the old data type was not a string, the new data type will be a string.
- **custom_[NAME]** - This sends a custom logging event whose contents is the action named NAME and the value of the variable being the description.
- **set_uid** - This associates the UID passed to the call.
- **audium_hotlink, audium_hotevent, audium_error, audium_action** - These four Unified CVP variables are created in the root document and must be passed along in the return `namelist`. The content of each deals with the occurrence of any global hotlinks, hotevents, errors, or actions (for example, a hang-up) while in this insert element. Because the subdialog has its own context and root document, this data has to be explicitly passed for any of these events to be recognized by VXML Server. The developer should not alter the contents of these variables.
- **audium_vxmlLog** - This variable contains the raw content for an interaction logging event. Adding to the interaction log is not required; the `audium_vxmlLog` variable can be passed empty. In order for VXML Server to parse the interaction data correctly, a special format is required for the content of the `audium_vxmlLog` variable.

  The format for interaction logging is:

  ```
  |||ACTION$$$VALUE^^^ELAPSED
  ```

  Where: ACTION is the name of the action.

  The following bullets list the possible action names and the corresponding contents of VALUE:

  - **audio_group** - Indicates that the caller heard an audio group play. VALUE is the name of the audio group.
  - **inputmode** - Reports how the caller entered their data, whether by voice or by DTMF key presses. VALUE should be contents of the `inputmode` VoiceXML shadow variable.
  - **utterance** - Reports the utterance as recorded by the speech recognition engine. VALUE should be the contents of the utterance VoiceXML shadow variable.

- **interpretation** - Reports the interpretation as recorded by the speech recognition engine. VALUE should be the contents of the interpretation VoiceXML shadow variable.
- **confidence** - Reports the confidence as recorded by the speech recognition engine. VALUE should be the contents of the confidence VoiceXML shadow variable.
- **nomatch** - Indicates the caller entered the wrong information, incurring a nomatch event. VALUE should be the count of the nomatch event.
- **noinput** - Indicates the caller entered nothing, incurring a noinput event. VALUE should be the count of the noinput event.

- ELAPSED is the number of milliseconds since the VoiceXML page was entered. The root document provides a JavaScript function named `application.getElapsedTime(START_TIME)` which returns the number of milliseconds elapsed since the time specified in `START_TIME`.

The root document created by VXML Server for use in all VoiceXML insert elements contains a VoiceXML variable named `audium_element_start_time_millisecs` that must be initialized with the time in order for the elapsed time intervals to be calculated correctly. This variable need only be initialized once in the *first VoiceXML page* of the insert element. All subsequent pages in the VoiceXML insert element must **not** initialize the variable because VXML Server requires the elapsed time from the start of the element, not the page. In VoiceXML, the line to appear must look like:

```
<assign name="audium_element_start_time_millisecs" expr="new Date().getTime()" />
```

For best results, this line should appear as early as possible in the first page, preferably in a `<block>` in the first `<form>` of the page, certainly before any additional logging is done.

In VoiceXML, setting the value of an existing variable requires the `<assign>` tag. Because the expression contains a JavaScript function, the `expr` attribute must be used. Additionally, in order to avoid overwriting previous log information, the expression must append the new data to the existing content of the variable. For example, to add to the interaction log the fact that the *xyz* audio group was played, the VoiceXML line would look like:

```
<assign name="audium_vxmlLog" expr="audium_vxmlLog + '|||audio_group$$$xyz^^^'
+application.getElapsedTime(audium_element_start_time_millisecs)"/>
```

In another example, the utterance of a field named xyz is to be appended to the log. The VoiceXML would look like:

```
<assign name="audium_vxmlLog" expr="audium_vxmlLog +'|||utterance$$$'+ xyz.$utterance +
'^^^' + application.getElapsedTime(audium_element_start_time_millisecs)"/>
```

Root Document

The subdialog context written by the developer must refer to a Unified CVP-generated root document. This is essential for proper integration of the VoiceXML insert element with VXML Server. The root document call must look like:

```
"/CVP/Server?audium_vxml_root=true&calling_into=APP&
namelist=element_log_value|RTRN1|RTRN2|…"
```

Where APP is the application name and RTRNX represents the names of all the element data, session data, and custom log entries (delimited by '|' characters) the insert element returns, using the same naming convention described in the outputs section.

The purpose for this requirement is related to how events are handled within the root document. The Unified CVP-generated root document catches events such as the activation of a global hotlink or a hangup, which

then requires the call flow to leave the insert element. The insert element, however, may have created element and session data or added custom content to the log. This information is stored in VoiceXML variables that would be deleted once the subdialog context is exited. The root document needs to know which VoiceXML variables to send along to VXML Server when one of these events is triggered so that it can store them accordingly. In order to avoid problems that might occur if a global hotlink or hotevent was activated right after the insert element began, the variables to be returned should be declared as near the start of the VoiceXML insert element as possible, even if they are not assigned initial values.

Note The ability to use a standard ampersand in the root document URL instead of escaping it (as &) is voice browser dependent. Most browsers will accept the escaped version so try that version first.

Note If the insert element does not need to send back any data in the `namelist` parameter, only the `element_log_value` variable need be included (the parameter should look like this: "...namelist=element_log_value").

Example of Insert Elements

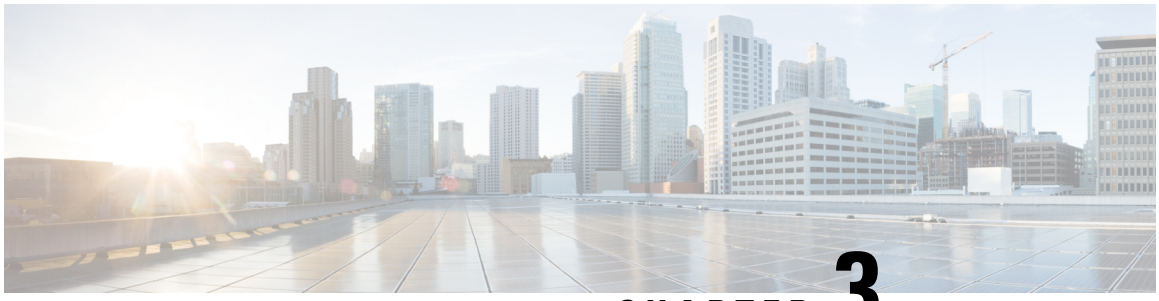
In the example, a block is used to log the playing of the `initial_prompt` audio group. After this action, some inputs passed to it from VXML Server are played. Once played, it creates two element variables named `var1` and `var2` and a session variable named `sessvar`. After this action, it goes through a field that catches a number, and when done saves the utterance to the activity log and returns the exit state *less* if the number is less than 5 and *greater_equal* otherwise. The `<return>` tag returns the exit state, log variable, the four variables from the root document (error, hotlink, hotevent, and action), the two element data variables, the session data variable and a custom log entry (the number captured).

Also note that these last four variables are also passed to the root document call in the `<vxml>` tag so that events triggered within the insert element will correctly pass the data if it was captured by then.

Note The VoiceXML shown here may not function on all browsers without modification.

```
<?xml version="1.0"?>
<vxml version="2.0" application="/CVP/Server?audium_vxml_root=true&calling_into=MYAPP&
namelist=element_log_var1|element_nolog_var2|session_sessvar|custom_custlog">
   <form id="testform">
      <block>This is the initial prompt
          <assign name="audium_element_start_time_millisecs" expr="new Date().getTime()"/>
          <assign name="audium_vxmlLog" expr="'|||audio_group$$$initial_prompt^^^'
+application.getElapsedTime(audium_element_start_time_millisecs)"/>
      </block>
      <block>In the VoiceXML element.
        The ani is <value expr="audium_telephony_ani"/>.
        The element history is <value expr="audium_history"/>.
        User by ani num calls is <value expr="user_by_ani_num_calls"/>.
        Element data foo from element first <value expr="audium_first_foo"/>.
        Session variable foo2 <value expr="audium_session_foo2"/>.
      </block>
      <var name="element_log_var1" expr="'log me'"/>
      <var name="element_nolog_var2" expr="'do not log me'"/>
```

```
      <var name="session_sessvar" expr="'session_data_value'"/>
      <field name="custom_custlog" type="number">
        <property name="inputmodes" value="voice" />
        <prompt>Say a number.</prompt>
        <filled>
          <assign name="audium_vxmlLog" expr="audium_vxmlLog + '|||utterance$$$' +
custom_custlog.$utterance + '^^^'
+application.getElapsedTime(audium_element_start_time_millisecs)"/>
          <if cond=" custom_custlog < 5">
            <assign name="audium_exit_state" expr="'less'"/>
            <else/>
            <assign name="audium_exit_state" expr="'greater_equal'"/>
          </if>
          <return namelist="audium_exit_state audium_vxmlLog audium_error audium_hotlink
audium_hotevent audium_action element_log_var1 element_nolog_var2 session_sessvar
custom_custlog" />
        </filled>
      </field>
  </form>
</vxml>
```



CHAPTER 3

Administration

Administration is an essential feature of any enterprise system. Once started, a system must remain operational for long periods of time with no downtime so it must provide ways for an administrator to manage it at runtime. This applies to both changes and updates to the application as well as providing information concerning its health. The more flexible and informative a system, the better an administrator will be able to ensure it runs efficiently and detect any issues with the system quickly.

VXML Server has been designed to afford maximum flexibility for administrators to control how it runs and to monitor vital statistics of its health. Administrators can add, remove and change applications deployed, are able to get information on the system and the applications, and even change the behavior of the system or components, without requiring a restart of VXML Server.

This chapter details the administration functions and statistics exposed by VXML Server and the methods by which these functions can be accessed and processed.

- Introduction to VXML Server Administration, on page 57
- Administration Information, on page 60
- Configuration Updates, on page 64
- Administration Functions, on page 68
- VXML Server Metrics, on page 78

Introduction to VXML Server Administration

VXML Server exposes three methods for an administrator to control it and obtain information. Each method is accessed differently and exposes different levels of functionality or information.

- The first method, and the most flexible, is the JMX-compatible management interface.
- The second method is through the use of administration scripts.
- The third method is using the system information web page.

The topics that follow discuss these three methods.

JMX Management Interface

Java Management Extensions (JMX) is a Java technology specifically designed for managing Java applications. It is part of the standard Java Virtual Machine and defines a standard interface for clients and servers. An application that to be managed by JMX will register MBeans to the JMX context. An MBean can be used to

expose information about the system that an administrator can fetch (for example, the total simultaneous calls on the system). An MBean can also be used to expose a function that an administrator can run (for example, to suspend an application). A client application communicates with the server through the JMX interface to allow administrators access to the information and function that is exposed.

VXML Server, is a server application, exposes many informational MBeans for information regarding itself as well as the applications deployed on it. It also exposes administrative MBeans for controlling important administrator functions. It does this in a fully JMX-complaint manner so that any JMX-compatible client will be able to interface with VXML Server to gain access to the information and functions. One such client is JConsole, which is a client bundled with JDKs provided by Sun Microsystems and others. Some JVMs and application servers provided by other companies may utilize alternative JMX-compatible clients that should work as well.

It is also possible for a developer to create their own custom MBeans for exposing functions or information that will then be viewed by a JMX-compatible client alongside the MBeans exposed by VXML Server. See the *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio* for more on creating custom MBeans.

VXML Server is configured to be JMX enabled when using Tomcat. The JMX port number by default is 9696.

Once VXML Server is started, a JMX client can then be launched and configured to point to the machine on which VXML Server runs, whether it be on the same machine or a remote one. Once connected, the client provides a graphical interface for displaying the information and functions. The client will be able to display information about the JVM itself and typically the Java application server will publish its own set of MBeans. VXML Server information will be displayed where the MBeans are listed in its own *domain*. The domain is typically rendered in a tree structure and will list global information and functions (that is, information having to do with VXML Server itself) as well as information on the deployed voice applications. Detailed explanations of the individual MBeans are provided in the following sections.

To address security, JMX client consoles require the proper security certificates (if JMX security is enabled on the VXML server) and the client attempts to connect to a remote server. Certificates are not required to connect to a local VXML Server because the client already has access to the local system. For details on securing communication and accessing secured communications, see the *Configuring and Modifying Unified CVP Security* section in Configuration and Administration Guide for Cisco Unified Customer Voice Portal.

Of the available administration interfaces, the JMX interface for VXML Server provides the greatest functionality and flexibility. It does, however, require the JVM to have JMX active and a JMX-compatible client. It also has a higher risk and overhead due to this flexibility.

Administration Scripts

Most of the administration functions and some of the information about VXML Server are provided via command-line scripts that can be run by an administrator manually or an automated system directly. The administrator scripts do not use the JMX interface described in the previous section and are functional by default without requiring any configuration on the administrator's part. The included scripts act as the client. The scripts are provided in two forms: batch scripts for Microsoft Windows (ending in `.bat`) and shell scripts for Unix (ending in `.sh`).

Scripts are provided to run global functions (on VXML Server itself) or functions for individual applications. The scripts used for global administrator functions are found in the `admin` directory of VXML Server. The scripts used for individual application administration are located in the `admin` directory of each application.

The provided scripts are primarily used to expose VXML Server functions to administrators such as loading a new application, updating an existing application, suspending VXML Server, and so on. Some scripts provide

information, such as the number of active simultaneous calls on the server. This chapter describes in detail all available scripts and their functionality.

Security is an important concern when it comes to administration functions that are accessed from the command-line. Unified CVP sets up these precautions to allow only the appropriate people access to these scripts:

- By providing scripts or batch files (as opposed to through a graphical or web interface), the administrator must be logged into the machine in order to access them. Accessing these programs is as secure as the remote login process (such as SSH) and the permissions given to these scripts or the entire `admin` folder.
- VXML Server will only accept commands from the local machine, so even scripts stored on one machine cannot issue commands to an instance of VXML Server running on another machine. These two precautions ensure that only authorized administrators can access these functions.

Because the global administration scripts are stored in a different location from application scripts, each directory can be assigned different permissions. That way an administrator can be given access to the global administration scripts while still allowing the application scripts to be accessed by voice application developers.

Every administration script can be configured to ask for confirmation before the action is taken, to prevent the accidental processing of the script. By default the confirmations are on. They can be turned off by passing the command-line argument *noconfirm* to the script. This action can be useful if the administration scripts are run by automated systems such as cron jobs.

While not as flexible as the JMX interface, administration scripts provide easy access to VXML Server functions for both administrators and automated systems out of the box. The risk potential is similar to that of the JXM interface although there is less overhead because JMX is not enabled.

System Information Page

The system information page provides basic information about VXML Server including the license information, the deployed gateway adapters and applications, the status of information on the application server on which VXML Server is running, and some miscellaneous system and Java information such as the version and memory usage. It does not provide the ability to run any functions, it is meant to be a quick way to check relevant information. It is also the easiest of the three methods to obtain information because all that is needed is a web browser. The system information page can be seen by pointing a web browser to the URL:

```
http://[HOST][:PORT]/CVP/Info
```

Where:

- HOST is the host name of the machine on which VXML Server is installed.
- PORT is the port the application server is configured to listen on. The default port for HTTP is 7000.

The first time you access the server information page you must configure a username and password. After you create the username and password you can log in and view the page.

The system information page is the easiest and safest way of obtaining administrative information, although it is also the least flexible.

Administration Information

Using the tools listed, an administrator can obtain a significant amount of information regarding VXML Server and the applications that are deployed on it. This information aids the administrator in determining the health of the system, detecting signs of issues that should be caught early, and debugging issues as they occur.

Much of the information made available by VXML Server can be found only through the JMX interface as that is the strength of JMX. Some of the more important information is available by using scripts and some of the static information is available through the system information page.

Application and System Status

VXML Server provides functions for reporting the status of a specific voice application or all voice applications running on the system. They are provided as functions to allow the administrator to query VXML Server to get the latest information immediately.

The application status function reports the following information:

- Whether the application is running, suspended, or has been suspended before being slated for removal.
- How many active sessions are currently visiting the application. Active sessions are defined as the number of callers that are interacting with the application at the time the status script is called.
- How many sessions are waiting to end. When an active caller ends their application visit, VXML Server delays the closing of the corresponding session to allow the completion of the session accessed by the final logger and end of call class actions. A session waiting to end does not take up a license port. The amount of time a session remains open after a call ends is a VXML Server configuration option .
- How many open sessions are experiencing the most recent past version of the application. Open sessions are the sum of active callers visiting the application and those sessions that are in the process of ending. The reason open sessions are listed here is because both active and ending sessions do need access to session information and an administrator would need to know when it is safe to disable any systems that the old application configuration depends on. This information is helpful for an administrator when performing an application update or suspension in order to determine when the function is complete. See the following sections for more on updating and suspending applications.
- How many callers are on hold waiting to get into the application. A call that is received when the system has used up all the allowed sessions defined in the license will hear a message asking them to stay on the line. This call then checks if a license session has become available and then lets the call into the application.

The VXML Server status function provides an easy-to-read report with the following information:

- If VXML Server itself has been suspended, this fact is listed first. See the following sections for more on suspending VXML Server.
- The total number of concurrent active callers visiting applications on this instance of VXML Server, how many concurrent sessions the license allows, the number of available ports (the license sessions minus the active callers), and the number of callers on hold (which would only appear if the number of current callers exceeds the number of license sessions).

Note This data is not available in case of a standalone deployment.

- How many active callers, sessions ending, and callers on hold for each application currently deployed on the system. This data is the same as would be displayed by the application-specific status function.

Note No on hold column will appear unless there are callers on hold.

- Whether each application is running or suspended.

JMX Interface

To get an application's status using the JMX interface, use a JMX client connected to the server to navigate to the `VoiceApplication/APPNAME/Command` MBean, where `APPNAME` is the name of the application to update. The **Operations** tab of this MBean will list a function named *status*. Pressing **Status** button will display a dialog box with the application status. To get the status of all applications using the JMX interface, navigate to the `Global/Command` MBean and click the function named *status* in the **Operations** tab. Pressing **Status** button will display a dialog box with the status of each application deployed on VXML Server in a table.

Administration Scripts

The script for obtaining an application status is found in the `admin` folder of the application to be updated. Windows users should use the script named `status.bat` and Unix users should use the script named `status.sh`. The script for obtaining the status of all applications is found in the `admin` folder of VXML Server. Windows users should use the script named `status.bat` and Unix users should use the script named `status.sh`. The scripts do not take any parameters.

VXML Server Information

VXML Server reports information about itself that is static so the administrator knows exactly what is installed. The following information is reported:

- The exact name and version of VXML Server.
- The expiration date, number of ports, and the supported gateway adapters listed in the VXML Server license.

Note The gateway adapter list is not a comprehensive list of the adapters installed on VXML Server but is a list of the gateway adapters the license allows the system to use.

- A detail of the version numbers of all components included with VXML Server. This information can be helpful for tracking changes made to individual components of the software installed at different times and this detailed information will typically be requested by Cisco support representatives when a question is raised about the software.

  The components whose versions are displayed are:

- The VXML Server web application archive (WAR) and the components residing within %CVP_HOME%\VXMLServer\.

Note This version is different from the VXML Server product version as that is a version for the whole system and this one is only for the WAR file.

- The core VXML Server elements, Say It Smart plug-ins, and loggers (both application and global) included with the software.
- The Gateway Adapters installed on the system.

JMX Interface

To obtain VXML Server information using the JMX interface, navigate to the `Info` MBean. The attributes tab displays all the information listed. To see all the gateway adapters supported in the license, you must open the value for the *LicensedGWAdapters* attribute (in JConsole this is done by double-clicking the value). The same procedure applies for obtaining the component versions by opening the value for the *ComponentVersions* attribute.

Administration Scripts

The only VXML Server information available by using a script is the versions of the components installed on VXML Server, though the name and version of VXML Server is displayed when it initializes and the license ports is always displayed using the global status script.

The script is found in the admin folder of VXML Server. Windows users should use the script named `getVersions.bat` and Unix users should use the script named `getVersions.sh`. In order to report on the version of the VXML Server web application archive (WAR), the script should be passed as an argument the full path of the WAR location (for example, %CVP_HOME%\VXMLServer\Tomcat\webapps\).

System Information Page

The same information is displayed in the system information page at the top of the table. It will also provide a list of the applications deployed on VXML Server as well as information on the application server, operating system, and Java memory usage.

Server Status Checks

Many load balancers can be configured to periodically access a URL that is used to determine if a server is running. These load balancers make a request to the URL, and if a response comes back within an acceptable time period, they consider the server available to handle connections. To determine the health of VXML Server, include the parameter `probe=true` in the request URL, using one of the following formats:

```
http://[DOMAIN][:PORT]/CVP/Server?probe=true
```

OR:

```
http://[DOMAIN][:PORT]/CVP/Server?application=[APPLICATION]&probe=true
```

The first URL format (*without* the `application` parameter) results in a simple HTML page with the following text if the VXML Server is accessible and is not suspended:

```
The Cisco Unified CVP VXML Server is up and running
```

However, if it is suspended (using the `suspendServer` administrative script), it will respond with:

```
The Cisco Unified CVP VXML Server is running, however it has been suspended.
```

This URL format has several optional parameters that may be used in conjunction with it:

- `activeCalls=true`

  This optional parameter causes the response HTML to include information about how many call sessions are active on the VXML Server instance. This is formatted as illustrated in the following example:

  ```
  running;activeCalls=12;
  ```

- `onHoldCalls=true`

  This optional parameter causes the response HTML to include information about how many call sessions are in an *on hold* status on the VXML Server instance. This is formatted as illustrated in the following example:

  ```
  running;onHoldCalls=3;
  ```

- `activeCalls=true&onHoldCalls=true`

  Specifying both of the optional parameters results in both data items being returned, as illustrated in the following example:

  ```
  running;activeCalls=77;onHoldCalls=0;
  ```

The second URL format (*with* the `application` parameter), results in a VoiceXML page which includes a `<submit>` to the listed voice application. If that VoiceXML page is returned, then VXML Server is accessible. This format is intended for use with load balancers that require the probe URL to match the URL through which actual content is retrieved. This format cannot be used to obtain additional information (that is, active and on-hold calls).

VXML Gateway Adapter

Gateway adapters are small plug-ins installed on VXML Server that provide compatibility with a particular Voice Browser. Once installed, all Unified CVP voice elements (and all custom voice elements not using browser-specific functionality) work on that Voice Browser.

