Building Your Custom CTI Application

System Requirements for Building Custom Applications

Use the following development tools for building custom applications:

Development Tool	Version
Microsoft Visual Studio	2015
.NET Framework	4.7.1
Java	1.8 Update 161

Environment Set Up for .NET

The Cisco CTI OS Toolkit introduces support for application development using Microsoft Visual Studio and .NET framework. You need not modify the existing .NET framework controls to run .NET CLR. Cisco CTI OS Toolkit provides a native .NET class library (.NET CIL) and runtime callable wrappers (RCWs) for COM CIL and the CTI OS ActiveX controls. The CTI OS Toolkit consists of a set of production ready desktops and five software development kits.

The setup program installs the .NET CIL and the RCWs in the Global Assembly Cache (GAC) making all the components available to the sample included in the toolkit and any new application in development. Use the CTI OS toolkit for environment settings for building .NET applications. Additional configuration steps are available for integration with the development environment.

The Production Ready Contact Center Desktop applications are the CTI OS Toolkit Agent Desktop, CTI OS Toolkit IPCC Supervisor Desktop, the CTI OS Toolkit Outbound Option Desktop, and the default client desktops for Cisco CTI OS used by call center agents and supervisors. These desktop applications are built using the COM CIL and the CTI OS ActiveX controls. These applications are implemented using Visual Basic .NET (VB.NET) and Microsoft Visual Studio.

Microsoft Visual Studio

Microsoft Visual Studio 2015 offers a wider spectrum of development possibilities and an advanced design experience. In addition to Service Pack 3 it also provides:

- Microsoft .NET Framework 4.7.1 application development
- New processor support (for example, Core Duo) for code generation and profiling
- Additional support for project file based Web applications
- Secure C++ application development

To access the .NET CIL and the RCWs directly from Visual Studio, add the following configuration to your environment.

Add CTI OS Toolkit Components to Add Reference Dialog Box

In Microsoft Visual Studio, you can select class libraries and assemblies from the .NET tab of the **Add Reference** dialog box. This facilitates the development process and ensures you can always use the correct version of the components.

To enable the .NET CIL class libraries to appear on the **Add References** dialog box, follow the steps described in https://msdn.microsoft.com/en-us/library/wkze6zky(v=VS.100).aspx.

Set a registry key that specifies the location of assemblies to appear.

To do this, add one of the following registry keys, where <*AssemblyLocation*> is the directory of the assemblies that you want to appear in the **Add Reference** dialog box:

```
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\.NETFramework\<version>\AssemblyFoldersEx\MyAss
emblies]@="<AssemblyLocation>"
```

```
[HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\.NETFramework\<version>\AssemblyFoldersEx\MyAss
emblies]@="<AssemblyLocation>"
```

Creating the registry key under the HKEY_LOCAL_MACHINE node allows all users to see the assemblies in the specified location in the Add Reference dialog box. Creating the registry key under the HKEY_CURRENT_USER node affects only the setting for the current user.

For example, if you want to add:

- Cisco .NET CIL to the **Add Reference** dialog box

  ```
  [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\.NETFramework\<version>\AssemblyFoldersEx\MyAss
  emblies]@="<AssemblyLocation>"
  ```

- Cisco CTI OS RCWs to the **Add Reference** dialog box

  ```
  [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\.NETFramework\v2.0.50727\AssemblyFoldersEx\Cisc
  oCtiOsRCWs]@="C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32
  CIL\.NETInterops"
  ```

Add Cisco CTI OS ActiveX Controls to Toolbox

The Microsoft Visual Studio IDE allows visual editing of Windows Forms based applications using the toolbox of available visual components. Because Windows Forms applications are native, the visual components are also native. You can still use ActiveX controls and include them in the toolbox.

Adding CTI OS ActiveX controls to the toolbox provides pre-packaged CTI functionality such as Agent Login, Make Call, Transfer Call, Barge In, and so on. The ActiveX controls use COM CIL as the API to provide call center and telephony services. These components are used in rapid software development. You can drag and drop selected components into your project and immediately gain the selected CTI functionality. These components are used in development environments such as: Microsoft Visual Studio, .Net Framework, and Java.