Starting from Release 10.5 onwards VXML Server supports the following gateway adapters:

- **Cisco DTMF:** Generates the grammar for DTMF detection at Cisco Gateway.
- **VXML 2.1 with Cisco DTMF:** Generates the grammar for DTMF detection at Cisco Gateway using VXML 2.1 tags.
- **Nuance 10:** Generates the grammar for Speech and DTMF detection on the Nuance 10 server.
- **VXML 2.1 with Nuance 10:** Generates the grammar for Speech and DTMF detection on the Nuance 10 server using VXML 2.1 tags
- **Speech:** Generates the grammar for Speech and DTMF detection on the SpeechWorks server.
- **VXML 2.1 with Speech:** Generates the grammar for Speech and DTMF detection on the SpeechWorks server using VXML 2.1 tags

Note Nuance 10 or Speech adapter can process the grammars that are present on Nuance 10 or Speech server respectively; however, Cisco DTMF adapter can process the grammars that are present locally on the Cisco IOS gateway.

The following table provides the gateway adapter mapping to be used, while migrating from older version of Call Studio to Release 10.5(1) and onwards.

Adapters Prior to Release 10.5	New adapters from Release 10.5 onwards
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 with Cisco DTMF	Cisco DTMF
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 VoiceXML 2.1 with Cisco DTMF	VXML 2.1 with Cisco DTMF
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 with Nuance 8.5	Nuance 10
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 VoiceXML 2.1 with Nuance 8.5	VXML 2.1 with Nuance 10
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 with OSR 3	Nuance 10
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 VoiceXML 2.1 with OSR 3/Nuance 9	VXML 2.1 with Nuance 10
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 with Speech	Speech
Cisco Unified CVP 4.1/7.0/8.0/8.5/9.0 VoiceXML 2.1 with Speech	VXML 2.1 with Speech

Configuration Updates

When an administrator monitors a VXML Server installation, they want to be aware of any warning signs that the system is overloaded. In these scenarios, it is advantageous if the administrator can alter a few settings to better handle the given load without worrying about updating or suspending applications or shutting down the Java application server. These chnages may enable a system to better handle spikes in call activity with no adverse effects. To this end, VXML Server exposes some of its configuration options and allows an administrator to change them at runtime. It also allows the administrator to change some application settings values for deployed application.

Note It is *important* that the administrator be very careful when altering these configuration options at runtime as improperly chosen values could make the system unstable and achieve the opposite effect than desired.

The ability to change VXML Server configuration options and application settings is available only through the JMX interface. The configuration options are exposed as attributes of an MBean, one for the VXML Server configuration options and one for each application's settings. Those attributes that allow their values to be changed will have editable values. When a new value is given, it takes affect immediately with no confirmation so it is important to ensure that the value entered is correct. There is some simple validation that takes place by VXML Server and if the value entered is inappropriate (such as entering -1 where a positive integer is required), the change will not take place and the original value will remain unchanged. The administrator will know that their entry was accepted if the value does not revert back.

Note It is *very important* that any changes made to these attributes are **not persisted**. The changes affect VXML Server in memory and do not affect the XML files that hold these values. As a result, should the Java application server or the VXML Server web application be restarted or for application-specific attributes the application is updated, the attributes will revert back to the values specified in their respective XML files.

VXML Server Configuration Options

To view the VXML Server configuration options using the JMX interface, navigate to the `Global/Configuration` MBean.

There are five attributes listed.

- The first, named *LoggerEventQueueSize*, will show the current size of the queue that holds logger events waiting to be sent to loggers and is not editable.
- The *next three* are related in that they control aspects of the logger thread pool.
- The final configuration option deals with a period of time VXML Server waits after a caller ends their call before the call session is invalidated. All of these options affect the performance of the system and are defined fully in VXML Server Configuration.

Use the following table to reference the JMX attribute name with the `global_config.xml` tag name.

JMX Attribute Name	Tag Name
LoggerMaximumThreadPoolSize	`<maximum_thread_pool_size>` in the `<logger>` tag
LoggerMinimumThreadPoolSize	`<minimum_thread_pool_size>` in the `<logger>` tag
LoggerThreadKeepAliveTime	`<keep_alive_time>` in the `<logger>` tag
SessionInvalidationDelay	`<session_invalidation_delay>`

Tuning Logger Options

The most important indication of whether VXML Server is encountering issues with loggers is the *LoggerEventQueueSize* attribute. In order to prevent logging from holding up calls, all logging is done in separate threads. The threads are managed within a thread pool, which has a maximum and minimum value. When VXML Server starts up, the thread pool allocates the minimum number of threads. As calls begin to be handled, they generate logger events, which are put into a queue of events.

The activation of a logger event also prompts VXML Server to request a thread from the pool and in that thread have the appropriate logger handle the top most event in the queue. The length of time this thread handles the event depends on the logger, but the event is typically handled in a very short period of time, measured in milliseconds. However as call volume on the system increases, more threads are used simultaneously to handle the increase in logger events added to the queue.

As more threads are needed, the thread pool grows until it reaches the maximum number of threads allowed. At that point the queue would grow until threads become available. Threads that complete their work and cannot find new logger events to handle because the queue is empty will be garbage collected after a certain amount of time being idle (this is governed by the *LoggerThreadKeepAliveTime* option).

Under typical operation, the logger event queue size should not be a large number (one might see it set to 0 to 10 most of the time). There could be spikes where the queue grows quickly but with plenty of available threads to handle the events, the queue size should shrink rapidly. The administrator should take note if the queue size shows a high number, though should be very wary if this number seems to grow over time (minutes, not seconds). A growing queue size is an indication that either the load on the system is too high for the thread pool to handle (which is more likely the smaller the maximum thread pool size is set) or for some reason loggers are taking longer to do their logging. In the latter case this could be due to a slow database connection, overloaded disk IO or other reasons. Regardless of the cause, a growing queue is a warning sign that if the call volume is not reduced, the Java application server is at risk of encountering memory issues and, in the worst case, running out of memory.

It is for this reason that choosing an appropriate maximum thread pool size is important. While the temptation to give the maximum number of threads a very high number this can also cause problems on the system as severe as memory issues. Using too many threads could cause what is called *thread starvation* where the system does not have enough threads to handle standard background processes and could exhibit unpredictable inconsistent behavior and could also cause the Java application server to crash.

The JMX interface supports the ability to change the maximum and minimum thread pool size at runtime. The administrator should only do this if they believed the change could avert an issue listed above. For example, if the system is encountering a temporary spike in activity and the administrator sees the LoggerEventQueueSize attribute report a growing number, then they can increase the maximum thread pool size to potentially allow for a more rapid handling of the queued events. Once the queue shrinks to a manageable number the maximum thread pool size can then be changed back to its original value.

The maximum number of threads set by default in VXML Server is sufficient to handle a very heavy load without issues so the administrator is urged to use caution when changing these values.

Session Invalidation Delay Option

The session invalidation delay option is also an important value that an administrator could be tuned should they see the need. A brief explanation of what this option does is warranted . When a caller ends the call by either disconnecting, going to another application, or the application ends up the connection with the caller, VXML Server must perform some final clean up of the call session. This is primarily for processing logging events that occurred when the call ended. Additionally, application developers can configure their applications to run code at the end of a call to perform their own clean up operations. In sophisticated applications this could involve closing database connections or generating call detail records. These end-of-call operations can take a non-trivial amount of time and may require access to information about the call session, such as element or session data. As a result, VXML Server waits for a preset period of time after a call ends before it invalidates the session, allowing all activities requiring additional time to complete. This period of time is governed by the `SessionInvalidationDelay` attribute and is measured in seconds.

It is important to understand the consequences of changing this value. If too low a time is given then there could be situations where the system under load cannot handle the end of call tasks in the given time and the global error log may see many errors containing the Java exception `IllegalStateException` which occurs when attempting to access data from an invalidated call session. One has to understand that system resources are limited and when it is under load what may have taken 100ms to complete could take longer and depending on what it is that needs to be done, could take much longer.

The administrator should refrain from the temptation of making this number too large. This is because while a call session is still valid but not representing a live call, all that information remains in memory. This may not be much but could be significant depending on the amount of data stored in element and session data by the application. Even though the session has not been invalidated, since the call has ended, VXML Server is ready and will accept new calls, which will allocate additional memory. Under high load, the Java application server could encounter memory issues if call sessions remain in memory for too long a period.

The JMX interface supports the ability to change the session invalidation delay at runtime. The administrator would increase this setting if `IllegalStateException` errors appear in the logs. They would lower the value if the JVM memory usage stays close to the maximum after each garbage collection. Keep in mind that there are many potential causes for JVM memory utilization to rise and is certainly not limited to this cause.

The default value of the session invalidation delay is sufficient to handle a heavy load without issues so the administrator is urged to be cautious when changing this value.

Application Configuration Options

To view the configuration options of an application using the JMX interface, navigate to the `VoiceApplication/APPNAME/Command` MBean, where `APPNAME` is the name of the application. There are four attributes listed:

- **DefautAudioPath** - Shows the audio path defining where the audio files are located (assuming the application was designed to take advantage of it).
- **GatewayAdapter** - Shows the gateway adapter that the application is using and is not editable. It is for informational purposes only.
- **SessionTimeout** - Shows the length of time, in seconds, of inactivity to consider a call session timed out.
- **SuspendedAudioFile** - The path for the audio file to play to callers when calling into an application that is suspended.

An administrator may choose to change the default audio path of an application at runtime should there be a need to change the audio callers hear quickly. One use case would be if the server that hosts the audio files is being restarted and the administrator wishes all audio to be fetched from a backup server.

Note The effectiveness of this change will be based on how consistently the application was designed to use the default audio path and also if the application explicitly sets the default audio path itself, which would override the value passed here.

An administrator may choose to change the session timeout value at runtime as part of the process of debugging a problem. Under ordinary circumstances no session should time out because the voice browser and VXML Server should be in constant communication regarding when a call starts and ends. An administrator experiencing some sessions timing out may choose to increase this attribute to see if it resolves the issue and if not, should look into network issues. The administrator should be careful not to set this value too small a number because there is a risk that an ordinary call could time out due to the caller visiting a particularly large VoiceXML page or taking their time entering a long DTMF input. Too large a number will mean that sessions that are no longer valid will remain in memory longer and the administrator would not be able to see which sessions are timed out until the timeout period elapsed.

An administrator may choose to change the suspended audio file at runtime if the application needed to be suspended due to a specific reason. For example, if a weather event required an application to be suspended, the administrator could point the suspended audio message to a recording explaining why the application is suspended rather then just pointing to a generic message. The administrator is taking advantage of the fact that this change is not persisted since it is expected that the event that caused the application's suspension is temporary.

Administration Functions

VXML Server exposes several functions that allow an administrator to make both small and large changes to the applications and VXML Server at runtime. They are divided into two categories: those that affect a specific application and those that affect all applications running on VXML Server. An administrator can use the JMX interface as well as administration scripts to run these functions.

Each administrator function, when activated, prompts VXML Server to send a logger event reporting the function and its result so that any loggers listening to these events can log the information. The logs will then maintain a history of administration activity that can be analyzed later.

Administrator functions include the ability to add, update, and remove applications as well as suspend both an application and VXML Server itself. This section describes all functions available.

Graceful Administration Activity

Administration functions are used primarily to alter an application, whether it be to update its contents or suspend its activity. Whenever changes are made to a live system handling callers, a concern is how these changes affect live callers. A robust, reliable system should strive for maximum uptime and minimal disruptions of live calls, and VXML Server does this by implementing a process for managing changes.

In the process, existing callers continue to experience the application as it existed before the change, while new callers experience the change. Only after all existing callers have naturally ended their calls will the change apply to all live callers. At this time, VXML Server will perform any necessary cleanup required to remove the old application configuration. In this manner, changes can be made to applications at any time; the administrator does not need to worry about the impact of the change on live callers as the transition will be handled.

Due to the interactive nature, when using administration scripts to perform graceful functions, the script will display a count down of callers that are actively visiting the application as they end their calls. This is provided because an aid to the administrator in determining how many callers are still experiencing the application before the change. Command-line arguments passed to the scripts can turn off this countdown if desired.

When using the JMX interface or if the countdown is turned off in the administration script, the only way to track the number of callers that are still experiencing the old configuration would be to get the system status.

Applications Update

Occasionally, an application will need to be updated. Possible changes can be small, such as renaming an audio file or altering a TTS phrase, or large, such as adding another item to a menu and creating a new call flow branch. They can involve simple configuration changes or may involve new or changed Java class files. While most changes are implemented during development time, there is a requirement to support updating an application at runtime.

The update functionality acts gracefully in that any callers on the system, at the time of update continue to experience their calls as if the application had not been updated, while new callers experience the updated voice application. In this manner, there is no downtime when a change is implemented for an application, the callers are handled as expected.

VXML Server exposes an update function for every application deployed. This Server will update only that application. It also has a function that updates all applications at once.

When updating individual voice applications note these guidelines:

- The update applies only to those resources controlled by VXML Server. These include the application settings and call flow, element configurations, Unified CVP decision elements, and Java classes placed in the `java/application` directory of the application. The following changes are not managed by VXML Server and therefore will not be updated:
  - Java classes placed anywhere else (including the `common` folder).
  - XML content passed to VXML Server by using the XML API.
  - The content of VoiceXML insert elements.
  - Other applications that the updated application transfers to or visits as part of a subroutine.
  - External back-end systems such as web services and databases (including the user management database).
  - Web servers hosting static content used by the application such as audio or grammar files.

  When each of these resources become unavailable or change, all callers would be affected. For small changes such as a revised audio file, this situation may be acceptable. For large-scale changes that span multiple systems, this might cause problems such as callers who are visiting an application when the update is made experiencing an error because a database is down.

  For large changes, the application should be suspended and the changes made once all callers have left the system (see the following section on suspending applications). Once the application is fully suspended, the administrator is free to make the changes and when done, the application should be updated followed by resuming it from its suspended state. This way, no caller will be in the system when the changes are made. The only disadvantage to this approach is that it will make the application unavailable for a period of time as opposed to a transparent change if the update feature alone is used. This may be a necessary compromise considering the consequences.
- When the update occurs, the event created by VXML Server to send to any loggers that are listening will reflect when the update function was run, not when it completed.
- If an error occurs during the update process, for example, due to an incorrectly configured XML file, a description of the error is displayed and sent to any loggers listening to the appropriate logger events and the update is cancelled.
- If an updated VXML server application is transferred from OAMP to VXML Servers while calls are in progress, the following message appears in the log:

  ```
  %CVP_8_5_VXML-3-VXML_INTERNAL_ERROR:DatafeedMgr.handleActEvent()
  java.lang.NullPointerException]
  ```

Note In this case, calls are not disconnected, but the related VXML events during the update will not be sent to the reporting server.

JMX Interface

To update an application using the JMX interface, use a JMX client connected to the server to navigate to the `VoiceApplication/<APPNAME>/Command` MBean, where `APPNAME` is the name of the application to update.

The **Operations** tab of this MBean will list a function named *updateApplication*. Pressing **updateApplication** button will cause the application to be updated and the result of the update will be displayed in a dialog box.

The administrator should be aware that there is no confirmation when this function is called, the update happens immediately once the function is processed.

Note While the function returns immediately, the old application may still be active if there were calls visiting the application at the time of the update. Only when all existing callers end will the old application configuration be removed from memory. To determine when that occurs, use the status function.

To update all applications at once using the JMX interface, navigate to the `Global/Command` MBean and click the function named *updateAllApps* in the *operations* tab. The results are displayed in a dialog box, listing each application updated. As with the application-specific update, use the status function to determine if there are callers experiencing old versions of the applications.

Administration Scripts

The scripts for updating an application are found in the `admin` folder of the application to be updated. Windows users should use the script named `updateApp.bat` and Unix users should use the script named `updateApp.sh`.

The script will first ask for confirmation of the desired action to prevent accidental processing of the script. To turn off the confirmation, pass the parameter *noconfirm*. By default, the script does not return to the command prompt until all pre-update callers are finished. Interrupting the countdown will not stop the update process, only the visual countdown. To turn off the countdown, pass the parameter *nocountdown*. If the countdown is interrupted or the script is passed with the nocountdown parameter then the only way to determine how many callers are experiencing the old application is to run the status script for the system, which displays this information.

The script to update all applications is found in the admin folder of VXML Server. Windows users should use the script named `updateAllApps.bat` and Unix users should use the script named `updateAllApps.sh`. The script behavior is the same as if the update script for each application deployed on VXML Server were run in series.

The `updateAllApps` script also displays a confirmation prompt, which can be turned off by passing the `noconfirm` parameter. Unlike the `updateApp` script, the `updateAllApps` script does not display a countdown of callers, it lists all the applications that are updated. The administrator would need to run the status function to determine how many callers are visiting the old versions of the applications.

Applications Suspension

There are many situations when an application needs to be temporarily suspended. There could be scheduled maintenance to the network, the voice application could have an expiration date (say it runs a contest that must end at a specific time), or the application is to be turned off while enterprise-wide improvements are made. There may also be situations where all applications are to be put in suspension if modifications are being made that affect all applications. In each of these situations, a caller would need to be played a designer-specified message indicating that the application has been temporarily suspended, followed by a hang-up. This is preferable to not answering or taking down the system, which would cause a cryptic outage message to be played.

First, the application designer defines the suspended message in the Application Settings pane in Builder for Call Studio. When the suspend order is given, VXML Server produces a VoiceXML page containing this suspended audio message to all new calls followed by a hang-up. Because VXML Server allows all calls

currently on the system to finish as usual when the command was issued, existing callers are unaware of any changes. VXML Server will keep track of the active callers visiting the application and make that information available for the administrator to access. Only when this number reaches 0 will it be safe for the administrator to perform the system maintenance that required the suspension.

VXML Server exposes suspend and resume functions for every application deployed that acts on just that particular application. It also exposes a function that will suspend VXML Server itself, which has the effect of suspending all applications. A separate resume function resumes VXML Server that restores the previous state of each application. So if an application was already suspended when VXML Server was suspended, resuming VXML Server leaves the application in a suspended state.

There are a few items to note when suspending a voice application:

- Only when all existing callers have exited the system will the application be officially suspended. Depending on the average length of calls to the voice application, this may take some time. The application status will appear as suspended since new callers cannot enter the application, and they will hear the suspended audio message.
- If changes were made to an application while it was suspended, the application should first be updated before being resumed (see the previous section on the update administration function).
- The suspension applies only to those resources under the control of VXML Server. External resources such as databases, other web servers hosting audio or grammar files, or servers hosting components through XML documents over HTTP are accessed at runtime by VXML Server. If any of these resources become unavailable while there are still presuspension callers on the system, those calls will encounter errors that will interrupt their sessions. Any maintenance made to backend systems should be initiated after the application status shows that all presuspended callers are finished with their calls.
- When the suspension occurs, the event created by VXML Server to send to any loggers that are listening will reflect when the suspend function was run, not when it completed.
- If an error occurs during suspension, a description of the error is displayed and sent to any loggers listening to the appropriate logger events and the update is cancelled.
- Suspending a voice application still requires VXML Server (and the Java application server) to be running in order to produce the VoiceXML page containing the suspended message. If the application server itself requires a restart, there are four possible ways to continue to play the suspended message to callers. Remember to run the suspend function before any of these actions are taken as this is the prerequisite.

  The solutions are listed in order of effectiveness and desirability:

  - **Load balance multiple instances of VXML Server**—In a load-balanced environment, one machine can be shut down, restarted, or reconfigured while the rest continue serving new calls. Once removed from the load-balance cluster, a machine will not receive new call requests. Eventually, all existing callers will complete their sessions, leaving no calls on the machine removed from the cluster. That machine can then be safely taken down without affecting new or existing callers.
  - **Use a web server as a proxy**—In a smaller environment, a web server can be used as a proxy for an application server so that when that application server becomes unreachable, the web server itself can return a static VoiceXML page containing the suspended message to the voice browser. The web server does not need to be on the same machine as the application server. Once the web server is configured, VXML Server can be suspended to locate all existing callers, then the application server can be taken down and the proxy server will take over producing the suspended message VoiceXML page. The disadvantage of this approach is that the web server setup is done outside of Unified CVP and if the suspended message changes, it needs to be changed in both the Builder for Call Studio and the web server configuration.

- **Redirect the voice browser**—The voice browser can be configured to point to another URL for calls coming on the specific number. This can point to another machine running VXML Server or even just a web server with a single static VoiceXML document playing the suspended message. A separate file would be needed for each application. This is a manual process and requires another machine with at least a web server (it can be on the same machine which would allow the Java application server to be restarted but would not allow the machine itself to be restarted).

JMX Interface

To suspend an application using the JMX interface, use a JMX client connected to the server to navigate to the `VoiceApplication/APPNAME/Command` MBean, where `APPNAME` is the name of the application to be suspended. The **Operations** tab of this MBean will list a function named *suspendApplication*. Pressing **suspendApplication** button causes the application to be suspended and the result is displayed in a dialog box. To resume the application, select the function named *resumeApplication*. The result is displayed in a dialog box.

The administrator should be aware that there is *no confirmation* when these functions are called, the suspension and resumption occurs immediately after you run the functions.

Note While the suspend function returns immediately, the application may still be active if there were calls visiting the application at the time of the suspension. Only when all existing callers end their calls will the application be fully suspended and the administrator is safe to take down any resources that the application depends on. To determine when all calls have ended, use the status function.

To suspend VXML Server itself using the JMX interface, navigate to the `Global/Command` MBean and click the function named *suspendVXMLServer* in the **operations** tab. The results will be displayed in a dialog box. As with the application-specific suspension, use the application-specific status function to determine if there are callers still visiting the applications. Click the function named *resumeVXMLServer* to resume VXML Server and restore the previous states of the applications.

Administration Scripts

The scripts for suspending and resuming applications are found in the `admin` folder of the application to be suspended. Windows users should use the script named `suspendApp.bat` and Unix users should use the script named `suspendApp.sh`. To resume the application, use the script named `resumeApp.bat` or `resumeApp.sh`.

It is possible to suspend all applications at once by accessing a script found in the `admin` folder of VXML Server. Windows users should use the script named `suspendServer.bat` and Unix users should use the script named `suspendServer.sh`. To restore all applications to their original status, use the script named `resumeServer.bat` or `resumeServer.sh`.

Note These scripts do not resume all applications; they only restore the administrator-specified status of each application. So if an application was already suspended when the server was suspended, resuming the server leaves the application in a suspended state.

Applications Addition

When VXML Server starts up, it will load all applications that have been deployed to its `applications` folder. A new application that is created in Builder for Call Studio and deployed to a machine on which VXML Server is already running cannot begin accepting calls until VXML Server loads the new application. To load the application, run the deploy application function. If the application is already deployed, running this function will do nothing. If multiple new applications are to be deployed together, one can run the deploy all applications function and all new applications will be deployed, and leave existing applications untouched.

JMX Interface

To deploy all new applications using the JMX interface, use a JMX client connected to the server to navigate to the `Global/Command` MBean and click the function named *deployAllNewApps* in the **Operations** tab. Pressing **deployAllNewApps** button displays a dialog box with the status of each application's deployment.

Alternatively, to deploy a single new application, first use the function named *listAllNewApps* in the **operations** tab to get a list of new application names. Then use the *deployNewApp* function to deploy the desired application by name.

Administration Scripts

The script for deploying a specific application is found in the `admin` folder of the application to be deployed. Windows users should use the script named `deployApp.bat` and Unix users should use the script named `deployApp.sh`. The script for deploying all new applications at once is found in the `admin` folder of VXML Server. Windows users should use the script named `deployAllNewApps.bat` and Unix users should use the script named `deployAllNewApps.sh`.

Applications Removal

VXML Server demonstrate two administrative functions to handle the removal of application from memory at runtime. Determining which function to use will depend on the operating system and whether the application being removed is actively handling calls.

The first method involves running the release application function of the application to be removed. This function prompts VXML Server to first suspend the application then remove it from memory when all the active callers at the time the function was run, have naturally ended their sessions. It suspends the application first to prevent new callers from entering the application. Once all active callers are done visiting the application the folder of the application can be deleted (or moved) from the VXML Server `applications` folder. This function affects only a single application so if multiple applications are to be removed using this method, the administrator would have to run this function for each application.

Note On the Microsoft Windows operating system, a user attempting to delete an application folder after the releaseApp function is called may be prevented from doing so by the operating system if the application references Java application archive (JAR) files placed within the `java/application/lib` or `java/util/lib` directories. This is due to the system keeping an open file handle for JAR files that will not be released until a garbage collection event occurs. As a result, the administrator will have to wait until the garbage collector activates before being able to delete the directory. The time to wait will be determined by how often garbage collection is run. A rule of thumb is that a high load system or one with a small amount of memory will encounter garbage collection often, a low volume system or one with a large amount of memory will take longer.

The second method supports the ability to delete multiple applications at once. This time one must first delete (or move) the folders holding the desired applications to be deleted. After which, the flushing of all old applications function is run and VXML Server will suspend and then remove from memory of all the applications that it no longer finds in the `applications` folder. As with the other method, the application is not removed from memory until all callers have ended their visits.

These issues can occur with the second method:

- If an application relies on files found within its folder at runtime, there may be problems with existing callers reaching a point where these files are needed and they will not be found.
- This process may not work on Microsoft Windows because Windows will not allow the deletion of a folder when resources within it are open. For example, the application loggers may have open log files located within the application's `logs` folder. This may work if no loggers are used or the only loggers used are those that do not manage files stored in the `logs` folder.

JMX Interface

To delete an application using the JMX interface, use a JMX client connected to the server to navigate to the `VoiceApplication/<APPNAME>/Command` MBean, where `APPNAME` is the name of the application to update. The **Operations** tab of this MBean will list a function named *releaseApplication*. Pressing **releaseApplication** button will cause the application to be suspended and then removed from memory when all active callers visiting the application at the time the function was completed.

The administrator should be aware that there is no confirmation when this function is called; the application is suspended and removed from memory immediately once the function is completed.

Note While the function returns immediately, the application will remain active if there were calls visiting the application at the time of the release. Only when all existing callers end, the call will the application be removed from memory. To determine if there are active callers, use the status function.

To delete all applications whose folders have been removed from the `applications` folder of VXML Server using the JMX interface, navigate to the `Global/Command` MBean and click the function named *releaseAllOldApps* in the **operations** tab. The results will be displayed in a dialog box, listing each application deleted. As with the application-specific update, use the status function to determine when the callers finish their visits to the applications.

Administration Scripts

The scripts for deleting an application are found in the `admin` folder of the application to be updated. Windows users should use the script named `releaseApp.bat` and Unix users should use the script named `releaseApp.sh`.

The script first asks for confirmation of the desired action to prevent accidental processing. To turn off the confirmation, pass the parameter *noconfirm*. By default, the script does not return to the command prompt until all callers are finished with their calls. Interrupting the countdown will not stop the release process. To turn off the countdown, pass the parameter *nocountdown*. If the countdown is interrupted or the script is passed the *nocountdown* parameter, then the only way to determine how many callers are actively in the application is to run the status script for the system.

The script to release all applications whose folders have been removed from the `applications` folder of VXML Server is found in the `admin` folder of VXML Server. Windows users should use the script named `flushAllOldApps.bat` and Unix users should use the script named `flushAllOldApps.sh`. All applications whose folders have been removed will be suspended and when their active calls have ended will be removed from memory.

The `flushAllOldApps` script also displays a confirmation menu which can be disabled by passing it the *noconfirm* parameter. Unlike the `releaseApp` script, the `flushAllOldApps` script does not display a countdown of active callers, it will list all the applications that were deleted. The administrator would need to run the `status` function to determine how many callers are actively in the applications.

Common Classes Update

When performing an application update, all the data and Java classes related to an application will be reloaded. Java classes placed in the `common` folder of VXML Server are not included in the application update. VXML Server provides a separate administrative function to update the `common` folder.

There are a few items to note about this function:

- The update affects all applications that use classes in the `common` folder, so running this function could affect applications that have not changed. Therefore, take precaution when running this function.
- The update affects *all* classes in the `common` folder, whether they were changed or not. This is usually not a issue unless those classes contain information in them that reloading would reset (such as static variables).
- Due to the fact that this function reloads classes that affect all applications, and those classes may themselves prompt the loading of configuration files from each application that uses those classes, the function may take some time to complete depending on the number of classes in the `common` folder and the number and complexity of the deployed applications.
- Changes are immediate, and are not done. Because this potentially affects all applications, the administrator must be aware of this.

JMX Interface

To update common classes using the JMX interface, use a JMX client connected to the server to navigate to the `Global/Command` MBean and click the function named *updateCommonClasses* in the **operations** tab. The results will be displayed in a dialog box.

Administration Scripts

The script for updating common classes is found in the `admin` folder of VXML Server. Windows users should use the script named `updateCommonClasses.bat` and Unix users should use the script named `updateCommonClasses.sh`. The script will ask for confirmation of the desired action to prevent accidental processing of the script. To disable the confirmation, pass the parameter *noconfirm*.

Global and Application Data Function

Global data holds information that applications decide to share across other applications deployed on VXML Server. Application data holds information that applications decide to share across all calls to the application. The VXML Server JMX interface provides the ability for an administrator to view the contents of these variables, change their values, and even create new variables.

This functionality provides an administrator direct access to live data that is being created on the system and can provide them some control of how applications operate. This is only possible when the application designers design that functionality into the applications. For example, an application designer for a utility company can build their application to look for the existence of a global data variable reporting a power outage. The administrator then creates the global data variable when a power outage occurs and automatically the applications will start reporting the power outage to callers. The administrator can then delete the global data

variable to signify the power has been restored. While this same functionality could be achieved with a database, this is a simpler approach to handle predictable situations without the need to use a database.

Global Data Access

To access global data using the JMX interface, navigate to the `Global/Data` MBean. The **Attributes** tab lists all the global data variable names in an attribute named *AllGlobalDataNames* (the value may need to be expanded in order to see all the global data names). The **Operations** tab lists four functions that can be processed by the administrator for global data:

- **setGlobalData**—This function allows the administrator to create a new global data variable. The function requires the name of the variable and the value. Click **setGlobalData** button to set the global data and the result will appear in a dialog box.

Note If there exists global data with the same name it will be overridden.

- **removeGlobalData**—This function allows the administrator to delete a global data variable. The function takes one input: the name of the global data variable to delete. Click **removeGlobalData** button to remove the global data and the result will appear in the dialog box.
- **removeAllGlobalData**—This function allows the administrator to delete all global data, whether it was created by the administrator or applications. Click **removeAllGlobalData** button to remove all global data and the result will appear in the dialog box.

  Be careful when using this function because it can affect the performance of applications that rely on global data.
- **getGlobalData**—This function allows the administrator to retrieve the value of a global data variable. The function takes one input: the name of the global data variable to retrieve. Click **getGlobalData** button to display a dialog box showing the value of the global data.

Application Data Access

To access application data using the JMX interface, navigate to the `VoiceApplication/APPNAME/Data` MBean, where `APPNAME` is the name of the application whose application data is to be accessed. The *Attributes* tab lists all the application data variable names in an attribute named *AllApplicationDataNames* (the value may need to be expanded in order to see all the application data names). The **Operations** tab lists four functions that can be processed by the administrator for application data:

- **setApplicationData**—This function allows the administrator to create a new application data variable. The function takes two inputs, the first being the name of the variable and the second being the value. Click **setApplicationData** button to set the application data and the result will appear in a dialog box.

Note If there is already application data with the same name it will be overridden.

- **removeApplicationData**—This function allows the administrator to delete a application data variable. The function takes one input: the name of the application data variable to delete. Click **removeApplicationData** button to remove the application data and the result will appear in the dialog box.

- **removeAllApplicationData**—This function allows the administrator to delete all application data, whether it was created by the administrator or applications. Click **removeAllApplicationData** button to remove all application data and the result will appear in the dialog box. Be careful with this function as it could affect the performance of the application.
- **getApplicationData**—This function allows the administrator to retrieve the value of a application data variable. The function takes one input: the name of the application data variable to retrieve. Click **getApplicationData** button to display a dialog box with the value of the application data.

Administrator Log Access

VXML Server includes various default loggers, including administration history loggers that store a history of the administration activity taken, such as when VXML Server started up, when an application was updated, the results of the suspension of VXML Server, and so on. These logs, which are rotated daily, are useful to an administrator as an audit history of administrator activity. As a convenience, the JMX interface exposes methods for the administrator to access the contents of these logs instead of viewing the files in a text editor.

Note The application designer and administrator has the ability to define any loggers desired for the applications as well as for VXML Server, including removal of the default administration history loggers. If this is done, then these functions will return error messages that explain that the log files could not be found.

To view an application's administration history log using the JMX interface, use a JMX client connected to the server to navigate to the `VoiceApplication/<APPNAME>/Command` MBean, where `APPNAME` is the name of the application to view. The **Operations** tab of this MBean lists functions named *retreiveAdminHistoryToday* and *retreiveAdminHistoryAll*. Clicking the first opens up a scrollable window listing the contents of the administration history log file from the day the function is called. Clicking the second opens up a scrollable window listing the contents of all administration history logs concatenated.

To view VXML Server administration history log using the JMX interface, navigate to the `Global/Command` MBean. The **operations** tab of this MBean list functions with the same name and functionality as the application functions do except that the files accessed are for the global administration history.

Administration Function Reference

The following tables list all the administration functions provided by VXML Server and whether they are available from the JMX interface and via script.

Application-Level Functions

Function	JMX	Script	Description
Suspend Application	Yes	Yes	Suspends the application in which the function belongs.
Resume Application	Yes	Yes	Resumes the application in which the function belongs.
Deploy Application	No	Yes	Prompts VXML Server to load the application in which the function belongs (does nothing if the application is already deployed).

Update Application	Yes	Yes	Prompts VXML Server to reload into memory the configuration of the application in which the function belongs.
Release Application	Yes	Yes	Prompts VXML Server to remove from memory the application in which the function belongs so that its folder can be deleted.

VXML Server-Level Functions

Function	JMX	Script	Description
Suspend Server	Yes	Yes	Suspends all applications deployed on VXML Server.
Resume Server	Yes	Yes	Restores the status of each application to the original state at the time VXML Server was suspended.
Deploy All New Applications	Yes	Yes	All applications deployed to VXML Server because the last time the application server started up or the deploy all new applications function was called are now loaded into memory and can handle calls.
List All New Applications	Yes	Yes	Lists the names of all new voice applications so that their names may be known to be deployed using Deploy New Application.
Deploy New Application	Yes	No	Loads and deploys the specified voice application.
Flush All Old Applications	Yes	Yes	When called, all applications in VXML Server whose folders were deleted are removed from memory.
Update All Applications	Yes	Yes	Prompts each application deployed on VXML Server to load its configuration from scratch from the application files.
Update Common Classes	Yes	Yes	Reloads all classes deployed in the `common` directory of VXML Server.

VXML Server Metrics

The more information administrators have, the better they will be able to determine the health of the system. VXML Server provides a significant amount of information on various metrics to allow the administrator to understand what is going on within the system. Provided with this information, the administrator will be able to react quickly to situations that could degrade the stability of the system.

The information falls into three categories: aggregate information, information on peaks, and average information. Aggregate information, such as the total number of calls handled, is helpful in determining how much work VXML Server has done so far. Peak information, such as the maximum concurrent calls occurring in the last 10 minutes, is very helpful in understanding how load is distributed on the system and can help the administrator understand how the volume is changing. Average information, such as the average HTTP request completion time, helps the administrator compare current metrics against historical averages.

The metrics maintained by VXML Server is available only through the JMX administration interface. To view the metrics, navigate to the `Global/Metrics` MBean. The **Operations** tab lists 15 separate functions that the administrator can call to obtain very specific information concerning how the system is running as well as how it has performed in the past. Many of the functions take a time duration as an input. It will display information of the specified period up to a maximum of 60 minutes.

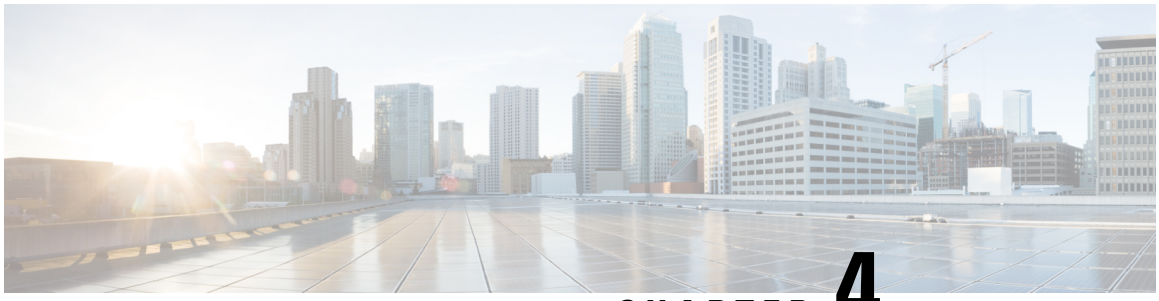
The following list describes each function and the information it returns:

- **totalCallsSinceStart**—Returns the total cumulative number of calls handled by VXML Server since it launched. This number will continually rise and only resets only when VXML Server or the Java application server is restarted.
- **maxConcurrentCallsInLast**—Returns the most number of simultaneous callers that occurred in the last X minutes where X is entered by the administrator (maximum of 60 minutes) and when the maximum was reached. This count is helpful in determining how close the call volume reached the license limit on simultaneous callers. Knowing when the maximum value is reached can be very helpful in determining if call volume is rising. For example, if the peak call volume for the last 10 minutes was achieved very close to the present time, that would indicate that call volume is rising.
- **avgConcurrentCallsInLast**—Returns the average number of simultaneous callers encountered in the last X minutes where X is entered by the administrator. This data is helpful in determining if a peak was an isolated occurrence or a sign of a trend. For example if the maximum number of concurrent calls in the last hour was 100 but the average is 10, then there is less to be alarmed about since the 100 peak did not last long and can be attributed to a temporary spike. If the average were 90, then this would indicate that the call volume is very steady.
- **maxReqRespTimeInLast**—Returns the maximum time, in milliseconds, it took VXML Server to produce an HTTP response in the last X minutes where X is entered by the administrator and when the maximum was reached. A voice browser makes an HTTP request to VXML Server, which then must respond with a VoiceXML page. A large response time is cause for concern because a slow performing system will cause callers to think that the application has encountered errors. In extreme cases, this response time might cause the voice browser to time out a request and end a call with an error.
- **avgReqRespTimeInList**—Returns the average time, in milliseconds, that it took to produce an HTTP response in the last X minutes where X is entered by the administrator. This value gives the administrator a good idea of how long it takes VXML Server to handle responses given the call volume. This value could help the administrator decide if the system is overloaded and is beginning to affect the perception of callers regarding the responsiveness of the application. It also establishes a baseline to compare with the maximum response time. A maximum response time significantly higher than the average might be an indication that there is a problem with an external resource accessed by a custom element such as a database or web service and the few calls that visited that element suffered from bad performance.

  This function can also help determine if the maximum response time was an isolated event or an indication of a trend. For example if the maximum response time was 500 ms, which occurred near the present, the average was 400 ms, the fact that the peak was 500 ms is not alarming because the average is so high. In this situation, the administrator may choose to throttle down the calls being handled by the system to bring the response times back down to more acceptable levels.
- **timeoutCallsInLast**—Returns the total number of calls that ended with a timeout in the last *X* minutes where *X* is entered by the administrator. More specifically, this counts calls where the result action of the end category is timeout. See section *The Application Activity Logger* for more on the different results and how ended values. Under usual circumstances a call should never time out. Many different types of conditions can yield session timeouts on VXML Server and so knowing if there are timeouts in the last period of time would tell the administrator how widespread these issues are.

- **failedCallsInLast**—Returns the total number of calls that ended with an error in the last *X* minutes where *X* is entered by the administrator. More specifically, this counts calls where the result action of the end category is error. See section *The Application Activity Logger* for more on the different results and how ended values. This helps the administrator determine how widespread a bug or other issue that caused a call to end in an error is. For example, if the last 60 minutes yielded only one failed call, while the issue should be investigated, it may not be a symptom of a larger more prevalent issue.
- **timeoutCallsSinceStart**—Returns the total number of calls that ended with a timeout since VXML Server launched. More specifically, this counts calls where the result action of the end category is timeout. See section *The Application Activity Logger* for more on the different results and how ended values. This information is good to compare with the number of timed-out calls in the past *X* minutes because if the numbers are close it might mean that the issue that is causing the timeouts is a recent occurrence. It also gives an indication of the stability of the system and allows the administrator to calculate the percentage of calls that had encountered timeouts.
- **failedCallsSinceStart**—Returns the total number of calls that ended with an error since VXML Server launched. More specifically, this counts calls where the result action of the end category is error. See section *The Application Activity Logger* for more on the different results and how ended values. This information is good to compare with the number of failed calls in the past *X* minutes because if the numbers are close it could mean that the issue that is causing the errors is a recent occurrence. It also gives an indication of the stability of the system is and allows the administrator to calculate the percentage of calls that had errors.
- **maxLoggerEventQueueSizeInLast**—Returns the largest the logger event queue received in the last *X* minutes where *X* is entered by the administrator and when the maximum was reached. For an explanation of the logger queue, see the section titled Tuning Logger Options earlier in this chapter. This value helps the administrator to understand, in an abstract way, how much VXML Server is logging. While it is not unusual for this number to be large, the administrator can track a trend, and if this number continually increases it might be an indication that the system cannot handle the logger event load and might eventually result in memory problems. The time when the maximum was reached can help indicate if VXML Server is able to handle the incoming stream of logger events.
- **maxLoggerThreadCountInLast**—Returns the most simultaneous threads VXML Server was using to handle loggers in the last *X* minutes where *X* is entered by the administrator and when the maximum was reached. For an explanation of the logger thread pool, see the section titled Tuning Logger Options earlier in this chapter. This is another indication of whether VXML Server can keep up with the stream of logger events because if the number is close to the maximum thread pool size it is an indication that VXML Server has almost reached its limit in handling events. When the maximum was reached helps determine if this is happening recently. When all of the threads in the pool are actively handling logger events, the logger event queue will rise rapidly. So, if this value is at the maximum thread pool size, then the `maxLoggerEventQueueSizeInLast` function will display rapidly increasing queue sizes.
- **callTransferRate**—Returns the percentage of calls that ended in a blind telephony transfer. More specifically, this counts calls where the how action of the end category is `call_transfer`. This can help the administrator determine what percentage of callers decided to speak to an agent rather than complete the call in the automated voice application.
- **callAbandonRate**—Returns the percentage of calls that ended with the caller disconnecting the call. More specifically, this counts calls where the how action of the end category is *hangup*. See section *The Application Activity Logger* for more on the different results and how ended values. Despite the name, a caller ending the call is not necessarily a bad situation because the caller might end the call right before the application disconnects on the caller and the end category would still be *hangup*. This value would therefore be a good indication of how callers interact with the applications on the system.

- **callCompleteRate**—Returns the percentage of calls that ended ordinarily. More specifically, this counts calls where the result action of the end category is *normal*. See section *The Application Activity Logger* for more on the different results and how ended values. This function does not count calls into a suspended application, calls ending in an error or timeout, or calls ending due to an element manually invalidating the session. It is expected that this percentage be close to 100 percent.
- **averageCallDuration**—Returns the average duration of all calls handled by VXML Server, in seconds. This information helps the administrator determine if a particular call being analyzed represents a typical call since a particularly long call might indicate a caller having trouble with the application and a short call might indicate caller frustration with the application.



CHAPTER 4

User Management

VXML Server includes a user management system for basic personalization and user-activity tracking. The primary reason for a user management system is to facilitate the customization of voice applications depending on user preferences, demographics, and prior user activity. It is not meant to be a replacement for fully featured commercial user management systems and can be used in conjunction with those systems. Additionally, Unified CVP voice applications do not require the presence of a user management system, it is provided as an aid to application designers.

While the bulk of the user management system is designed to track individual users, its most basic form can prove useful for certain applications. This bulk help those applications that do not need to track individual users, but still want to provide very simple personalization, such as playing *Welcome back* when a call is received from a phone number that has called before. When turned on, the user management system automatically keeps track of information based on the phone numbers of callers. This is available automatically; the developer does to need to do any additional work.

The user management system is fully integrated into VXML Server. An API is included to provide two different interfaces to the user management system. The first interface manages the user database, allowing separate, external processes to populate, maintain, and query the system. The second interface is provided for dynamic components of a voice application to allow runtime updates and queries to the system. This second interface allows a voice application to perform tasks such as playing a customized message to registered users, making decisions based on user demographics or history, and even adding new users after the caller completes a successful registration process. The API has both Java and XML versions. These APIs are fully detailed in Programming Guide for Cisco Unified CVP VXML Server and Unified Call Studio.