To use the Cisco CTI OS ActiveX controls in Microsoft Visual Studio, you must configure the Cisco CTI OS RCWs:

Procedure

Step 1 From Visual Studio's View menu, choose **Add/Remove Toolbox Items**.

Step 2 From the **Customize Toolbox** dialog box, select the **.NET Framework Components** tab.

Warning If you click the COM Components tab from the Customize Toolbox dialog box or select the CTI OS ActiveX controls, you cause Microsoft Visual Studio to automatically generate a set of private RCWs that are not optimized and approved by Cisco, which can result in application failure.

Step 3 From the list, select the CTI OS RCW that corresponds to the CTI OS ActiveX Control you want to add to the toolbox. For example, for the Agent State Control select **AxAgentStateCtl**.

Step 4 To add more CTI OS ActiveX controls, repeat steps 1 to 3.

Integration Between Your Application and CTI OS via CIL

Creating an integration between your application and CTI OS via the CIL is straightforward. The first step is to articulate the desired behavior, and to create a complete design specification for the integration.

Integration Planning and Design

Good design depends on understanding how CTI fits into your application and workflow. Your requirements analysis and design process should address the following points, as they relate to your specific application:

- **Start with the call flow**. What kind of call processing is done before calls are targeted for a specific skill? Determine how you collect CTI data from the caller before the call arrives at an agent.
- **Study agent workflow**. What are the points where CTI can make the workflow easier and faster? Build a business case for the CTI integration.
- **Evaluate what CTI will do for your application**. A good approach is to make a list based on the priority (for example, screen pop, then call control) and then design and implement features in that order.
- **Design how CTI should work within your application**. What are the interaction points? Get specifications as to which screens interact, and which data values should be sent between your application and the CTI OS platform.
- **Determine when the application should connect to the CTI OS Server**. Some applications are server-type integrations that connect at startup, specify a *monitor-mode event filter*, and stay connected permanently. Agent-mode applications connect up when a specific agent begins the work shift.
- **Clean up when you are done**. When and how does the application stop? Some applications stay up and running permanently, while others have a defined runtime, such as agent workday or shift. For server-type applications without a specified stopping point, create an object lifetime model and procedure for recovering no-longer-used resources. For applications with a specific stopping point, determine the kind of clean up that needs to be done when the application closes (for example, disconnect from server, release resources).

Language and Interface

The CTI OS Client Interface Library API comes in programming languages, each with benefits and costs. The choice of interface is important to direct you through this developers guide, because this guide addresses the CIL API for the C++ and COM programming environments.

The main decision point in choosing which API to use depends on your workstation operating system, your existing applications, and the language skills of your developers.

- **ActiveX Controls**. The CTI OS ActiveX controls are the appropriate choice for creating a rapid drag and drop integration of CTI and third-party call control with an existing desktop application. The CTI OS ActiveX controls are an appropriate choice for developing a CTI integration with any fully ActiveX-compliant container, or any other container that fully supports ActiveX features (for example, Powerbuilder, Delphi, and many third-party CRM packages). The ActiveX controls are the easiest to implement in graphical environments, and help achieve the fastest integrations by providing a complete user interface. All CTI OS ActiveX components are distributed via dynamic link library files (.dll), which you only have to register once to work on any Microsoft Windows platform. These components are not appropriate for non-Windows environments. You can use the CTI OS ActiveX controls in Windows Forms .NET applications only if the Runtime Callable Wrappers (RCWs) provided with the CTI OS Toolkit are a part of the project. For more information, see CTI OS ActiveX Controls, on page 7.
- **COM**. The CTI OS Client Interface Library for Microsoft's Component Object Model (COM) is the appropriate choice for developing a CTI integration with any COM-compliant container, or any other container that supports COM features, such as Microsoft Internet Explorer or Visual Basic for Applications scripting languages. The COM CIL is the easiest to implement in scripting environments, and helps

achieve the fastest integrations requiring a custom or non-graphical user interface. All CTI OS components are distributed via dynamic link library files (.dll), which you only have to register once to work on any Microsoft Windows platform. These components are not appropriate for non-Windows environments. You can use the COM CIL in Windows Forms .NET applications only if the Runtime Callable Wrappers (RCWs) provided with the CTI OS Toolkit are a part of the project. For more information, see Hook for Screenpops, on page 9.