- Deployment, on page 83
- Database Design, on page 84

Deployment

The user management system is basically a database accessed by VXML Server. Each hosted voice application may refer to a separate user management database or may share databases if users are to be shared across applications. The user management system can be activated by providing a JNDI name for the relational database where the user data is to be stored. This activation is done in the settings pane for the application in the Builder for Call Studio. Currently, the databases supported are MySQL and SQLServer.

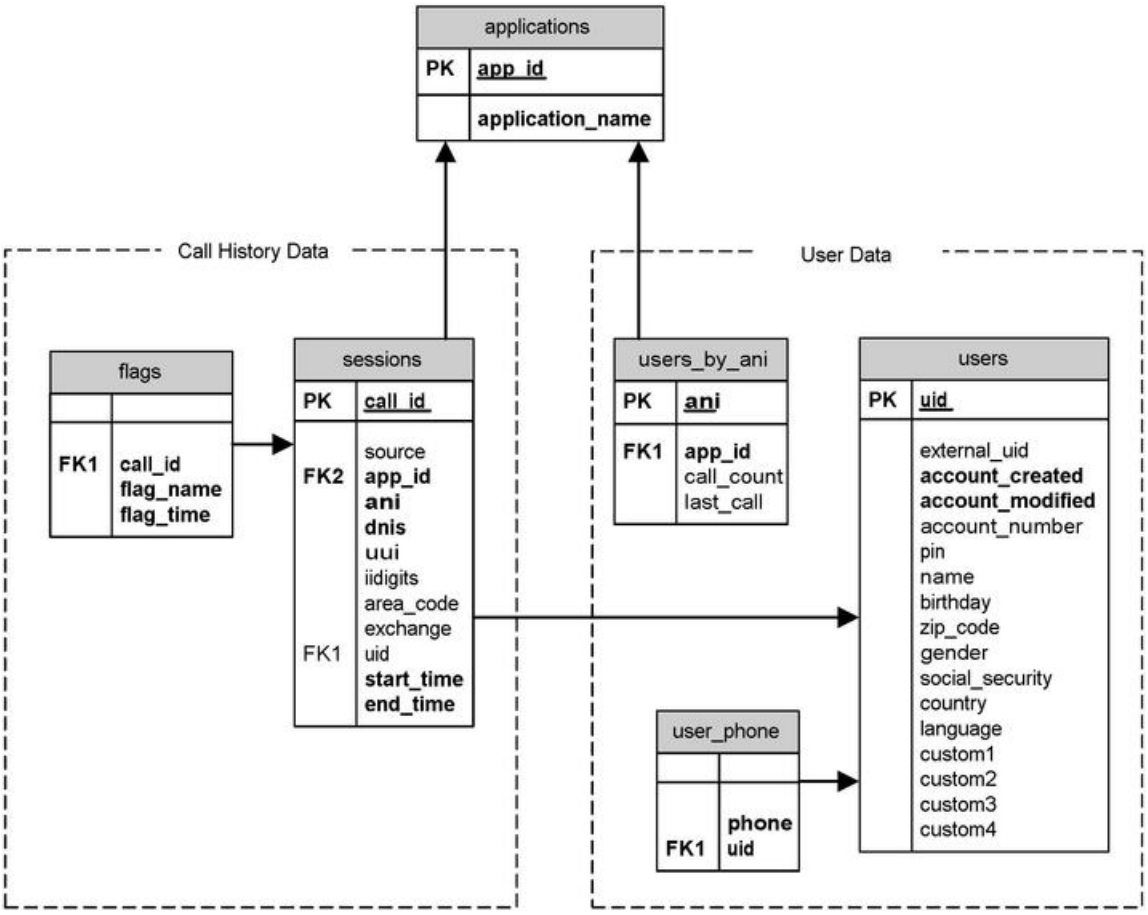
Note The application server must be set up to manage connections to this database.

Once the database is set up, VXML Server automatically handles the process of creating the database tables.

Database Design

The following figure displays an ER diagram of the database tables comprising the user management system. The following sections describe each table individually and its purpose.

Figure 24: Database ER Diagram



Applications

Column	Type	Description
app_id	integer (primary key)	Automatically generated application ID.
application_name	varchar(50)	The name of the application with the specified application ID.

User Data

The tables under this category are used to store information about the users in the system.

users

This table is the main user table. Each row contains the information for a single user. Both demographic and account information are stored here. The table specification is as follows:

Column	Type	Description
uid	integer (primary key)	This is a user ID automatically generated by the system to identify a particular user. Once a call is associated with a UID, the system knows the caller's identity. The user management system relies on this UID throughout.
external_uid	varchar(50)	If an external user management system is used in conjunction with this one, there must be a way to link a user on the Unified CVP system with one in the external system. This column stores the ID for this user on the external system to provide that link. Can be null if the Unified CVP user management system is used exclusively.
account_created	datetime	This stores the time the user was added to the system. It will always have a value.
account_modified	datetime	This stores the time of the last update to this user in the system. It will always have a value.
account_number	varchar(50)	Some voice applications identify users by account numbers. If so, the account number should be stored here, otherwise, it can be null.
pin	varchar(20)	If the voice application uses a PIN to verify the user, the PIN is stored here. Null if no PIN is used or required.
name	varchar(50)	The user's name. Can be null.
birthday	varchar(50)	The user's birthday. Can be null.
zip_code	varchar(10)	The user's zip code. Can be null.
gender	varchar(10)	The user's gender: male, female, or null if not stored.
social_security	varchar(10)	The social security number of the user. Can be null.
country	varchar(50)	The user's full country name. Can be null.
language	varchar(50)	The language the user speaks or prefers. This can be used to provide audio content in different languages. Can be null.
custom1-custom4	varchar(200)	These columns are provided to allow the developer to place custom user-related data in the system. It can be used for such data as e-mail addresses, financial account balances, proprietary IDs, and so on. Can be null.

user_phone

This table is an adjunct to the main user table. It is used to store the phone numbers associated with the user. The reason this data is placed in a separate table is to allow an application to associate more than one phone number with a user. For example, a voice application allowing a user to associate with their account both their home and work numbers can automatically recognize who the caller is when calls are received from either number, rather than requiring them to log in. If multiple phone numbers are not required or necessary, this table can contain one entry per account or remain empty. Because there may be multiple rows in the system with the same UID, there is no primary key to this table. The table specification is as follows:

Column	Type	Description
phone	varchar(10)	A phone number to associate with this account.
uid	integer (foreign key)	The UID identifying the user.

users_by_ani

This table is used to track calls made from specific phone numbers (ANIs). This table is automatically updated by VXML Server and need only be queried by the developer when information about a caller is desired. The table contains information about the number of calls and the last call made from a phone number. This information can be used to welcome a caller back to the application or warn that menu options have changed since their last call even if the application itself is not set up to track individual users through logins. The table specification is as follows:

Column	Type	Description
ani	varchar(10)	The phone number of the caller.
app_id	integer	The application the caller called into. This exists in case multiple applications share a common user management system.
call_count	integer	The number of calls received by this phone number to this application.
last_call	datetime	The last time a call was received by this phone number to this application.

Historical Data

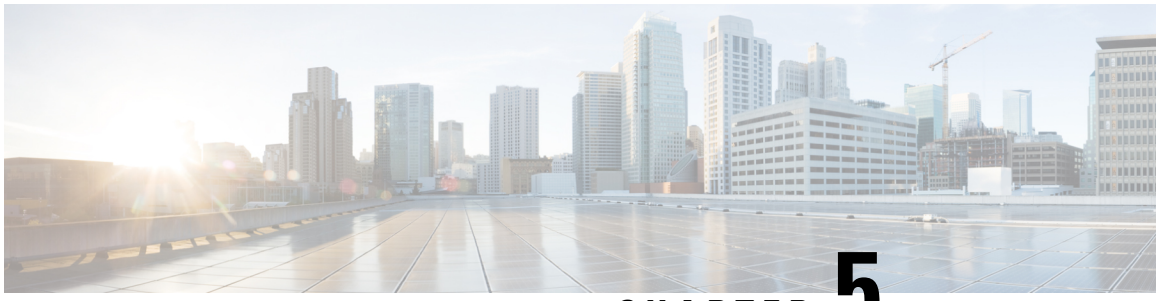
	The application ID of the application called. If the user management system is not shared across multiple applications, this ID would be the same for all calls.	
ani	varchar(10)	The ANI of the originating caller. Is NA if the ANI was not sent by the telephony provider.

dnis	varchar(10)	The DNIS of the originating caller. Is NA if the DNIS was not sent by the telephony provider.
uui	varchar(100)	The UUI of the originating caller. Is NA if the UUI was not sent by the telephony provider.
iidigits	varchar(100)	The IIDIGITS of the originating caller. Is NA if the IIDIGITS was not sent by the telephony provider.
area_code	varchar(10)	The area code of the originating caller. Is null if the ANI is NA.
exchange	varchar(10)	The exchange of the originating caller. Is null if the ANI is NA.
uid	integer	The UID of the caller if the call was associated with a user. If not, it will appear as null.
start_time	datetime	The date and time the visit to the application began. If no other application can transfer to this one, this will be the time the call was made.
end_time	datetime	The date and time the visit to the application ended. If this application cannot transfer to any other application, this will be the time the call ended in a hang-up or disconnect.

flags

This table contains records of the flags triggered by every call made to the system. Because flags are used to indicate important parts of the voice application, knowing what areas of the voice application people visited in the past can be very useful. The table specification is as follows:

Columns	Type	Description
call_id	integer	This refers to the call ID of the call.
flag_name	varchar(100)	This is the name of the flag that was triggered.
flag_time	datetime	This is the date and time the flag was triggered.



CHAPTER 5

VXML Server Logging

Logging plays an important part in voice application development, maintenance, and improvement. During development, logs help identify and describe errors and problems with the system. Voice applications relying heavily on speech recognition require frequent tuning in order to maximize recognition effectiveness. Voice application design may also be changed often, taking into account the behaviors of callers over time. The more information an application designer has about how callers interact with the voice application, the more that can be done to modify the application to help callers perform their tasks faster and easier.

For example, a developer could determine the most popular part of the voice application and make that easier to reach for callers. If a large proportion of callers ask for help in a certain part of the application, the prompt might need to be rewritten to be clearer. After analyzing the declaration of various callers, the effectiveness of grammars can be determined so that additional words or phrases can be added or removed. None of this is possible without detailed logs of caller behavior. While each component of a complete VRU system, such as the voice browser and speech recognition system provide their own logs, VXML Server provides logs that combine all this information with the application logic. This chapter explains the details of logging on VXML Server.

Because of the importance of logging, VXML Server has been designed to offer the maximum flexibility with regards to what can be logged, how it is logged, and where it is logged. The logs generated by VXML Server by default can be customized to fit the needs of a deployment. In addition, a Java API exists that allows developers to create their own ways of handling logging for better integration with the deployed environment or tailored specifically for special needs.

- Loggers, on page 89
- Global Loggers, on page 90
- Application Loggers, on page 95
- Correlating Unified CVP Call Server Logs with VXML Server Logs, on page 112

Loggers

VXML Server handles all logging activity through the use of loggers. Loggers are plug-ins to VXML Server that listen for certain logging events and handle them in a custom manner, from storing the information in log files, sending the information to a database, or even to interface with a reporting system. Any number of loggers can be used, even multiple instances of the same logger. A logger may or may not require a configuration that will allow the designer to customize how the logger performs.

VXML Server comes with several loggers that provide all necessary information in text log files. Some provide configurations to allow for a level of customization in how the loggers perform. VXML Server exposes a Java API to allow developers the flexibility of creating their own loggers to allow for even more customization.

See the *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio* for detailed information on how to build custom loggers.

VXML Server communicates with loggers by triggering logging events that the loggers listen for and then deal with. VXML Server activates loggers in a fully multithreaded environment to maximize performance.

Loggers are divided into two categories: global loggers and application loggers. Global loggers are activated by logging events that apply to VXML Server as a whole and that is not directly related to any particular application (for example, a record of all calls made to the VXML Server instance). Application loggers are activated by logging events that apply to a particular application running on VXML Server (for example, a call visiting an element). Each logger type is constructed using separate Java APIs and deals with a separate list of possible logging events . Each logger type is also given a separate area to store logs, although a logger may choose to ignore this area if it does not log to files.

Global Loggers

The `global_config.xml` file found in the `conf` directory of `%CVP_HOME%\VXMLServer` is used to define the global loggers VXML Server is to use. The administrator can define any number of global loggers to be simultaneously active, even multiple instances of the same logger class. This file also lists the names of the configuration files for these loggers, if they are configurable. The configuration files must be placed in the same conf directory as the `global_config.xml` file. The `global_config.xml` file and any configuration files must be edited by hand, there is no interface for editing them. Refer to VXML Server Configuration for more details about this file and how to define global loggers within it.

Global loggers are loaded by VXML Server when it starts up and remain in memory until it is shut down. Any change made to the `global_config.xml` file is not loaded until VXML Server is restarted.

VXML Server provides the `logs` folder of `%CVP_HOME%\VXMLServer` for log file storage if the Global Loggers require it. To keep each logger instance's logs separate, a subfolder with the name of the logger instance is created, and all logs generated by the logger instance are stored there.

By default, VXML Server utilizes three loggers to create text log files containing VXML Server-specific information: a log that keeps track of calls made to the system, a log for tracking VXML Server administration activity, and an log that shows errors that occur on the VXML Server level (as opposed to the application level). The global error logger requires a configuration that allows for detailed control over how the logger operates.

The following sections describe these three prebuilt global loggers, their configurations (if any), and the information stored in their logs.

Global Call Logger

The global call logger records a single line for every application visit handled by VXML Server into a text call log. Most calls will begin and end in a single application so in that case a line in the call log is equivalent to a physical phone call. For situations where one application performs an application transfer to another application, a separate line will be added to the call log for each application visit despite the fact that they all occur in the same physical call. Because each application visit is logged separately in each application's own log file, the call log provides a way to stitch together a call session that spans multiple applications.

The call log file names are in the format *call_logYYYY-MM-DD.txt* where *YYYY*, *MM*, and *DD* are the year, month, and day when the call log was first created. By default, the log folder for is named *GlobalCallLogger* (though the name is set in the `global_config.xml` file and can be changed by the administrator). Call log files are rotated daily. The file is organized in a comma-delimited format with 6 columns:

- **CallID**—This is a nonrepeating value generated by VXML Server to uniquely identify calls. It is designed to be unique even across machines, because the log files of multiple machines running the same applications may be combined for analyses. The format of the session ID is IP.SECS.INCR where IP is the IP address of the VXML Server instance on which the call originated, SECS is a large integer number representing the time the application visit was made and INCR is an automatically incremented number managed by VXML Server. Each part is delimited by dots and contains no spaces. For example: 192.168.1.100.1024931901079.1.

Note If a voice application uses a Subdialog Invoke element to transfer across multiple VXML Server instances, the IP address included in the CallID is the IP address of the instance the call started on. Because of this, it is possible that a CallID in log files on one machine may contain an IP address for another machine. This allows a physical call to be traced across multiple servers (from a logging standpoint), even if Subdialog Invoke is used to transfer to between various voice applications.

- **SessionID**—The session ID is used to track a visit to a specific application. Therefore, with application transfers, one call ID may be associated with multiple session IDs. For this reason, session IDs are basically the call ID with the application name appended to the end. For example: 192.168.1.100.1024931901079.1.MyApp.
- **callers**—This integer represents the total number of callers interacting with the system at the time the call was received (excluding the current call).
- **order**—A number indicating the order of each application visited in a call. The order begins at 1. This column exists to report the order in which a caller visited each application should the data be imported to a database.
- **Application**—The name of the application visited.
- **Time**—A timestamp of the application visit in the format *MM/DD/YYYY HH:MM:SS.MMM* where the hour is in 24-hour time and *MMM* represents a 3-digit millisecond value. This represents when the call was received or the application transfer occurred.

Global Error Logger

The Global Error Logger records errors that occur outside the realm of a particular application. Application-level errors are logged by application-level loggers, which are described later in this chapter. Another type of error that the Global Error Logger receives is an application-level error that encountered trouble with its logging. In order to prevent the loss of the data, VXML Server activates a global logger event with the original application error as a backup.

The error log file names are in the form *error_logYYYY-MM-DD.txt* where YYYY, MM, and DD are the year, month, and day when the error log was first created. By default, the log folder is named *GlobalErrorLogger* (though the name is set in the `global_config.xml` file and can be changed by the administrator). Global error log files are rotated daily.

Note If no error occurred on a particular day, no error log is created.

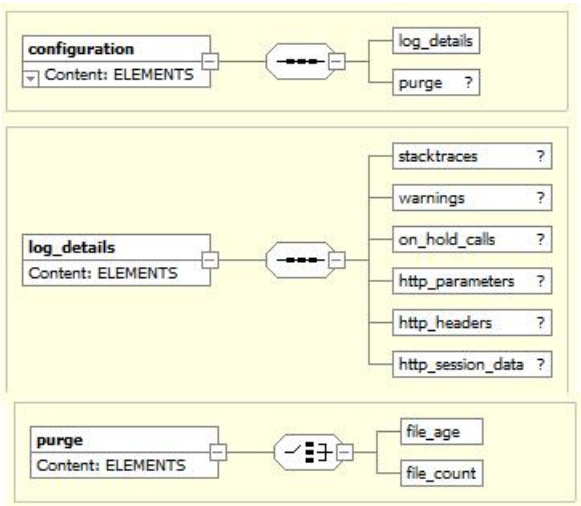
The file is organized in a comma-delimited format with 2 columns:

- **Time**—The time the error occurred.
- **Description**—The error description. One possible value can be *max_ports*, indicating the caller was put on hold because all the Unified CVP license ports were taken. While the call was eventually handled correctly, this is placed here as a notice that the license may not have enough Unified CVP ports to match caller volume. Another value is *bad_url:[URL]*, indicating that a request was made to VXML Server for a URL that could not be recognized. This most likely will occur if the voice browser refers to an application that does not exist. The last description is error, indicating that some other error occurred.

Note The global error log is not designed to be parsed, even though the columns are separated with commas. This is because when the error log reports a Java-related error, it may include what is called a *Java stack trace*, which contains multiple lines of output.

The Global Error Logger utilizes a configuration to control how it logs certain types of errors and how often the log files should be purged. The configuration is specified as an XML file created by the designer and placed in the `conf` directory of *%CVP_HOME%\VXMLServer*.

Figure 25: Global Error Log Configuration



The *Global Error Log Configuration* diagram displays the format for the XML Global Error Logger configuration file. The main tag for the configuration, `configuration`, has two attributes, `name` and `version`. `Name` is expected to contain the logger instance name. The `version` is expected to include the version of the configuration, which is currently *1.0*. The subsequent sections describe the functionality of the various tags in the configuration.

Global Error Logger Configuration: Log Details

The `<log_details>` tag controls which errors to log and what information to include about those errors. The possible child tags are:

- **<stacktraces>**—Indicates that any Java errors that occur should also have their stack traces printed in the log. The absence of this tag indicates not to include stack traces.

- **<on_hold_calls>**—Indicates that a call that was put on hold should be logged. The `application_name` attribute can have the values *true* and *false*, *true* being to include the name of the application the caller attempted to reach when being put on hold and *false* to not include the application name.
- **<http_parameters>**—Indicates that an error caused by an unrecognized URL (such as a request for an application that does not exist) should include the HTTP parameters passed to the URL. This tag can be helpful to know since it could help determine why the request was made. The `length` attribute provides a limit, in a number of characters, to be included in the log. This prevents the log from being filled up with too much parameter data.

Note The parameter data appears on one line, no matter how long.

- **<http_headers>**—Indicates that an error caused by an unrecognized URL (such as a request for an application that does not exist) should include the HTTP headers passed to the URL. This can be helpful to know since it could help determine why the request was made. The `length` attribute provides a limit, in a number of characters, to be included in the log. This tag prevents the log from being filled up with too much header data.

Note The header data appears on one line, no matter how long.

- **<http_session_data>**—Helps debug situations where the VXML Server receives HTTP requests that it does not expect or understand. When this tag is used, the JSession ID (if known) and its association with the VXML Server Call ID (if known) are displayed in the global error logger. This tag is helpful in debugging *bad_url* errors. *Bad_url* errors are generally displayed when the VXML Server receives a HTTP request that cannot be recognized. Use of this option increases the amount of memory used by the VXML Server. **Use this feature only for debugging situations.**

Global Error Logger Configuration: File Purging

The Global Error Logger can be configured to automatically delete files that conform to certain criteria. Properly configured, this allows an administrator to avoid having the system's hard drive fill up with logs, which would prevent new calls from being logged.

Note the following information about file purging:

- Because loggers are activated only when events occur in a call, the file-purging activity only takes place when an error event occurs. As a result, a system that encounters no errors will not automatically delete files until a new error occurs.
- When the Global Error Logger starts up for the first time, it applies the purging strategy on any files that exist in the logger directory. Therefore, if an application server is shut down with files in the logger directory and then restarted a long time later, these files might be deleted when the application server starts up and the logger initializes.
- The Global Error Logger applies its purging strategy to any files found in its logger directory, including non-error log files. Other files added to the logger folder after the application server has started could be deleted when the Error Logger encounters a new error.

The optional `<purge>` tag defines the purging strategy. If this tag does not appear in the configuration, no file purging will take place. The tag can contain one of the following child tags:

- **file_age**—The Global Error Logger will delete error log files older than *X* days, where *X* is an integer greater than 0 specified in the `older_than` attribute.
- **file_count**—The Global Error Logger will delete error log files if the logger folder contains greater than *X* files, where *X* is an integer greater than 0 specified in the `greater_than` attribute. When the files are deleted, the oldest ones are deleted first until the folder reaches the desired file count.

Global Error Logger Configuration Example #1

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE configuration SYSTEM "../dtds/GlobalErrorLoggerConfig.dtd">
<configuration version="1.0" name="MyGlobalErrorLogger1">
  <log_details>
    <stacktraces/>
    <http_parameters length="100"/>
    <http_headers length="300"/>
  </log_details>
  <purge>
    <file_age older_than="14"/>
  </purge>
</configuration>
```

This configuration has the following features:

- Java stack traces will appear in the error logs.

Note Because stack traces span multiple lines, including stack traces may complicate the process of importing the error logs into spreadsheets or databases. This is rarely done for error logs.

- If there is a bad URL error message, it will include 100 characters of the URL input parameters and 300 characters of the HTTP headers, all on one line in the log file.
- Nothing is logged for a call that is put on hold.
- When a new file is added to logger instance's dedicated directory by the Global Error Logger, if the directory contains files that are older than 14 days (2 weeks), the files will be deleted.

Error Logger Configuration Example #2

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE configuration SYSTEM "../dtds/GlobalErrorLoggerConfig.dtd">
<configuration version="1.0" name="MyGlobalErrorLogger2">
  <log_details>
    <on_hold_calls application_name="true"/>
  </log_details>
  <purge>
    <file_count greater_than="100"/>
  </purge>
</configuration>
```

This configuration has the following features:

- Java stack traces will not appear in the error logs. When a Java exception occurs, only the error message itself will appear in the error log without the stack trace.
- When a call is put on hold, that fact will be logged along with the application name that the caller was attempting to visit.

- If there is a bad URL error message, only the URL itself will be logged without any HTTP parameters or headers.
- No file purging will take place. The administrator is responsible for maintaining the logs on the system.

Global Administration History Logger

The Global Administration History Logger records administration events that occur on VXML Server itself. Application-level administration history is logged by application-level loggers, which are described later in this chapter. These events are triggered by an administrator running administration script (see Administration for more on administering VXML Server).

The administration log file names begin with *admin_historyYYYY-MM-DD.txt* where YYYY, MM, and DD are the year, month, and day when the administration log was first created. By default, the log folder is named *GlobalAdminLogger* (though the name is set in the `global_config.xml` file and can be changed by the administrator). Administration history log files are rotated daily.

Note If no administration activity occurred on a particular day, no administration history log will be created.

The file contains three columns: the time, what script was run, and its result, separated by commas. The result is usually *success* and if not, contains the description of the error encountered. The possible values of the result are:

- **server_start**—Listed when the VXML Server web application archive initializes. This occurs if the Java application server on which VXML Server is installed starts up or the administrator of the application server explicitly started up the VXML Server web application archive.
- **server_stop**—Listed when the VXML Server web application archive is stopped. This occurs if the Java application server on which VXML Server is installed shuts down or the administrator of the application server explicitly stops the VXML Server web application archive.
- **deploy_all_new_apps**—Listed when the `deployAllNewApps` script is run.
- **flush_all_old_apps**—Listed when the `flushAllOldApps` script is run.
- **suspend_server**—Listed when the `suspendServer` script is run.
- **resume_server**—Listed when the `resumeServer` script is run.
- **update_common_classes**—Listed when the `updateCommonClasses` script is run.

Note Running the `status` script does not trigger an administration event and thus does not update the history log.

Application Loggers

Application loggers are defined in the settings for that application. The application designer can choose any number of application loggers they want to listen to events for a particular application, giving each instance a name. A logger may or may not require a configuration that will allow the designer to customize how the

logger performs. The configuration files must be placed in the `data/application` directory of the deployed application.

Unique to application loggers is the ability for one to specify that all logging events for a call be passed to the logger it in the order in which they occurred in the call. Some application loggers may even require this functionality to be turned on as their functionality depends on the events arriving in order. The application designer can choose to ensure this functionality is the case even for application loggers that do not explicitly require it to have logs appear orderly. There is some performance degradation as a result of this functionality so an application logger that does not require this should not enable it.

VXML Server provides the `logs` folder of a particular application for log file storage should the loggers require it. To keep each application logger instance's logs separate, a subfolder with the name of the instance is created and all logs created by the logger instance are stored there.

By default, VXML Server includes four loggers that provide various application-specific information: an activity logger that records caller behavior, an application administration history logger that records administration activities, an error logger that lists errors that occur within calls to the application, and a debug logger that provides additional information useful when creating and debugging a new application. The activity logger and error logger require configurations that allow for detailed control over how the loggers operate.

The following sections describe these four prebuilt application loggers, their configurations (if any), and the information stored in their logs.

Application Activity Logger

The Activity Logger is the main application logger included with VXML Server. It records into text log files all of the activity taken by callers when they visit an application. It stores information about the call itself such as its ANI, what elements the caller encountered and in what order, and even detailed actions such as the values entered by the caller or the confidences of their declaration. The names of the log files created by the Activity Logger begin with *activity_log* and are delimited for easy importing into spreadsheets and databases. These logs have a fixed number of columns:

- **SessionID**—The session ID of the application visit as described in the *VXML Server Call Log* section.
- **Time**—A timestamp of the event in a readable format.
- **[Element name]**—The name of the current element the activity belongs to. Only functional elements (voice elements, action elements, decision elements, and insert elements) can appear here. This column would be empty if the activity does not apply to an element.
- **Category**—The category of the action:
  - **start**—Information on new visits to the application.
  - **end**—Information on how the application visit ended.
  - **element**—Information on the element visited and how the element was exited. The element column is empty for the `start` and `end` categories.
  - **interaction**—Detailed information about what a caller did within a voice element.
  - **data**—Element data to be logged.
  - **custom**—Custom developer-specified data to log.
- **Action**—A keyword indicating the action taken. A list of actions is given in the following table.

- **Description**—Some qualifier or description of the action.

The following table lists all of possible category and actions that can appear in the activity log and descriptions on what they represent.

Category	Action	Description
start	newcall or source	*newcall* is used when the application visit is a new call. The description is empty. *source* is used when another application transferred to this application. The name of the application transferred from is listed in the description.
start	ani	The description is the ANI of the caller. *NA* if the ANI is not sent.
start	areacode	The area code of the ANI. *NA* if the ANI is not sent.
start	exchange	The exchange of the ANI. *NA* if the ANI is not sent.
start	dnis	The description is the DNIS of the call. *NA* if the DNIS is not sent.
start	iidigits	The description is the IIDIGITS of the call. *NA* if the IIDIGITS is not sent.
start	uui	The description is the UUI of the call. *NA* if the UUI is not sent.
start	uid	The application visit is associated with a user. The UID is listed in the description.
start	parameter	An HTTP parameter attached to the initial URL that starts a Unified CVP application. The description lists the parameter name followed by an "=" followed by the value. A separate line will appear for each parameter passed.
start	error	An error occurred in the on-call start action (either a Java class or XML-over-HTTP). The description is the error message.
end	how	How the call ended. The description is either *hangup* to indicate the caller hung up, *disconnect* to indicate the system hung up on the caller, *application_transfer:APPNAME* to indicate a transfer to another Unified CVP application occurred (where APPNAME stands for the name of the destination application), *call_transfer* to indicate a telephony blind transfer occurred, or *app_session_complete* to indicate that the call session ended by another means such as a timeout or the call being sent to an VRU system outside of Unified CVP.
end	result	The description explains why the call ended. *normal* indicates the call ended ordinarily, *suspended* indicates the application is suspended, *error* indicates an error occurred, *timeout* indicates that the VXML Server session timed out, and *invalidated* indicates the application itself invalidated the session.
end	duration	The duration of the call, in seconds.

end	error	An error occurred in the on call end action (either a Java class or XML-over-HTTP). The description is the error message.
element	enter	The element was entered. The description is empty. This is always the first action for an element.
element	hotlink	A hotlink was activated while in the element. This can be either a global or local hotlink. The description lists the hotlink name.
element	hotevent	A hotevent was activated while in the element. The description lists the hotevent name.
element	error	An error occurred while in the element. The description lists the error message.
element	flag	A flag was triggered. The description lists the flag name.
element	exit	The element was exited. The description lists the exit state of the element or is empty if a hotlink, hotevent or error occurred within the element.
interaction	audio_group	An audio group was played to the caller. The description is the audio group name.
interaction	inputmode	How the caller entered data. The description can be *dtmf* or *speech*.
interaction	utterance	The caller said something that was matched by the speech recognition engine. The description lists the match it made of the utterance. This action will always appear with the interpretation and confidence actions.
interaction	interpretation	In a grammar, each utterance is mapped to a certain interpretation value. The description holds the interpretation value for the caller's utterance. This action will always appear with the utterance and confidence actions.
interaction	confidence	The confidence of the caller's matched utterance. This is a decimal value from 0.0 to 1.0. DTMF entries will always have a confidence of 1.0. This action will always appear with the utterance and interpretation actions.
interaction	nomatch	The caller said something that did not match anything in the grammar.
interaction	noinput	The caller did not say anything after a certain time period.
data	[NAME]	When an element creates element data, one can specify if to log the element data. Element data slated to be logged will appear here with the element data name as the action and the value as the description.
custom	[NAME]	Anywhere the developer adds custom name/value information to the log will have the name appear as the action and the value stored within as the description.

Note the following guidelines about the Activity Logger:

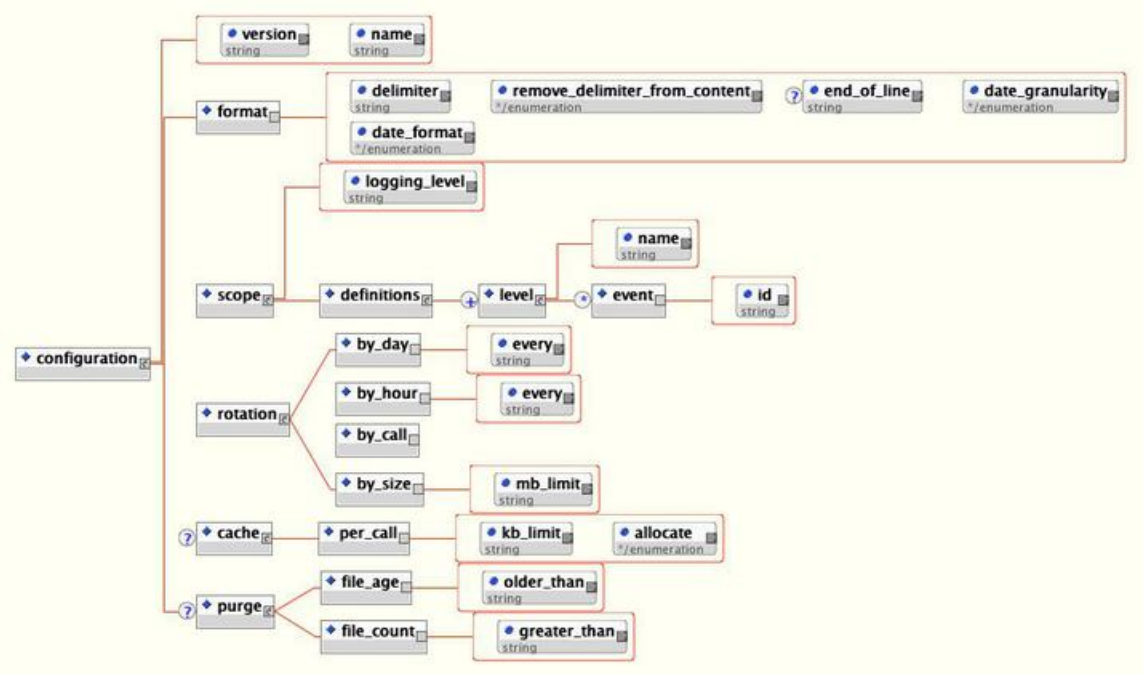
- Due to its complexity, the Activity Logger requires that the enforce call event order option to be set for the logger instance using it and will throw an error if it is not set.
- When one Unified CVP application performs an application transfer to another application, the reported timestamps of the *end* category of the source application and the *start* category of the destination application could be imprecise when the source application ends with the playing of audio content. This is due to the fact that voice browsers typically request VoiceXML pages in advance if the current page contains only audio and a submit to the next page. In other words, the browser could be playing audio to the caller while making a request for the next VoiceXML page. If that page were the last of an application, the subsequent request would begin the process of entering the new application including having the Activity Logger handle start and end of call logging for the two applications. It would then report the end time for the source application as being before the time the caller actually *experienced* the destination application by hearing its audio.

The Activity Logger utilizes a configuration to control the finer details of the information it stores in its log files. The configuration controls five different aspects of the Activity Logger:

- Format of the files
- How much data to store in them
- How often to rotate the files
- How caching should work
- How often should log files be purged

This configuration is specified as an XML file created by the designer in Builder for Call Studio. The following figure shows the format for the XML Activity Logger configuration file.

Figure 26: Activity Logger Configuration File Format



The main tag for the configuration, configuration, has two attributes, `name` and `version`. `Name` is expected to contain the logger instance name although can be given any name desired. The `version` is expected to include the version of the configuration, which is currently *1.0*. The subsequent sections describe the functionality of the various tags in the configuration.

Activity Logger Configuration: Format

The `<format>` tag allows for the modification of how the activity log files are formatted. All Activity Logger configurations are required to define a format. The possible attributes are:

- **delimiter**—This required attribute defines the delimiter to use to separate columns on a line. Delimiters can be any string value, though typically will be a comma or tab. To use a special white space character such as a new line or tab, use the escaped version.

  The possible values are:

  - **\n** (denoting a new line)
  - **\t** (denoting a tab)
  - **\r** (denoting a return)
  - **\f** (denoting a line feed)

- **remove_delimiter_from_content**—When this required attribute is set to *true*, the Activity Logger attempts to eliminate the delimiter from any content appearing in the logs to ensure that the log file can be imported flawlessly. For example, if the delimiter is a comma and the configuration is set to remove the delimiter, when it is to log the content *This, is the description*, it will appear in the log as *This is the description* so that it does not affect the accuracy of the importing process. This extra step, though, does incur a slight performance hit. This step will not be performed if this attribute is set to false.

- **end_of_line**—This optional attribute controls the delimiter used to separate lines. When this optional attribute is set to *true*, the Activity Logger will separate lines appropriate to the operating system on which VXML Server is running. Set the attribute to explicitly set the new line delimiter. Delimiters can be any string value, though typically will be a white space character. To use a special white space character such as a new line or tab, use the escaped version.

  The possible values are:

  - **\n** (denoting a new line)
  - **\t** (denoting a tab)
  - **\r** (denoting a return)
  - **\f** (denoting a line feed)

- **date_format** and **date_granularity**—These required attributes set how the second column of the activity log references a date when the event occurred. The format and granularity are specified.

  There are three possible values for the `date_format` attribute:

  - **standard**—This is a standard readable date format in the form *MM/DD/YYYY HH:MM[:SS][.MMM]* where the hour is in 24-hour time and the last three digits are the milliseconds. The seconds and milliseconds are displayed with brackets to indicate that their appearance is based on the `date_granularity` attribute. For a `date_granularity` attribute set to *minutes*, just the hours and minutes of the time will be displayed. For a granularity set to *seconds*, just the hours, minutes and seconds will be displayed. For a granularity set to *milliseconds*, all components will be displayed.

- **minimal**—This is a minimal time value that omits the date and is in the form *HH:MM[:SS][.MMM]* where the hour is in 24-hour time and the last three digits are the milliseconds. The seconds and milliseconds are displayed with brackets to indicate that their appearance are based on the `date_granularity` attribute. For a `date_granularity` attribute set to *minutes*, just the hours and minutes will be displayed. For a granularity set to *seconds*, just the hours, minutes and seconds will be displayed. For a granularity set to *milliseconds*, all components will be displayed.
- **number**—This displays a large integer number representing the full date and time as an elapsed time since January 1, 1970, 00:00:00 GMT. For a `date_granularity` attribute set to *minutes*, the number will be 8 digits in length (representing the number of minutes elapsed since that date). For a granularity set to *seconds*, the number will be 10 digits in length (representing the number of seconds elapsed since that date). For a granularity set to *milliseconds*, the number will be 13 digits in length (representing the number of milliseconds elapsed since that date).

Activity Logger Configuration: Scope

The Activity Logger configuration provides the administrator the ability to control what is logged based on their own needs. This configuration is done by defining logging levels and the events that each level contains. During the debugging stage, for example, the logging level can be set to record all events and once in production, the logging level can be set to record more important events.

The `<scope>` tag defines the logging level to use in the `logging_level` attribute. The child tag `<definitions>` encapsulates all possible logging levels. All Activity Logger configurations are required to define a scope with at least one logging level.

To define a logging level, a separate `<level>` tag is added within the `<definitions>` tag and given a name in the `name` attribute. This tag will include a separate `<event>` tag for each event the logging level includes. The `id` attribute defines the name of the event. The following table lists all possible event IDs and describes when that event occurs.

Note At minimum, the *start* and *end* events are required for any logging level as these events are used by the Activity Logger to maintain information about its log files and which calls are using them.

Event ID	Event Description
start	This event occurs when a new visit is made to the application (could be a new call or visit using an application transfer). This event is **required** in all logging levels.
end	This event occurs when an application visit ends. This event is **required** in all logging levels.
elementEnter	This event occurs when an element is entered. This applies to both standard and configurable elements as well as VoiceXML Insert elements.
elementExit	This event occurs when an element exits (either ordinarily or due to something occurring within it that took the call flow elsewhere).
elementFlag	This event occurs when a flag element is visited by a caller.
defaultInteraction	This event occurs when a voice element returns interaction logging content as a result of caller activity within a VoiceXML page.

elementData	This event occurs when element data is created that has been configured to be stored in the log.
custom	This event occurs when custom content is to be added to the log, either by visiting an element whose configuration specified content to add or by running custom code using either the Java or XML APIs that specifies to add to the log.
hotlink	This event occurs when a global or local hotlink that points to an exit state (as opposed to throwing a VoiceXML event) is activated by the caller.
hotevent	This event occurs when a hotevent that has an exit state is activated in the call.
warning	This event occurs when a warning is encountered.
systemError	This event occurs when VXML Server encounters an internal error (that is, an error that does not originate from a custom component). This event will include a stack trace.
javaApiError	This event occurs when a custom component created with the Unified CVP Java API encounters an error. This event will include a stack trace.
xmlApiError	This event occurs when a custom component created with the Unified CVP XML API encounters an error. This event will *not* include a stack trace.
vxmlError	This event occurs when an error event is received from the voice browser. This event will *not* include a stack trace.

Activity Logger Configuration: File Rotation

In any system that stores information in log files, high volume can cause these files to become very large. The goal is to have a strategy for creating new log files in order to avoid files that are too large. Additionally, file rotation strategies can help separate the log files into more logical parts. The Activity Logger defines several rotation strategies to choose from.

Note To ensure that the information for a single call is not split across multiple log files, the Activity Logger ensures that all call information appears in the log that was active when the call was received. As a result, it is possible for calls to be updating both pre- and post-rotation log files simultaneously.

Each rotation strategy determines how the log files are named (though all activity log filenames begin with *activity_log*). The `<rotation>` tag defines the rotation strategy to use by containing one of the following tags:

- **<by_day>**—Creates a new log file every *X* days where *X* is an integer value greater than 0 specified in the `every` attribute. Typically this value is 1, meaning that every day at midnight, a new log file is created. For low volume systems, the value can be given a larger value. For example, when set to 7, a new log file is created once a week. The log files are named *activity_logYYYY-MM-DD.txt* where *YYYY* is the year, *MM* is the month, and *DD* is the day that the file is created.
- **<by_hour>**—Creates a new log file every *X* hours where *X* is an integer value greater than 0 specified in the `every` attribute. There is no upper bound on this value, so it can be greater than 24. The log files are named *activity_logYYYY-MM-DD-HH.txt* where *YYYY* is the year, *MM* is the month, *DD* is the day, and *HH* is the hour that the file is created.

Note The hour is measured in 24-hour time (0 - 23).

Note In locales that use Daylight Saving Time (DST), calls that are placed after the clock is turned back an hour will continue to be logged in the current log file for the one a.m hour (the current log file). A new log file is not created when the clock is turned back for DST for the one a.m hour.

- **<by_call>**—Creates a separate log file for each call made to the application. The log files are named *activity_logYYYY-MM-DD-HH-SESSIONID.txt* where *YYYY* is the year, *MM* is the month, *DD* is the day, and *HH* is the hour that the file is created (in 24-hour time) and SESSIONID is the VXML Server session ID (for example, *activity_log2000-01-01-17-192.168.1.100.1024931901079.1.MyApp.txt*). The session ID is included in the filename to ensure uniqueness of the files.

Note Care must be taken before using this log file rotation strategy on systems with high load as this will create a very large number of files.

- **<by_size>**—Creates a separate log file once the previous log file has reached *X* megabytes in size where *X* is an integer value greater than 0 specified in the mb_limit attribute.

Note Due to the fact that multiple calls will be updating the same file and that the Activity Logger will ensure that all data for a single call appear in the same log file, the final log file may be slightly larger than the limit.

The log files are named *activity_logYYYY-MM-DD-HH-MM-SS.txt* where *YYYY* is the year, the first *MM* is the month, *DD* is the day, *HH* is the hour (in 24-hour time), the second *MM* is the minute, and *SS* is the second that the file is created. The time information is included in the file name in order to ensure uniqueness.

Activity Logger Configuration: Caching

The Activity Logger has the ability to use a memory cache to store information to log until either the cache fills or the call ends. Using a cache has several advantages. The first is that it increases performance by waiting until the end of the call to perform the file IO. Without a cache, the log file would be updated each time an event occurred. Another advantage is that with caching on, the log file will be more readable by grouping the activities belonging to a single phone call together. Without the cache, the events for all calls being handled by every application running on VXML Server would be intermingled. While one can still sort the calls after the log is imported to a spreadsheet or database, it is much more difficult to track a single call when simply reading the log file without the cache. The one disadvantage of using a cache is that the log file is not updated in real-time, only after a call has completed. If there is a desire to have the logs updated immediately after the events occur, then caching should be left out of the configuration.

The `<cache>` tag has only one child tag: `<per_call>`, indicating that the cache's lifetime is a single call to an application. `<per_call>` defines two attributes: `kb_limit`, an integer value greater than 0 that defines the size of the cache in kilobytes, and `allocate` that defines the cache allocation strategy.

The attribute can be set to two values:

- **once**—The Activity Logger will allocate the full memory needed for the cache once and then fill it up with logging information. When filled, the cache is flushed to the log file and the same section of memory is cleared and then refilled.
- **as_needed**—The Activity Logger will allocate memory as events arrive in the call until the total amount of memory has been allocated. When it is to be flushed, the memory is released and then the allocation begins again.

The advantage of allocating the memory at once is that since a contiguous section of memory is being used, the updating, maintenance, and flushing of that memory will be slightly faster. Additionally, with only one area of memory per call fewer memory allocations take place, which can affect how often Java garbage collection runs. A disadvantage is that the cache size needs to be chosen carefully. A cache incurs too small performance hits as the cache fills up and is logged multiple times within a call. A cache means too large that a large amount of memory is allocated and then never used, potentially starving the rest of the system. A good cache size would be approximately the size of a log for a typical call to the application. Because the cache is flushed at the end of a call, there is little reason to make the cache much larger.