- **C++**. The CTI OS Client Interface Library for C++ is the appropriate choice for building a high-performance application running on a Windows platform in a C++ development environment. The C++ CIL is distributed as a set of header files (.h) that specify the class interfaces to use and statically linked libraries (.lib) that contain the compiled implementation code.
- **Java**. The CTI OS Java Client Interface Library (Java CIL) is an appropriate choice for non-Microsoft (typically UNIX) operating systems, as well as for browser based applications.
- **.NET Cil class libraries**. This section covers the steps required to reference the .NET CIL components in a C# and Visual Basic .NET project files.

CTI Application Testing

Testing is often characterized as the most time-consuming part of any application development process.

Test Plan Development

Testing CTI applications requires a detailed test plan, specific to the business requirements set forth in the requirements gathering phase of the project. The test plan should list behaviors (test cases) and set requirements to prove that each test case is successfully accomplished. If a test case fails, it should be investigated and corrected (if appropriate) before proceeding to the next phase of testing.

Perform (at minimum) the following test phases:

- **Unit Testing**. In a unit test, you ensure that the new code units can execute properly. Each component operates correctly based on the input, and produces the correct output. An example of a unit test is to stub-in or hardcode the expected screen-pop data and ensure that all the screens come up properly based on this data.
- **Integration Testing**. In an integration test, you ensure that the new components work together properly. The physical connections and data passing between the layers and servers involved in the system are tested. An example of an integration test is testing your client application with the CTI OS server, to ensure that you can pass data correctly through the components.
- **System Testing**. In a system test, you ensure that the correct application behavior is exhibited. An example of a system test is to make a phone call to a VRU, collect the appropriate caller information, transfer the call to an agent, and ensure that the screen pop arrives correctly.
- **User Acceptance Testing**. In a user acceptance test, you ensure that your application has met all business requirements set by your analysis and design process. An example of a user acceptance test is to try your new application with real agents and ensure that it satisfies their requirements.

Test Environment

The CTI OS Software Development Toolkit (SDK) CD media includes a *CTIServerSimulator* that you can use for application development and demonstration purposes. It can roughly simulate a Lucent PBX/ACD or a Cisco Unified Contact Center environment. Documentation on how to configure and use the simulator is available in the Tools\Simulator directory.

Note This simulator is appropriate *only* for preliminary testing of client applications. Because it does not fully replicate the behavior of the actual switch environment, you should not use the simulator for any type of QA testing. To ensure proper design conformance and ensure the correctness of the application, you ***must*** test the CTI application with the actual telephony environment in which it will run. This enables the event flow and third-party control components, which are driven by the switch- and implementation-specific call flow, to be properly and thoroughly tested.

Developer Sample Applications

The CTI OS Software Development Toolkit (SDK) is distributed with a rich set of Developer Sample Applications (DSAs) for Cisco Unified CCE customers and similar Production Class Applications for Unified ICM customers.

The DSAs are provided as tools for Unified CCE customers to accelerate development efforts. The DSAs demonstrate several basic working applications that use varying implementations of the CTI OS Client Interface Library API. The samples are organized by programming language and demonstrate the syntax and usage of the API. For many developers, these DSAs form the foundation of your custom application. The samples are available for you to customize and distribute as a part of your finished product.

For Unified ICM ACD types (such as Avaya, Aspect, and so on), you can deploy some DSAs as Production Class Applications. Cisco certifies and supports the out-of-the-box CTI OS Agent Desktop application in a production environment when used in conjunction with a supported Unified ICM ACD. Refer to the ACD Supplement, Cisco Unified Intelligent Contact Management (Unified ICM)ACD PG Supportability Matrices for the current list of supported ACD types.

For Unified CCE, these same DSAs are generally not intended for production use "as-is". They are neither certified nor supported by Cisco as working out-of-the-box applications.

The following table lists the sample programs in the CTI OS Toolkit.