The advantage to allocating the memory as needed is that this minimizes the memory used since only the memory needed to store the information is used. The cache size is not as important, and making it larger will not affect the overall memory usage as drastically as if the cache was allocated all at once because the memory would not be allocated unless needed.

Configure the cache to be allocated once for performance and as needed if memory on the system is limited.

Activity Logger Configuration: File Purging

The Activity Logger can be configured to automatically delete files that conform to certain criteria. Properly configured, this logger allow an administrator to avoid having the system's hard drive fill up with logs, which prevents new calls from being logged.

Note the following information about file purging:

- A logger has control only over the files appearing under the logger instance's dedicated log folder and cannot control those files managed by other logger instances. This logger even applies to multiple instances of the same logger since each logger instance is given its own unique folder within the `logs` folder of the application. Activity Logger file purging therefore applies only to those files appearing under the logger instance's folder.
- Because loggers are activated only when events occur in a call, the file-purging activity will only take place when a call ends. As a result, a system that receives no calls at all will not automatically delete files until a new call is received and completes.
- When the Activity Logger starts up for the first time, it will apply the purging strategy on any files that exist in the logger directory. Therefore, if an application server is shut down with files in the logger directory and then restarted a long time later, these files could be deleted when the application server starts up and the logger initializes. This applies to any file appearing in the logger directory, not just activity logs.
- The Activity Logger keeps information about the activity log files in memory and acts on that to determine whether to delete them rather than by monitoring the remaining hard drive space on the system. This is done to avoid having to do file IO to determine if a file is to be purged and so minimizes overhead (although there still is overhead in deleting files). One consequence is that the logger keeps track *only* of those files it is managing. The logger is unaware of any files added to the directory after the application server initializes, so the purging strategy will affect those files only.

The optional `<purge>` tag defines the purging strategy. If this tag does not appear in the configuration, no file purging takes place. The tag can contain one of the following child tags:

- **file_age**—The Activity Logger deletes activity log files older than *X* days, where *X* is an integer greater than 0 specified in the `older_than` attribute.
- **file_count**—The Activity Logger deletes activity log files if the logger folder contains greater than *X* files, where *X* is an integer greater than 0 specified in the `greater_than` attribute. When the files are deleted, the oldest ones are deleted first until the folder reaches the desired file count.

Activity Logger Configuration Example #1

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE configuration SYSTEM "../../../../dtds/ActivityLoggerConfig.dtd">
<configuration version="1.0" name="MyLogger1">
   <format delimiter="\t" remove_delimiter_from_content="true" end_of_line="\n"
date_format="standard" date_granularity="milliseconds"/>
   <scope logging_level="Complete">
      <definitions>
         <level name="Minimal">
            <event id="start"/>
            <event id="end"/>
         </level>
         <level name="Complete">
            <event id="start"/>
            <event id="end"/>
            <event id="elementEnter"/>
            <event id="elementExit"/>
            <event id="elementFlag"/>
            <event id="defaultInteraction"/>
            <event id="elementData"/>
            <event id="custom"/>
            <event id="hotlink"/>
            <event id="hotevent"/>
            <event id="warning"/>
         </level>
      </definitions>
   </scope>
   <rotation>
      <by_day every="2"/>
   </rotation>
   <cache>
      <per_call kb_limit="10" allocate="once"/>
   </cache>
   <purge>
      <file_age older_than="3"/>
   </purge>
</configuration>
```

This configuration has the following features:

- The activity logs will be delimited with a tab (“\t”) and will have any tabs that appear in the content removed.
- The activity logs will use a Unix-style new line character (“\n”) to delimit lines. As a result, these log files would not appear orderly on Windows Notepad because it does not recognize these new line characters.
- Dates in the activity logs will appear in the standard format with millisecond granularity. For example, *05/09/2006 15:45:02.654*

- Two logging levels are defined: Minimal, which logs only when a caller entered and exited an application, and Complete, which logs all events. The Complete logging level is the one that will be used.
- The activity log files will be rotated every two days, meaning each log file will contain two days worth of calls before a new file is created.
- The cache is set to 10 K or 5000 characters and is allocated once at the start of a call.
- Files that are older than three days that appear in the logger instance's dedicated directory will be purged.

Activity Logger Configuration Example #2

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE configuration SYSTEM "../../../../dtds/ActivityLoggerConfig.dtd">
<configuration version="1.0" name="MyLogger2">
   <format delimiter="," remove_delimiter_from_content="false" date_format="minimal"
date_granularity="minutes"/>
   <scope logging_level="MyLoggingLevel">
      <definitions>
         <level name="MyLoggingLevel">
           <event id="start"/>
           <event id="end"/>
           <event id="elementEnter"/>
           <event id="elementFlag"/>
           <event id="elementExit"/>
         </level>
      </definitions>
   </scope>
   <rotation>
      <by_size mb_limit="100"/>
   </rotation>
</configuration>
```

This configuration has the following features:

- The activity logs will be delimited with a comma and will not remove any commas that appear in the content potentially complicating any importing of these logs into spreadsheets or databases.
- The activity logs will end each line with the character appropriate for the operating system on which it is generated. If this system is running under Windows, the activity logs can be viewed in Notepad and if this system is running under Unix, the activity logs can use the Unix end of line characters that would not be recognized if opened by Windows Notepad.
- Dates in the activity logs will appear in the minimal format with minute granularity. For example, *15:45*.
- Only one logging level is defined that logs when calls enter and exit an application, enter and exit an element, and when a flag element is visited.
- A new activity log is created when the previous one has reached approximately 100 MB in size, regardless on whether the calls spanned weeks or hours.
- No logging cache is used, meaning that when a logging event occurs in a call, it is placed into the activity log immediately. It allows for real-time logging but incurs a performance overhead in managing much more IO operations.
- No file purging will take place. The administrator is responsible for maintaining the logs on the system.

Application Error Logger

During the voice application development process, errors can be introduced by configuring elements incorrectly, spelling mistakes in audio filenames, or by Java coding bugs. In each of these cases, errors occur while running the application. While the Activity Logger does report errors, it is preferable to isolate errors in a separate file so that they are easily found and addressed. Additionally, when reporting Java errors, a stack trace is desired. The application Error Logger provides a place for these errors to appear. The error log file names are in the form *error_logYYYY-MM-DD.txt* where YYYY, MM, and DD are the year, month, and day when the error log was first created and is rotated daily.

Note The application Error Logger will report information on errors that are affiliated with the application in which it is configured. It can even report errors encountered by other loggers in the same application only if the Error Logger is listed *before* other loggers in the application. If another logger is loaded before the Error Logger, any errors it encounters will be logged instead to the VXML Server Call Error Log. It is for this reason that by default Builder for Call Studio puts the Error Logger at the top of the list of loggers to use for a new application.

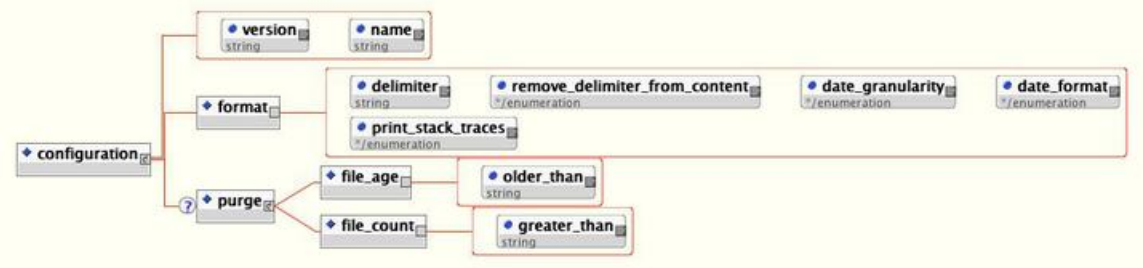
Starting in Release 8.0(1), the application error log now reports on application timeout events. Previously, timeout events were not located in the application activity logs.

The columns of the error log are:

- **SessionID**—The session ID of the application visit described in the VXML Server Call Log section.
- **Time**—The time the error occurred.
- **Description**—The error description including a Java stack trace if applicable.

The Error Logger utilizes a configuration to control two different aspects of the error logs: the format of the files and how often should log files be purged. This configuration is specified as an XML file created by the designer in Builder for Call Studio, as shown in the following figure.

Figure 27: Error Logger Configuration Format



The main tag for the configuration, `configuration`, has two attributes, `name` and `version`. `Name` is expected to contain the logger instance name. The `version` is expected to include the version of the configuration, which is currently *1.0*. The subsequent sections describe the functionality of the various tags in the configuration.

Error Logger Configuration: Format

The `<format>` tag allows for the modification of how the error log files are formatted. All Error Logger configurations are required to define a format. The possible attributes are:

- **delimiter**—This required attribute defines the delimiter to use to separate columns on a line. Delimiters can be any string value, though typically will be a comma or tab. To use a special white space character such as a new line or tab, use the escaped version.

  The possible values are:

  - **\n** (denoting a new line)
  - **\t** (denoting a tab)
  - **\r** (denoting a return)
  - **\f** (denoting a line feed)

- **remove_delimiter_from_content**—When this required attribute is set to *true*, the Activity Logger will attempt to eliminate the delimiter from any content appearing in the logs to ensure that the log file can be imported flawlessly. For example, if the delimiter is a comma and the configuration is set to remove the delimiter, when it is to log the content *This, is the description*, it will appear in the log as *This is the description* so as not to affect the accuracy of the importing process. This extra step, though, does incur a slight performance hit. This step will not be performed if this attribute is set to *false*.

Note If the error log contains Java stack traces, the error logs might be difficult to import as stack traces fill multiple lines (though their content will be cleaned of the delimiter if desired).

- **date_format** and **date_granularity**—These required attributes set how the second column of the activity log references a date when the event occurred. The format and granularity are specified.

  There are three possible values for the `date_format` attribute:

  - **standard**—This is a standard readable date format in the form *MM/DD/YYYY HH:MM[:SS][.MMM]* where the hour is in 24-hour time and the last three digits are the milliseconds. The seconds and milliseconds are displayed with brackets to indicate that their appearance is based on the `date_granularity` attribute. For a `date_granularity` attribute set to *minutes*,only hours and minutes of the time will be displayed. For a granularity set to *seconds*, only hours, minutes and seconds will be displayed. For a granularity set to *milliseconds*, all components will be displayed.
  - **minimal**—This is a minimal time value that omits the date and is in the form *HH:MM[:SS][.MMM]* where the hour is in 24-hour time and the last three digits are the milliseconds. The seconds and milliseconds are displayed with brackets to indicate that their appearance are based on the `date_granularity` attribute. For a `date_granularity` attribute set to *minutes*,only hours and minutes will be displayed. For a granularity set to *seconds*, only hours, minutes and seconds will be displayed. For a granularity set to *milliseconds*, all components will be displayed.
  - **number**—This displays a large integer number representing the full date and time as an elapsed time since January 1, 1970, 00:00:00 GMT. For a `date_granularity` attribute set to *minutes*, the number will be 8 digits in length (representing the number of minutes elapsed since that date). For a granularity set to *seconds*, the number will be 10 digits in length (representing the number of seconds elapsed since that date). For a granularity set to *milliseconds*, the number will be 13 digits in length (representing the number of milliseconds elapsed since that date).

- **print_stack_traces**—This required attribute is set to either *true* or *false* and determines whether the error log will contain Java stack traces. Stack traces are very useful to a developer in tracking down the cause of a Java error. You must keep this option on.

Error Logger Configuration: File Purging

The Error Logger can be configured to automatically delete files that conform to certain criteria. Properly configured, this allows an administrator to avoid having the system's hard drive fill up with logs, which would prevent new calls from being logged.

Note the following information about file purging:

- Becasue loggers are activated only when events occur in a call, the file purging activity will only take place when an error event occurs. As a result, a system that encounters no errors will not automatically delete files until a new error occurs.
- When the Error Logger starts up for the first time, it will apply the purging strategy on any files that exist in the logger directory. Therefore, if an application server is shut down with files in the logger directory and then restarted a long time later, these files can be deleted when the application server starts up and the logger initializes.
- Unlike the Activity Logger, the Error Logger applies its purging strategy to any files found in its logger directory, including non-error log files. If other files are added to the logger folder after the application server has started, they might be deleted when the Error Logger encounters a new error.

The optional `<purge>` tag defines the purging strategy. If this tag does not appear in the configuration, no file purging will take place. The tag can contain one of the following child tags:

- **file_age**—The Error Logger deletes error log files older than *X* days, where *X* is an integer greater than 0 specified in the `older_than` attribute.
- **file_count**—The Error Logger deletes error log files if the logger folder contains greater than *X* files, where *X* is an integer greater than 0 specified in the `greater_than` attribute. When the files are deleted, the oldest ones are deleted first until the folder reaches the desired file count.

Error Logger Configuration Example #1

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE configuration SYSTEM "../../../../dtds/ApplicationErrorLoggerConfig.dtd">
<configuration version="1.0" name="MyErrorLogger1">
     <format delimiter="," remove_delimiter_from_content="true" date_format="standard"
date_granularity="seconds" print_stack_traces="true"/>
     <purge>
        <file_count greater_than="10"/>
     </purge>
</configuration>
```

This configuration has the following features:

- The error logs will be delimited with a comma and will have any commas that appear in the content removed.
- Dates in the error logs will appear in the standard format with seconds granularity. For example: *05/09/2006 15:45:02*.
- Java stack traces will appear in the error logs.

Note Because stack traces span multiple lines, including stack traces may complicate the process of importing the error logs into spreadsheets or databases. This process is rarely done for error logs.

- When a new file is added to logger instance's dedicated directory by the Error Logger, if the directory contains more than 10 files the oldest file will be deleted.

Note With a large application or a large number of applications, it is possible to fill all available disk space with logs. For this reason, all applications have a default log retention set to 10 GB (100 logs). Customers should review this setting as needed and modify it to suit their situation.

Error Logger Configuration Example #2

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE configuration SYSTEM "../../../../dtds/ApplicationErrorLoggerConfig.dtd">
<configuration version="1.0" name="MyErrorLogger2">
   <format delimiter="***" remove_delimiter_from_content="false" date_format="minimal"
date_granularity="seconds" print_stack_traces="false"/>
</configuration>
```

This configuration has the following features:

- The error logs will be delimited with the string "***" and will not attempt to remove that string from the content.

Note The delimiter does not need to be limited to a single character and can be a multicharacter string. Usually, a single character makes importing into spreadsheets and databases straightforward.

- Dates in the error logs will appear in the minimal format with seconds granularity. For example, *15:45:02*.
- Java stack traces will not appear in the error logs. When a Java exception occurs, only the error message itself will appear in the error log without the stack trace.
- No file purging will take place. The administrator is responsible for maintaining the logs on the system.

Application Administration History Logger

Whenever an application-specific administration script is run, a log file is updated with information on the script that was run. The administration log filenames are in the form *admin_historyYYYY-MM-DD.txt* where *YYYY*, *MM*, and *DD* are the year, month, and day when the administration history log was first created and is rotated daily. The file contains three columns: the time the script was run, what script was run, and its result. The result is usually *success* and if not contains the description of the error encountered.

The possible values are:

- **server_start**—Each application's history log contains records of each time the application server starts.

- **deploy_app**—Listed when the `deployApp` script is run.
- **suspend_app**—Listed when the `suspendApp` script is run.
- **resume_app**—Listed when the `resumeApp` script is run.
- **update_app**—Listed when the `updateApp` script is run.
- **release_app**—Listed when the `releaseApp` script is run.
- **update_common_classes**—Listed when the global `updateCommonClasses` script is run. The reason this global admin event is logged by the Application Administration History Logger is because elements that appear in the `common` directory are reloaded by this command, causing those elements to reload their application-specific configurations.

Running the `status` script does not update the history log. The Administration History Logger does not use a configuration.

Application Debug Logger

At times when debugging an application, it is advantageous to see information concerning the HTTP requests made by the voice browser and the corresponding HTTP responses of VXML Server. The Debug Logger creates a single file per call that contains all HTTP requests and responses that occurred within that call session. The log files are named *debug_logYYYY-MM-DD-HH-SESSIONID.txt* where *YYYY* is the year, *MM* is the month, *DD* is the day, and *HH* is the hour (in 24-hour time) that the file is created and *SESSIONID* is the VXML Server session ID (for example, *debug_log2000-01-01-17-192.168.1.100.1024931901079.1.MyApp.txt*). The Session ID is included in the filename to ensure uniqueness of the files.

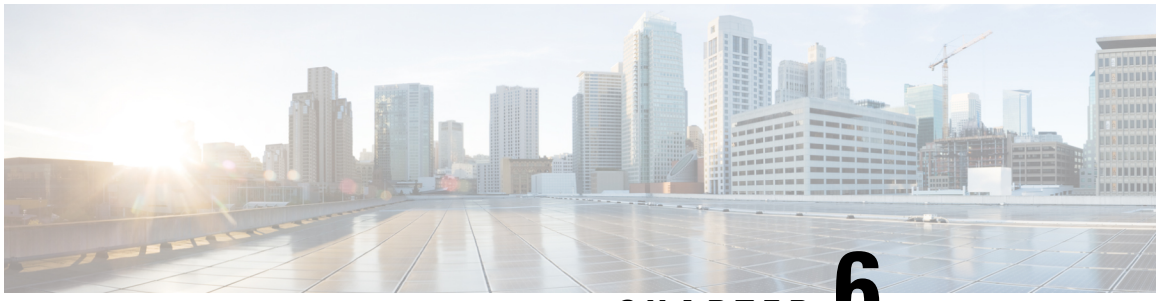
The debug log contains:

- A timestamp of when each HTTP request was received from the voice browser as well as when the response was sent back by VXML Server.
- All headers of the HTTP request.
- All arguments passed with the HTTP request, whether they be set with GET or POST.
- The entire VoiceXML page returned in the HTTP response.
- We recommend that you use the Debug Logger only when performing debugging and not in a production environment because it incurs overhead on the system in creating and managing file IO and replicating the HTTP response, which must be generated once for the voice browser and once for each Debug Logger instance.

Note The Debug Logger does not require the enforce call event order to be turned on, however, without it there could be situations where under load the HTTP requests and responses are out of order or mixed together in the file.

Correlating Unified CVP Call Server Logs with VXML Server Logs

Starting in Release 8.0(1), VXML Server (by default) receives callid (which contains the call GUID), _dnis, and _ani as session variables in comprehensive mode even if the variables are not explicitly configured as parameters in the ToExtVXML array. If the variables are configured in ToExtVXML then those values are used. These variables are available to VXML applications as session variables and they are displayed in the VXML server log.



CHAPTER 6

VXML Server Configuration

VXML Server can be configured to modify its function. This chapter explains all configuration options and how to change them.

VXML Server uses default values for these configuration options and functions without modification. Improperly chosen values can cause significant performance degradations and could even prevent VXML Server from functioning correctly.

Note Only an experienced administrator should consider changing these options.

- Global Configuration File, on page 113
- Setup Options, on page 113

Global Configuration File

The method to edit the VXML Server configuration is through an XML file named `global_config.xml` found in the `%CVP_HOME%\VXMLServer\conf` directory. This file must be edited by hand; there is no graphical interface.

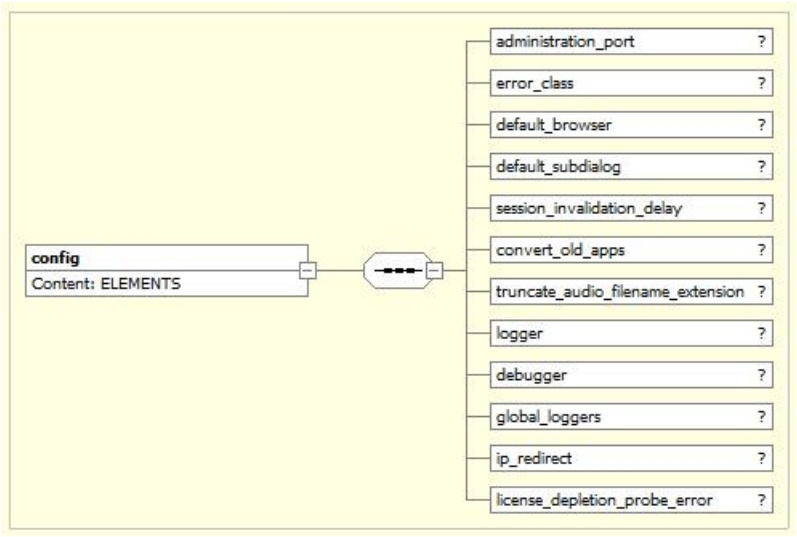
This file is loaded by VXML Server when it is initialized and cached in memory. Loading the file is one of the first tasks performed by VXML Server when it starts up because the configuration options affect how it runs. Any changes to this file requires VXML Server to be restarted in order for the changes to take affect.

Note When performing an upgrade of VXML Server, the administrator will have to reimplement the configuration changes.

Setup Options

The following figure displays the DTD diagram of the `global_config.xml` file.

Figure 28: Global Configuration Options



The elements in the XML document are:

- **administration_port**—This tag defines the port on which administration activity takes place and can be any positive integer. By default, the port is set to 10100. See Administration for more on administration activities.
- **error_class**—This tag defines the fully qualified Java class name of a class to run when an error occurs for notification purposes. By default no class is defined. See Programming Guide for Cisco Unified CVP VXML Server and Unified Call Studio for more on how to write the On Error Notification class.
- **default_browser**—This tag defines the real name of the gateway adapter that should be used by default when VXML Server needs to produce a VoiceXML page in a scenario where the current application is unknown and therefore the gateway adapter for that application is unknown. One such scenario is an error where the VXML Server session is unrecognized. The reason this exists is because some gateways require the VoiceXML to be formatted in a specific way (such as requiring an XML namespace to appear in the document) that if the VoiceXML page were produced in a different format would cause an error on the gateway. An application lists its gateway in its settings and generally this is available to VXML Server to produce the correct VoiceXML. However, in rare cases, an error occurs and VXML Server does not have access to the session and the application that the call belonged to needs to know which gateway to have the resulting VoiceXML page conform to. By default, if left blank in `global_config.xml`, VXML Server will search through the directory of installed gateway adapters and use the first one it finds.
- `default_subdialog`—This tag defines whether to treat a call that is not associated with an application as if it were a VoiceXML subdialog and whose possible values are `true` and `false`. Some gateways (such as Cisco gateways) call all VXML Server applications as VoiceXML subdialogs. VXML Server must be aware of this because it determines how the VoiceXML it produces looks and if not produced correctly would cause an error on the gateway. Typically, a call is made to an application which defines in its settings whether to treat the application as a subdialog. However, in rare cases, an error occurs and VXML Server does not have access to the session and the application that the call belonged to needs to know whether to treat the call as a subdialog. By default, if left blank in `global_config.xml`, VXML Server will consider a call to the application to **not** be a subdialog.

- `session_invalidation_delay`—This tag defines the amount of time in seconds that VXML Server will wait for after a call session ends before actually invalidating that session (this can be any integer greater than or equal to 0). This configuration option is necessary because there may be various activities taken by loggers and end of call classes that require the session to remain alive to access data within it (such as element or session data), and if the session was invalidated errors can occur when attempting to access the data. If this value were too small (such as 0 seconds), many errors can occur for routine actions such as logging at the end of a call. If this value was too high, too many sessions would remain in memory for too long, potentially causing memory issues. We highly recommend keeping the default value of 30 seconds, or testing the system if this value changes.
- `convert_old_apps`—This tag defines whether to convert applications deployed from a version of Call Studio that VXML Server detects is old (possible values are `true` and `false`). By setting this configuration option to true, a deployed application can be copied to the `applications` directory of VXML Server without requiring the application to be redeployed from the latest version of Call Studio.

Note For new application settings, the converter will choose default values.

Note This converter is limited to converting the XML files that define an application with regards to Call Studio and VXML Server and will **not** convert any other files or Java classes for the application. By default this configuration option is on.

- **logger**—This tag acts as the parent tag for three additional tags that relate to loggers. The first two tags, `<minimum_thread_pool_size>`, and `<maximum_thread_pool_size>` define the minimum and maximum size of the thread pool that is used for handling logger threads. The minimum thread pool size value can be any positive integer and the maximum thread pool size value can be any positive number as long as it is greater than the minimum thread pool size value.

Note If the maximum number of logger threads is used, VXML Server will queue the logger events to be used when a thread becomes available so the data will not be lost. Because these values affect thread usage, we highly recommend that any deviation from the default values (1 minimum / 500 maximum) be fully tested for any complications. For example, if the maximum is set to a *low* value and the system encounters high load, VXML Server might encounter a situation where the queued logger events accumulate faster than the logger threads can handle them, leading to a scenario where the application server runs out of memory. If the maximum value is set *too high* and the system encounters high load, the system on which VXML Server runs might run out of threads to allocate, which can cause many other problems with the application server as well as the operating system. Of all the VXML Server configuration options, these two have the highest potential for causing major problems if misused.

The third child tag, `<keep_alive_time>` defines the amount of time in seconds that a thread should be idle before it is removed from the thread pool. This tag allows for the thread pool size to decrease over time as logger volume decreases. This value allows for optimum thread pool size based on the call volume.

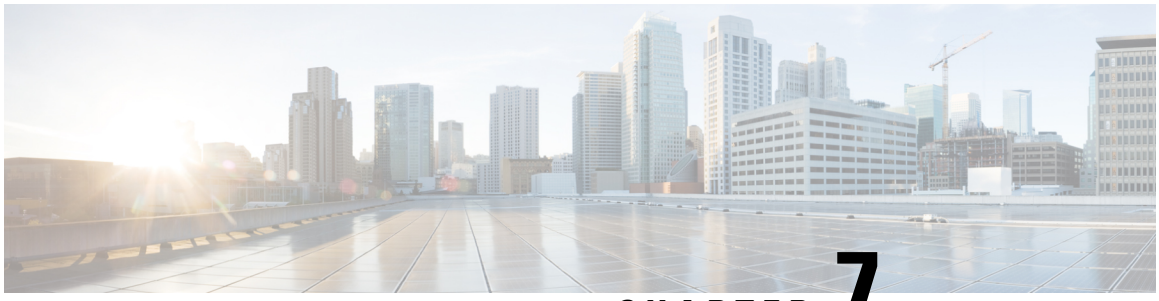
The default value is 30 seconds. We recommend not change drastically from the default becasue too high a number will keep unnecessary resources around, and too low a number will reduce efficiency and defeat the purpose of using a thread pool completely. Refer to VXML Server Logging for more on logging.

- **debugger**—This tag defines the RMI registry port for the Call Studio debugger. This configuration option is used only by VXML Server implementations used by Call Studio for debugging purposes and should not be used in a production environment. The default is 8099 and the value can be any positive integer.
- **global_loggers**—This tag defines the global loggers to use within VXML Server. Administrators can add additional global loggers as well as change or remove the loggers listed by default: the global call, admin, and error loggers. Each logger instance is defined by a separate child tag `<logger_instance>`. The required `name` attribute gives the logger instance a name and must be unique. The required `class` attribute gives the fully qualified Java class name that defines the global logger. The optional `configuration` attribute gives the name of a configuration file for the global logger if needed. This configuration file is expected to reside in the same `%CVP_HOME%\VXMLServer\conf` directory. Refer to VXML Server Logging for more on logging and the *Programming Guide for Cisco Unified CVP VXML Server and Cisco Unified Call Studio*for more on creating custom loggers.
- **ip_redirect**—This tag enables a feature that redirects the gateway to point directly to the VXML server, which circumvents any load balancers that may lie between the gateway and server. This tag uses a VoiceXML goto with the explicit IP address of the server for the first VoiceXML page of a call. When this feature is enabled, the VXML server uses a load balancer only for the first HTTP request of a call session, but not for subsequent requests for the same call session. The tag, if used, takes a required attribute `active` which can be *true* or *false*. It also takes an optional attribute, `ip_to_use`, which contains the IP address to use for a redirect if you do not want to use the IP address returned by the default VXML server.

  This feature minimizes the effect of load-balancer related issues by using the load balancer only for the first HTTP request of a call session. For example, if a loadbalancer fails, then a VXML Server may incur many session timeouts. Because a load balancer failure affects all VXML servers that it handles, a downward effect can quickly occur where sessions are stale and calls are placed on hold across all VXML servers in the pool.

Note If this feature is enabled, you do not need to configure sticky cookies on the load balancers.

- **license_depletion_probe_error**—This tag defines the response to a probe when licenses have been depleted. If this configuration is used, and the body of the tag is set to *true*, then an HTTP 500 error is returned when licenses are depleted. This tag ensures that loadbalancers do not continue to send traffic to the server. If this tag is not used, or the body of the tag is set to *false*, then a HTTP 200 response is sent back to probes. This feature must only be used if the `ip_redirect` feature is set to *active*.



CHAPTER 7

JavaScript Utilities

- JSONPath Expression, on page 117
- XPath Expression, on page 117
- Date Validation, on page 118
- Time Validation, on page 119

JSONPath Expression

Cisco Unified Call Studio includes a new utility that allows you to use JSONPath expressions in JavaScript to return the values from the JSON(JavaScript Object Notation).

To use this utility, include the following syntax as part of the JavaScript when you define the local variables:

```
importPackage(com.audium.server.cvpUtil);
JSONPathUtil.eval(String inputJSON , String expression);
```

Table 1: Syntax Parameter and Description

Parameter	Description
importPackage(com.audium.server.cvpUtil)	This parameter imports the package to find the XPath values.
JSONpathUtil.eval(String inputJSON , String expression)	This parameter returns the value from the JSON document based on the JSONPath expression provided.

Sample Script of JSONPath function with REST element:

```
importPackage(com.audium.server.cvpUtil);
var inputJSON = {Data.Element.Rest_Client_01.response_body};
JSONPathUtil.eval(String inputJSON , String expression);
```

XPath Expression

Cisco Unified Call Studio includes a new utility that allows you to use XPath expressions in JavaScript to return the values from the XML.

To use this utility, include the following syntax as part of the JavaScript when you define the local variables:

```
importPackage(com.audium.server.cvpUtil);
XpathUtil.eval(String inputXML , String expression);
```

Table 2: Syntax Parameter and Description

Parameter	Description
importPackage(com.audium.server.cvpUtil)	This parameter imports the package to find the XPath values.
XpathUtil.eval(String inputXML, String expression)	This parameter returns the value from the XML document based on the XPath expression provided. **Note** This function returns a Java Object, which needs to be explicitly typecasted before it can be used, for example, *"var value = String(XpathUtil.eval(xml,xpathsearch));"*

Sample Script of XPath function with REST element:

```
importPackage(com.audium.server.cvpUtil);
var xml = {Data.Element.Rest_Client_01.response_body};
XpathUtil.eval(xml , "/Results/Row[age<30]/name");
```

Sample Script of XPath function with DB element:

```
importPackage(com.audium.server.cvpUtil);
var xml ={Data.Element.Database_01.xml_resultset};
XpathUtil.eval(xml , "/Results/customer");
```

Date Validation

Cisco Unified Call Studio includes a new utility that allows you to validate date in JavaScript on local variables.

To use this utility, include the following syntax as part of the JavaScript:

```
importPackage(com.audium.server.cvpUtil);
DateTimeUtil.isValidDate(String dateToValidate, String dateFormat);
```

Table 3: Syntax Parameter and Description

Parameter	Description
importPackage(com.audium.server.cvpUtil)	This parameter imports the package to find the XPath values.
DateTimeUtil.isValidDate(String dateToValidate, String dateFormat)	This parameter verifies whether the date provided is a valid format.
String dateToValidate	This parameter is the input date.

Parameter	Description
String dateFormat	This parameter specifies the format in which the date needs to be validated.
return value	If the input date is in the valid format, the return value is 1. If the input date is not in the valid format, the return value is 0.

The following date formats are supported in JavaScript:

- dd/MM/yyyy
- dd.MM.yyyy
- dd-MM-yyyy
- ddMMyyyy

Note The month must always be represented by the upper case letters MM.

For example:

importPackage(com.audium.server.cvpUtil);

DateTimeUtil.isValidDate("02/05/1990","dd/MM/yyyy");

Time Validation

Cisco Unified Call Studio includes a new utility that allows you to validate time in JavaScript on local variables.

To use this utility, include the following syntax as part of the JavaScript:

```
importPackage(com.audium.server.cvpUtil);
DateTimeUtil.isValidTime(String timeToValidate, String timeFormat);
```

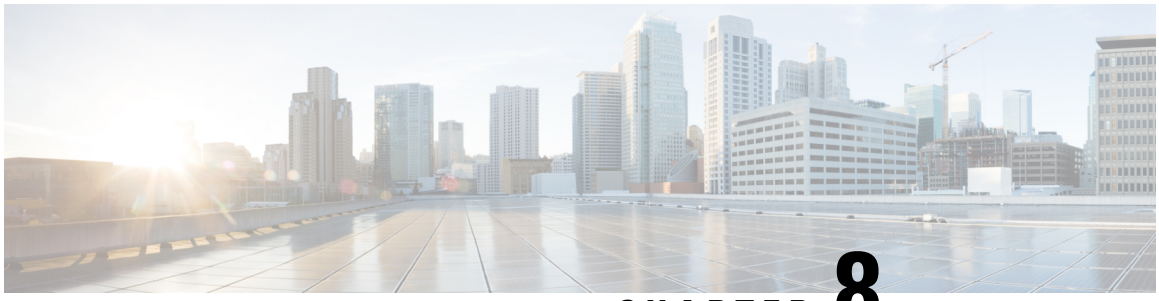
Table 4: Syntax Parameter and Description

Parameter	Description
importPackage(com.audium.server.cvpUtil)	This parameter imports the package to find the XPath values.
DateTimeUtil.isValidTime(String timeToValidate, String timeFormat)	This parameter verifies whether the time provided is a valid format.
String timeToValidate	This is the input time that is validated.

Parameter	Description
String timeFormat	This is the format in which the input time has to be provided.
return value	If the input date is in the valid format, the return value is 1. If the input date is not in the valid format, the return value is 0.

The following time formats are supported in JavaScript:

- hh:mm:ss -24 hour format
- hh:mm:ss am -12 hour format
- hh:mm:ss pm -12 hour format



CHAPTER 8

Web Service Integration

- SOAP Service, on page 121
- Rest Service, on page 121

SOAP Service

Web Services Element

Web services are a common way for any kind of application to communicate with externally hosted servers to retrieve information or send notification events in a standard manner. Voice applications that access a web service can use the *Web Services* element.

- **Web Services Element**—A special action element used to interface with a web service.

The Web Services element is an action element so it has the same features as the action element: it does not affect the call flow and has a single exit state. The Web Services element, however, has a more complex configuration than a standard action element. Call Studio renders this configuration with its own special interface.

One unique feature of the Web Services element is its ability to configure itself at design time. This is done by loading a Web Services Description Language (WSDL) file. A WSDL file is an XML file that defines the operations supported by the web services server. It is necessary in order to define the inputs required by the service that must be entered by the designer and the outputs returned by the service that can then be stored for use later in the application.

For much more detailed information about how to use the Web Services element, refer to the Call Studio online help.

Rest Service

Rest_Client Element

Cisco Unified Call Studio 11.x and above includes the Rest_Client element. The Rest_Client element provides a flexible interface in order to interact with REST endpoints. The communication between the REST client

and server is made completely secure using two-way Secure Sockets Layer (SSL). The Rest_Client element permits users to send GET, POST, PUT, or DELETE requests to application servers.

Ignore Certificate Validation

REST uses the boolean flag **Ignore Certificate Validation** to validate the certificate. The flag can be set to **`True`** or **`False`**. If the flag is set to **`False`**, the client checks for a valid server certificate in its keystore. If the certificate is not found, an error message appears.

The **Ignore Certificate Validation** flag checks for the availability of a valid certificate in the following key stores:

- Call Studio in debug mode: `C:\Cisco\CallStudio\eclipse\jre\lib\security\cacerts`
- Call Studio in VXML Server: `C:\Cisco\CVP\jre\lib\security\cacerts`

Note Before you validate, ensure that the required certificate is in the respective keystore.

Import Certificate in Call Studio for Debug Mode

Procedure

Step 1 Copy the REST server certificate file manually to the call studio machine.

Step 2 From the command prompt, navigate to `C:\Cisco\CallStudio\eclipse\jre\bin`.

Step 3 Run the following command to import the server certificate to the client keystore:

```
keytool.exe -importcert -file <path to REST server certificate> -keystore
c:\Cisco\CallStudio\eclipse\jre\lib\security\cacerts
```

Enter the keystore password. The default password is **changeit**.

The certificate is imported to the client keystore with the default alias name **mykey** and password **changeit**

Step 4 Run the following command to check whether the certificate is imported.

```
keytool.exe -list -keystore c:\Cisco\CallStudio\eclipse\jre\lib\security\cacerts.
```

Import Certificate in VXML Server

Procedure

Step 1 Copy the REST server certificate file manually to VXML server.

Step 2 From the command prompt, navigate to `%CVP_HOME%\jre\bin`.

Step 3 Run the following command to import the server certificate to the client keystore:

```
keytool.exe -importcert -trustcacerts -file <path to REST server certificate> -alias <unique alias name> -keystore %CVP_HOME%\jre\lib\security\cacerts
```

Enter the keystore password. The default password is **changeit**.

Step 4

Step 5 Run the following command to check whether the certificate is imported.

```
keytool.exe -list -keystore %CVP_HOME%\jre\lib\security\cacerts
```

Step 6 Restart the VXML Server after importing the certificate.

Create One-Way Communication Between VXML and REST Server

One-way secure communication imports the REST Server Certificate Authority (CA) certificate into the VXML server trust store, if CA is not available by default.

Perform the following steps to import the REST Server CA certificate into the VXML server:

Procedure

Step 1 Use the Java key tool to export the CA certificate from the REST Server.

Step 2 Copy the exported CA certificate file from the REST Server to the VXML Server.

For example: <RESTServer_ca_cert>

Step 3 From the command prompt, run the following command to import the REST Server CA certificate into the VXML truststore:

```
..\..\bin\keytool -importcert -keystore <path to the VXML Truststore> -alias <alias name> -file <Path to RESTServer_ca_cert>
```

File path to VXML truststore: `%CVP_HOME%\jre\lib\security\cacerts`. The default password is **`changeit`**.

Note
For a self- signed certificate, export the ca_cert from the REST Server and the self-signed certificate. Then, import this self-signed certificate in the VXML Server trust store.

Step 4 Open Windows Registry Editor (regedit) in the VXML Server and navigate to `HKEY_LOCAL_MACHINE\SOFTWARE\WOW6432Node\Apache Software Foundation\Procrun 2.0\VXMLServer\Parameters\Java\Options`.

Add the following entries:

- **Djavax.net.ssl.trustStore=<Path to RESTServer_ca_cert>**
- **Djavax.net.ssl.trustStorePassword=changeit**
- **Djavax.net.ssl.trustStoreType=JCEKS**

Step 5 Restart the Cisco Unified CVP VXML Server service running in VXML Server.

Note

Do not import a server certificate signed with a standard CA to the VXML Server trust store, as it contains standard CA details.

Create Two-Way Communication Between VXML and REST Server

Two-Way secure communication between VXML and REST Server involves importing the VXML Server CA certificate into the REST Server trust store.

Perform the following steps to import the VXML Server CA certificate on the REST Server:

Procedure

Step 1 Retrieve the keystore password from the security.properties file on the VXML Server. Filepath `%CVP_HOME%\conf\security.properties`

Step 2 Use the Java key tool to find the certificate and export the VXML Server CA certificate from the keystore.

File path to root: `%CVP_HOME%\conf\security\.ormKeystore`.

Use the list flag to check your keystore entries by running the following command:

```
%CVP_HOME%\jre\bin\keytool.exe -storetype JCEKS -keystore
%CVP_HOME%\conf\security\.ormKeystore -list
```

Run the following command to export the VXML Server certificate:

```
%CVP_HOME%\jre\bin\keytool.exe -export -v -keystore %CVP_HOME%\conf\security\.ormKeystore
-storetype JCEKS -alias vxml_root_certificate -file %CVP_HOME%\conf\security\<root>
```

Step 3 Copy the exported certificate file from the managed Cisco Unified CVP VXML Server to the REST Server.

Step 4 Use the following Java key tool command to import the certificate into the REST Server truststore

```
keytool -import -trustcacerts -keystore <Path to REST server Truststore> -alias <Alias_name>
vxml_root_certificate -file <path to VXMLca_cert_file >
```

Note

- For a self-signed certificate, export the ca_cert from the VXML Server and import the ca_cert to the REST Server truststore.
- For a VXML standard trusted CA, do not import the CA certificate on the REST Server truststore.

XPath Expression

Cisco Unified Call Studio includes a new utility that allows you to use XPath expressions in JavaScript to return values from the XML. You can specify an XPath expression in the element setting. If the REST response is an XML, then the nodes which are returned are available as element data. Based on the XML result from the GET method, you can add XPath expression to get the value of a specific row.

For example, consider the following XML you get when you query WSM SNMP public:

```
<?xml version="1.0" encoding="UTF-8" standalone="yes"?>
<results>
    <communities>
        <community>
            <name>Hello</name>
            <snmpversion>V1</snmpversion>
            <acceptfromanyhost>true</acceptfromanyhost>
            <accessprivilege>readWrite</accessprivilege>
            <servers>
                <server>IP address</server>
            </servers>
        </community>
    </communities>
    <pageinfo>
        <resultsPerPage>25</resultsPerPage>
        <startIndex>0</startIndex>
        <totalResults>1</totalResults>
    </pageinfo>
</results>
```

To get the value from one specific row, use the following XPath expression: **`/results/communities/community/snmpversion`**.

The output of the expression is **V1**.

If you use the following XPath expression:**`/results/communities/community/name`**.

The output of the expression is **Hello**.

JSONPath Expression

Cisco Unified Call Studio includes a new utility that allows you to specify a JSONPath expression in the element setting. The nodes which are returned are available as element data if the REST response is a JSON.

For example, consider the following REST response:

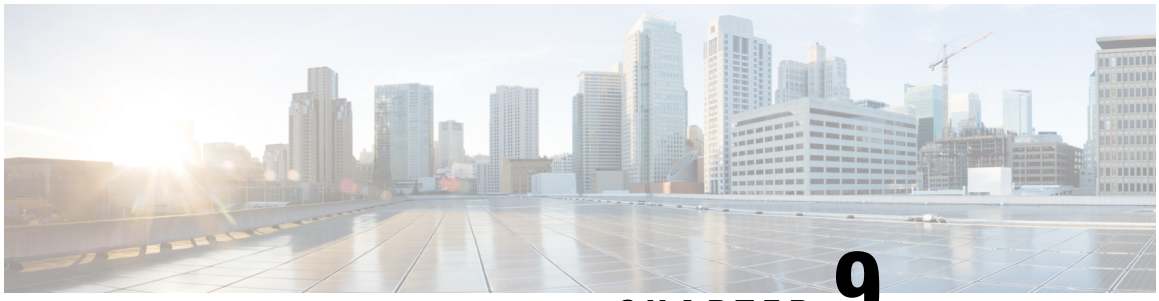
```
{"results": {
 "communities": {
  "community": {
   "name": "Hello",
   "snmpversion": "V1",
   "acceptfromanyhost": true,
   "accessprivilege": "readWrite",
   "servers": {
   "server": "IP address"}
   }
  },
"pageinfo": {
"resultsPerPage": 25,
"startIndex": 0,
"totalResults": 1
}
}
}
```

To get the value from one specific row, use the following XPath expression: **`$.results.communities.community.snmpversion`**

The output of the expression is **V1**.

If you use the following XPath expression: **`$.results.communities.community.name`**

The output of the expression is **Hello**.



CHAPTER 9

Standalone Application Builder

Generally a designer builds an application in Call Studio and then deploy to Call Services. Call Studio has the ability to deploy an application locally as well as to a remote system via FTP. Deploying an application becomes more difficult in an environment where many designers are working on a single application or when the enterprise follows a strict deployment policy to the runtime servers. In the first scenario, multiple designers are adding content to a source repository system and no single designer may have the full application in necessary to perform the deployment and even if possible, would require coordination among all designers involved. In the second scenario, the production environments do not allow direct access via FTP and require an automated system to place new content on to those environments, providing the flexibility to control exactly how and when the content is deployed. The desire is to extract the ability to create a Call Services application from the Call Studio project without requiring a person to launch Call Studio and deploy.

Universal Edition provides a tool to support this requirement named the Standalone Application Builder. It allows for the deployment of an application through a command-line interface. By exposing this as a command-line tool, an administrator can integrate this tool into any process that has the ability to run scripts. For example, the administrator can configure a crontab to launch this utility every day with the latest content checked into a source repository. Another example is to modify existing build and deploy Ant scripts to deploy the application once all other components such as elements, grammars, etc. are assembled.