Table 1: CTI OS Toolkit Sample Programs

Program Name	Location	Description
CTI Toolkit Outbound Desktop	CTIOS Toolkit\Win32 CIL\Samples\CTI Toolkit Outbound Desktop	A softphone application that demonstrates Outbound Option (formerly Blended Agent) functionality.
All Agents Sample .NET	CTIOS Toolkit\dotNet CIL\Samples\All Agents Sample.NET	A Microsoft C# program demonstrating a monitor mode application. This program lists all agents in a grid along with current state updates.

Program Name	Location	Description
All Calls Sample.NET	CTIOS Toolkit\dotNet CIL\Samples\All Calls Sample.NET	Similar to AllAgents but lists calls instead of agents.
CTI Toolkit Combo Desktop.NET	CTIOS Toolkit\dotNet CIL\Samples\CTI Toolkit Combo Desktop.NET	A Microsoft C# program that interfaces to CTI OS via the .NET CIL interface. The program demonstrates how to build a multi-functional contact center desktop that contains Agent, Supervisor and Outbound Option features.
CtiOs Data Grid.NET	CTIOS Toolkit\dotNet CIL\Samples\CtiOs Data Grid.NET	Microsoft C# program that implements a Tabular Grid used by the CTI Toolkit Combo Desktop.NET to show calls and statistics.
CTI Toolkit Agent Desktop	CTTIOS Toolkit\Win32 CIL\Samples\CTI Toolkit AgentDesktop	A Visual Basic .NET program using the CTI OS ActiveX controls. The application is the source code used by the out of the box CTI Toolkit Agent Desktop.
CTI Toolkit Supervisor Desktop	CTTIOS Toolkit\Win32 CIL\Samples\CTI Toolkit SupervisorDesktop	A Visual Basic .NET program using the CTI OS ActiveX controls. The application is the source code used by the out of the box CTI Toolkit Supervisor Desktop.
C++Phone	CTIOS Toolkit\Win32 CIL\Samples\CTI Toolkit C++Phone	A softphone written in C++ linking to the static C++ libraries. Sending requests and event handling as well as the use of the wait object is demonstrated.
JavaPhone	CTIOS Toolkit\Java CIL samples	A Java counterpart to the C++phone sample programs.
AllAgents	CTIOS Toolkit\Java CILsamples	A Java counterpart to the Visual Basic all agents program.

CTI OS ActiveX Controls

This section discusses the steps involved in building CTI OS Applications with Microsoft Visual Basic .NET (VB.NET) using the CTI OS ActiveX controls.

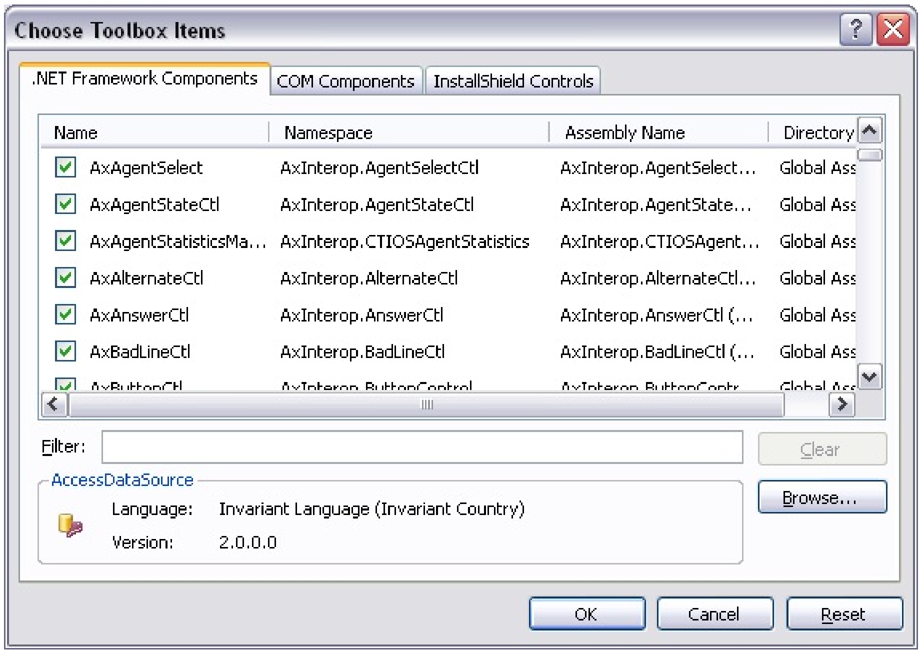
Build Simple Softphone with ActiveX Controls

To use the CTI OS ActiveX controls, you must copy the ActiveX controls on the target system and register with Windows. You accomplish this with the CTI OS toolkit install, as well as the CTI OS Agent and Supervisor installs. For more information, see Deployment of Custom CTI OS Applications, on page 64.