This chapter explains what the Standalone Application Builder does and how to use it.

- Standalone Application Builder Introduction, on page 127
- Script Processing, on page 128
- Script Output, on page 128
- User Level Access Control for Call Studio, on page 129

Standalone Application Builder Introduction

The Standalone Application Builder is a utility that deploys a Call Studio application project to a format that is required by VXML Server. It is launched via a batch script named `buildApp.bat` located in the Call Studio root directory. There is no license required to use this utility.

When launched, the Standalone Application Builder first validates the Call Studio project to ensure it is a valid application, and if successful, deploys the VXML Server version of the application to the destination folder. If there are validation errors, those errors are displayed in the output similar to validation errors that are displayed in Call Studio. The tool only deploys a single application at a time. To deploy multiple applications, the script can be called repeatedly pointing to different projects.

Script Processing

The command-line usage of the Standalone Application Builder is as follows:

```
buildApp <project path> <deploy path> [-quiet <log file>] [-debug]
```

Where:

- **<project path>**—The directory in which the Call Studio project to convert resides. This path should point to the location where Call Studio is configured to store application projects. By default, this path is the `workspace` folder within the `eclipse` folder.
- **<deploy path>**—The directory to deploy the application to. If the Standalone Application Builder is installed on the same machine as VXML Server, you can pass the `applications` directory of *%CVP_HOME%\VXMLServer* so that the application is deployed directly to the VXML Server instance. To make the application live, you only need to call the `deployApp` VXML Server administration script.
- `-quiet <log file>` - An optional parameter that is designed to pipe the output the script usually produces into a text file whose name is passed as `<log file>`. This parameter is useful for scenarios where the Standalone Application Builder is run through from an automated system that does not display data printed to the console. By piping the data to a file, any results can be analyzed later.
- **-debug**—An optional parameter that produces additional output to use for debugging purposes should the deployment fail. This option should not be used unless directed to by customer support.

Script Output

The following is how the output of the Standalone Application Builder will look for a successful deployment:

```
Cisco Unified Call Studio 6.0 (Standalone Application Build Mode)
© 1999-2007 Cisco Systems, Inc.
All rights reserved. Cisco, the Cisco logo, Cisco Systems, and the Cisco Systems
logo are trademarks or registered trademarks of Cisco Systems, Inc. and/or its
affiliates in the United States and certain other countries.
Start: Tue Jan 1 11:47:56 EDT 2000
*** Loading project.
*** Validating project 'MyApp'.
*** Building project 'MyApp'.
*** Unloading project 'MyApp'.
*** Done.
End: Tue Jan 1 11:47:58 EDT 2000
```

The following is the output for a deployment that encounters validation errors:

```
Cisco Unified Call Studio 6.0 (Standalone Application Build Mode)
© 1999-2007 Cisco Systems, Inc.
All rights reserved. Cisco, the Cisco logo, Cisco Systems, and the Cisco Systems
logo are trademarks or registered trademarks of Cisco Systems, Inc. and/or its
affiliates in the United States and certain other countries.
Start: Tue Jan 1 11:47:56 EDT 2000
*** Loading project.
*** Validating project 'MyApp'.
Error: Project is not valid. Aborting. See details below:
[Start Of Call] Exit States Error: Please connect all the exit states for this element.
```

User Level Access Control for Call Studio

The administrator can set up access control for Call Studio application users by installing Call Studio in the Program Files directory, thereby preventing users from having write access. Users can then create a workspace in their user directory to access Call Studio.

Steps for the Administrator

Below are the steps to be done by an administrator to enable access control for users:

Procedure

Step 1 Install the Call Studio installer file (setup.exe).

Create the necessary folder structure and, during installation, change the default location from `C:\Cisco\CallStudio` to your desired folder location.

For example: `C:\Program Files\Cisco\CallStudio`.

Note
For users who have installed Call Studio in the `Program Files` folder after uninstalling it, go to the system Environment Variables. Identify and remove the path variable named `CS_USER_HOME`.

Step 2 After the installation is complete in the folder location, start Call Studio by running the `startStudio.cmd` file located in the `%CallStudio%` directory or by using the desktop shortcut.

Step 3 Create a shortcut for the `startStudioUser.cmd` file located in the `%CallStudio%` directory.

Ensure that the shortcut is available to users so they can launch the Call Studio directly.

Steps for the User

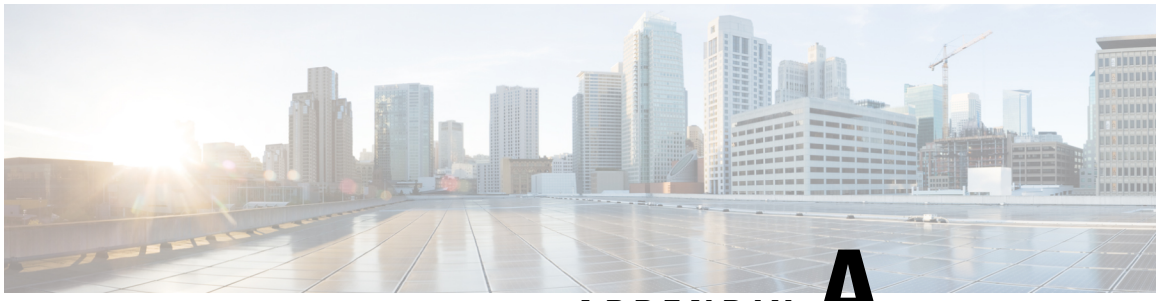
Below are the steps to be done by the user to launch Call Studio:

Procedure

Step 1 Launch Call Studio using the `startStudioUser.cmd` shortcut provided by the administrator, or directly launch the `startStudioUser.cmd` file from the `%CallStudio%` directory.

Step 2 Create your desired workspace folder (for example: `%user_directory%\Cisco\CallStudio\workspace`), and when you launch Call Studio, navigate and select this folder.

Step 3 To deploy CallStudio applications, change the default deployment location to a desired folder where the user has write privileges.



APPENDIX A

Substitution Tag Reference

The following table lists the contents of tags used for setting value substitution. To represent each of the data values, the tag is rendered with braces containing the tag content listed and is case sensitive. The fragments rendered **bold** represent values replaced by the application designer. Optional information is enclosed in brackets ([]).

Tag Content	Description
CallData.ANI	The ANI of the current call or NA if not sent.
CallData.DNIS	The DNIS of the current call or NA if not sent.
CallData.UUI	The UUI of the current call or NA if not sent.
CallData.IIDIGITS	The IIDIGITS of the current call or NA if not sent.
CallData.SOURCE	The name of the application that transferred to this one.
CallData.APP_NAME	The name of the current application.
CallData.DURATION	The duration, in seconds, of the call up to this point.
CallData.LANGUAGE	The language for the application, up to this point in the call.
CallData.ENCODING	The VoiceXML encoding for the application, up to this point in the call.
Data.Session.**VAR**	The value of Session Data where VAR represents the name of the session variable. The object stored there will be represented as a string.
Data.Element.**ELEMENT.VAR**	The value of Element Data where ELEMENT represents the name of the element and VAR represents the name of the element variable.
Data.Session.lastException.type	The type of the last exception occurred.
Data.Session.lastException.code	This is the exception code for the last exception occurred.
Data.Session.lastException.message	The message of the last exception.

Data.Session.lastException.custom_field1, custom_field2, and custom_field3	This is the user-defined fields of the last exception.
CallerActivity.NthElement.**N**	The name of a certain element visited in the call where N represents the number for the nth element.
CallerActivity.NthExitState.**N**	The name of a certain element's exit state visited in the call where N represents the number for the nth element.
CallerActivity.TimesElementVisited.**ELEMENT**	The number of times an element was visited in the call where ELEMENT represents the name of the element.
CallerActivity.imesElementVisitedExitState.**ELEMENT.EXIT_STATE**	The number of times an element was visited in the call with a particular exit state where ELEMENT is the name of the element and EXIT_STATE is the exit state.
GeneralDateTime.HourOfDay.CURRENT	The current hour.
GeneralDateTime.HourOfDay.CALL_START	The hour the call started.
GeneralDateTime.Minute.CURRENT	The current minute.
GeneralDateTime.Minute.CALL_START	The minute the call started.
GeneralDateTime.DayOfMonth.CURRENT	The current day of the month.
GeneralDateTime.DayOfMonth.CALL_START	The day of the month the call started.
GeneralDateTime.Month.CURRENT	The current month.
GeneralDateTime.Month.CALL_START	The month the call started.
GeneralDateTime.DayOfWeek.CURRENT	The current day of the week.
GeneralDateTime.DayOfWeek.CALL_START	The day of the week the call started.
GeneralDateTime.Year.CURRENT	The current year.
GeneralDateTime.Year.CALL_START	The year the call started.

The following tags will cause an error if the User Management System is inactive. Additionally, these tags relate to the current user and will cause an error unless the call is linked to a UID.

Tag	**Description**
UserInfo.Demographic.NAME	The name of the current user.
UserInfo.Demographic.ZIP_CODE	The zip code of the current user.
UserInfo.Demographic.BIRTHDAY	The birthday of the current user.
UserInfo.Demographic.GENDER	The gender of the current user.
UserInfo.Demographic.SSN	The social security number of the current user.
UserInfo.Demographic.COUNTRY	The country of the current user.

UserInfo.Demographic.LANGUAGE	The language of the current user.
UserInfo.Demographic.CUSTOM1	The contents of the first custom column of the current user.
UserInfo.Demographic.CUSTOM2	The contents of the second custom column of the current user.
UserInfo.Demographic.CUSTOM3	The contents of the third custom column of the current user.
UserInfo.Demographic.CUSTOM4	The contents of the fourth custom column of the current user.
UserInfo.AniInfo.FIRST	The first phone number associated with the current user's account.
UserInfo.AniInfo.NUM_DIFF	The total number of different phone numbers associated with the current user's account.
UserInfo.UserDateTime.HourOfDay. LAST_MODIFIED	The hour of the last time the current user's account was modified.
UserInfo.UserDateTime.HourOfDay. CREATION	The hour of the last time the current user's account was created.
UserInfo.UserDateTime.HourOfDay. LAST_CALL	The hour of the last time the current user called.
UserInfo.UserDateTime.Minute. LAST_MODIFIED	The minute of the last time the current user's account was modified.
UserInfo.UserDateTime.Minute.CREATION	The minute of the last time the current user's account was created.
UserInfo.UserDateTime.Minute. LAST_CALL	The minute of the last time the current user called.
UserInfo.UserDateTime.DayOfMonth. LAST_MODIFIED	The day of the month of the last time the current user's account was modified.
UserInfo.UserDateTime.DayOfMonth. CREATION	The day of the month of the last time the current user's account was created.
UserInfo.UserDateTime.DayOfMonth. LAST_CALL	The day of the month of the last time the current user called.
UserInfo.UserDateTime.Month. LAST_MODIFIED	The month of the last time the current user's account was modified.
UserInfo.UserDateTime.Month.CREATION	The month of the last time the current user's account was created.
UserInfo.UserDateTime.Month.LAST_CALL	The month of the last time the current user called.

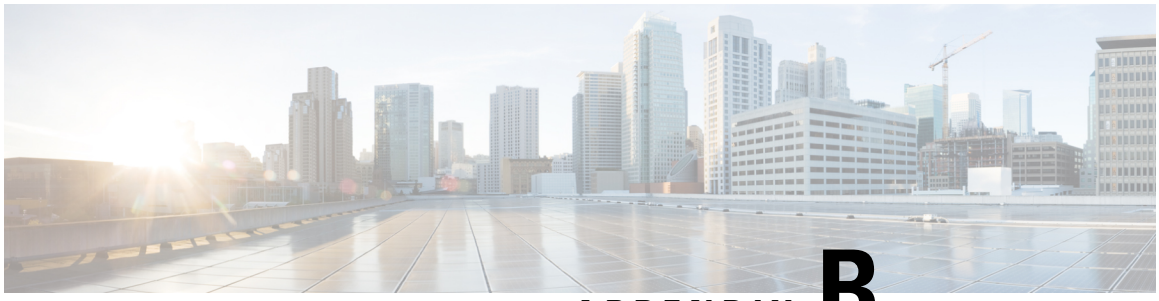
UserInfo.UserDateTime.DayOfWeek. LAST_MODIFIED	The day of the week of the last time the current user's account was modified.
UserInfo.UserDateTime.DayOfWeek. CREATION	The day of the week of the last time the current user's account was created.
UserInfo.UserDateTime.DayOfWeek. LAST_CALL	The day of the week of the last time the current user called.
UserInfo.UserDateTime.Year. LAST_MODIFIED	The year of the last time the current user's account was modified.
UserInfo.UserDateTime.Year.CREATION	The year of the last time the current user's account was created.
UserInfo.UserDateTime.Year.LAST_CALL	The year of the last time the current user called.
UserInfo.CalledFromAni	Is *true* if the current user has made calls from the current phone or *false* if not.
UserInfo.AccountInfo.PIN	The PIN number of the current user's account.
UserInfo.AccountInfo.ACCOUNT_NUMBER	The account number of the current user's account.
UserInfo.AccountInfo.EXTERNAL_UID	The external UID of the current user's account.

These tags relate to historical data. While still requiring the User Management System to be active, these do not require a user to be associated with the call. The fragments rendered **bold** represent values replaced by the application designer. Optional information is encapsulated in brackets ([]).

Tag Content	**Description**
GeneralAniInfo.AniDateTime.HourOfDay. LAST_CALL[.**ANI**]	The hour of the last time a call was received from the current phone number. Use ANI to get the last time a call was received from another number where ANI is the number.
GeneralAniInfo.AniDateTime.Minute. LAST_CALL[.**ANI**]	The minute of the last time a call was received from the current phone number or ANI if specified.
GeneralAniInfo.AniDateTime.DayOfMonth. LAST_CALL[.**ANI**]	The day of the month of the last time a call was received from the current phone number or ANI if specified.
GeneralAniInfo.AniDateTime.Month. LAST_CALL[.**ANI**]	The month of the last time a call was received from the current phone number or ANI if specified.
GeneralAniInfo.AniDateTime.DayOfWeek. LAST_CALL[.**ANI**]	The day of the week of the last time a call was received from the current phone number or ANI if specified.
GeneralAniInfo.AniDateTime.Year. LAST_CALL[.**ANI**]	The year of the last time a call was received from the current phone number or ANI if specified.
GeneralAniInfo.AniNumCalls[.**ANI**]	The number of calls received from the current phone number or ANI if specified.

- Each Date / Time tag evaluates to 0–23 when referring to the hour, 0-59 when referring to the minute, 1–12 when referring to the month, 1–31 when referring to the day of the month, 1–7 when referring to the day of the week (where 1 is Sunday), and the year is represented as a four-digit number.
- If any data represented by the tag ends up as null, substitution renders it as an empty string. For example, if a setting contained *source{CallData.SOURCE}* and there was no application that transferred to the current application, the setting would be evaluated as *source*. In this case, a warning appears in the Error Log for the application noting that a substitution value was null and was replaced with an empty string.

Substitution Tag Reference



APPENDIX B

Directory Structure

The directory in which the installation is made (referred to as the INSTALLATION_PATH directory) contains all the files necessary for the various components of Unified CVP software. The following table describes what each folder in the INSTALLATION_PATH is used for. Each folder is described in detail in subsequent sections.

Folder	Description
VXMLServer	This directory contains the files required for VXML Server to run, including all voice applications.
CallStudio	This directory contains Call Studio and Builder for Call Studio
UninstallerData	The application inside this folder is used to uninstall Unified CVP software.

The `%CVP_HOME%\VXMLServer` folder contains the following folders:

Folder	Description
admin	This directory holds the scripts that perform administrator functions affecting all applications on VXML Server.
admin/appScripts	This directory holds copies of the application-level administration scripts. If an application's administration scripts require refreshing, the contents of this folder can be copied to the `applications\[APPNAME]\admin` directory.
agent	SNMP agent related files.
applications	The voice applications built by Builder for Call Studio and hosted by VXML Server are stored here. Each application has its own folder bearing the name of the application.
applications / [APPNAME] / admin	This directory holds the scripts that perform administrator functions affecting only the application in which the scripts reside.
applications / [APPNAME] / data	This directory contains the application's static data files required for VXML Server to load the application.
applications / [APPNAME] / data / application	This directory contains the settings and call flow of the application as well as any configurations for application loggers.

applications / [APPNAME] / data / configurations	This directory holds the static voice, action, and decision element configurations created by Builder for Call Studio for this application. Depending on the size of the voice application, this directory may end up with many element configuration files.
applications / [APPNAME] / data / misc	This directory holds miscellaneous data files used by Unified CVP decision elements or other proprietary files used by the developer.
applications / [APPNAME] / java	This directory contains all Java related classes or JAR files required for this application only. No other application will have access to the Java classes in this directory.
applications / [APPNAME] / java / application	This directory contains all the classes used for this application only. Individual Java classes go in the `classes` directory while complete JAR files go in the `lib` directory.
applications / [APPNAME] / java / util	This directory contains utility classes used by the classes in the `application` directory. Any utility classes that refer to Unified CVP API classes must be deployed here or in the application directory. Individual Java classes go in the `classes` directory and JAR files go in the `lib` directory.
applications / [APPNAME] / logs	This directory contains the administrator, activity and error logs affiliated with this application. Logs are rotated daily so this directory may eventually contain many files.
common	This folder contains the Java classes and JAR files shared across all voice applications hosted on VXML Server. Individual Java classes go in the `classes` directory and JAR files go in the `lib` directory.
conf	This directory holds settings files used for VXML Server.
docs	This folder contains Javadocs and third-party licenses for components used by Unified CVP. Download Unified CVP documentation. After downloading, you can place the documentation in the `docs` folder.
dtds	The DTDs for all XML documents used throughout VXML Server are found here. Many are referred to in XML documents, though others are provided for reference.
gateways	This folder contains all the installed Gateway Adapters for VXML Server. Each subfolder in this directory contains a separate Gateway Adapter.
lib	The JAR files within this folder are necessary for administration scripts to run. They are also used by the developer to compile custom Java code that uses the Unified CVP API.
license	The VXML Server license files are to be placed here.
logs	Logs affiliated with VXML Server are placed here.
management	Files required to support the JMX administration interface are found here.

The `%CVP_HOME%\CallStudio` folder contains the following directories:

Folder	Description
eclipse	This directory holds all the required files for Call Studio and Builder for Call Studio.
eclipse\features	This folder contains descriptions of the installed features: Call Studio and Builder for Call Studio. Features consist of a set of plug-ins providing certain functionality.
eclipse\jre	This folder contains the JRE used by Call Studio.
eclipse\plugins	This directory contains a set of plug-ins defining the functionality of Call Studio.
eclipse\workspace	The voice applications built by Builder for Call Studio are stored here. Each application has its own folder bearing the name of the application.
eclipse\workspace\.metadata	A Call Studio internal system folder containing configuration and settings files.
eclipse\workspace\ [PROJECT NAME]\callflow	This directory contains the configuration files for the given voice application. Those files are used by Builder for Call Studio to properly render the call flow.
eclipse\workspace\ [PROJECT NAME]\deploy	This folder holds all the resources that will be deployed along with the given application. It can contain such components as custom Java classes and libraries as well as custom data files.

INDEX

A

Administration Scripts 58, 60–61, 68, 70, 73, 75
  adding applications 73
  application and system status info 60
  get basic VXML Server info 61
  oveview 58
  removing applications 73
  suspending applications 70
  update "common" classes, includes cautions 75
  updating applications 68
administrator log access 77
Application Development 60, 67, 70, 75, 137
  application status info types 60
  configuration options, JMX Interface 67
  directory structures 137
  get and set global and application data 75
  play "suspended" message during VXML Server restart 70
  update "common" classes, cautions 75
averageCallDuration 78
avgConcurrentCallsInLast 78
avgReqRespTimeInList 78

C

callAbandonRate 78
callCompleteRate 78
callTransferRate 78

D

Data 75
  get and set global and application data 75
DefautAudioPat, app config options defined 67
directory structure details 137

E

Examples 61
  VXML Server status checks 61

F

failedCallsSinceStart 78

G

GatewayAdapter, app config options defined 67
getApplicationData 75
getGlobalData 75

J

JMX Interface 57, 60–61, 64, 67–68, 70, 73, 75, 77
  adding applications 73
  admin log access 77
  application and system status info 60
  application config options 67
  basic VXML Server info, obtain 61
  overview 57
  removing applications 73
  suspending applications 70
  update "common" classes, includes cautions 75
  updating applications 68
  VXML Server runtime config options 64

L

LoggerEventQueueSize, described 65
LoggerMaximumThreadPoolSize, described 65
LoggerMinimumThreadPoolSize, described 65
Loggers 65, 77
  admin log access 77
  runtime option JMX attributes 65
LoggerThreadKeepAliveTime, described 65
Logging 65
  tuning VXML Server runtime attributes 65

M

maxConcurrentCallsInLast 78
maxLoggerEventQueueSizeInLast 78
maxLoggerThreadCountInLast 78
maxReqRespTimeInLast 78

R

removeAllApplicationData 75
removeAllGlobalData 75

removeApplicationData 75
removeGlobalData 75

S

scripts, 58
SessionInvalidationDelay, described 65
SessionTimeout, app config options defined 67
setApplicationData 75
setGlobalData 75
system information page 59, 61
system status info types for VXML Server 60

T

Tags 131
    tables of tag contents for value substitutions 131
timeoutCallsInLast 78
timeoutCallsSinceStart 78
totalCallsSinceStart 78

V

VXML Server 57–61, 64–65, 68, 70, 73, 75, 77–78, 113
    adding applications 73
VXML Server *(continued)*
    admin log access 77
    administration scripts, overview 58
    administration, three methods 57
    altering config at runtime, discussion and warnings 64
    application and system status info 60
    configuration options at runtime, described 65
    configuration overview 113
    configuration, altering during runtime, warnings 64
    get/set global and application data 75
    getting basic information about 61
    graceful admin activity 68
    JMX mgmt overview 57
    logging, tuning runtime attributes 65
    metrics listed with VXML functions 78
    obtaining server metrics 78
    reference to admin functions, table 77
    removing applications 73
    status checks 61
    suspending applications 70
    suspending apps, prerequsite 70
    system information page 59, 61
    update "common" classes, includes cautions 75
    updating applications 68
    ways to play "suspended" message during restart 70