After you launch Visual Basic .NET, you can use the ActiveX controls by selecting them via the Customized Toolbox dialog (**Tools** > **Add/Remove Toolbox Items** via the menu).

Note Note: If the CTI OS ActiveX controls are not listed as shown in the following figure the files are either not copied on the target system or the controls were not properly registered.

Figure 1: Customize Toolbox in Visual Basic .Net Listing CTI OS ActiveX Controls Runtime Callable Wrappers

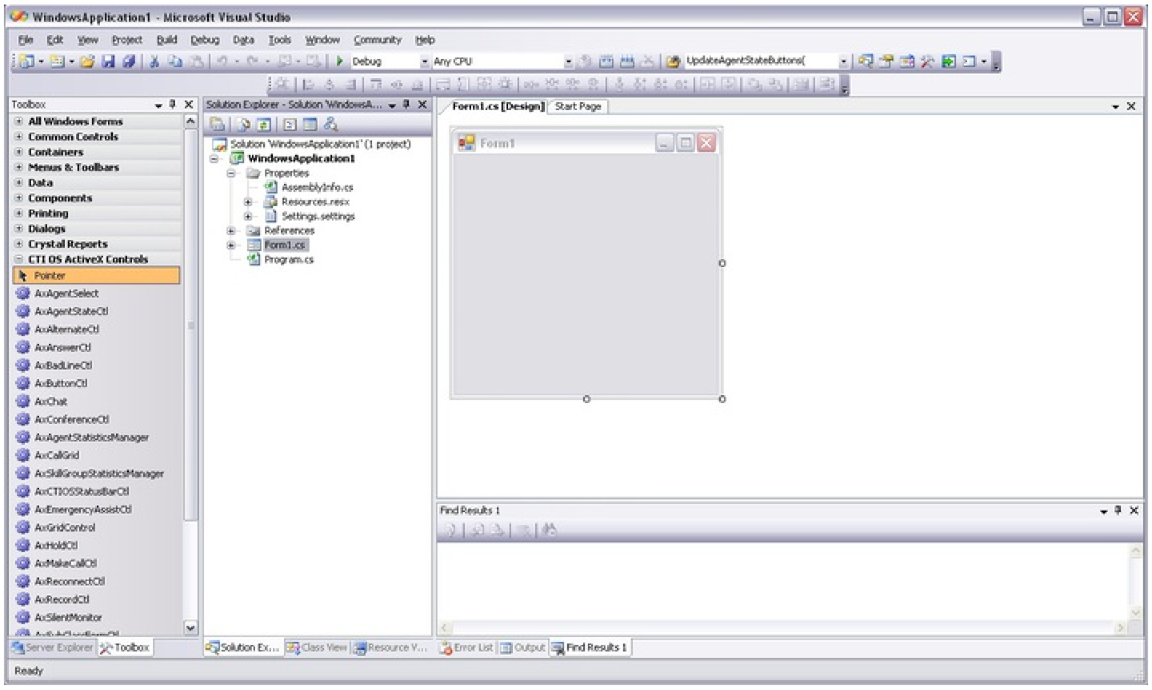


Name	Namespace	Assembly Name	Directory
✓ AxAgentSelect	AxInterop.AgentSelectCtl	AxInterop.AgentSelect...	Global Ass
✓ AxAgentStateCtl	AxInterop.AgentStateCtl	AxInterop.AgentState...	Global Ass
✓ AxAgentStatisticsMa...	AxInterop.CTIOSAgentStatistics	AxInterop.CTIOSAgent...	Global Ass
✓ AxAlternateCtl	AxInterop.AlternateCtl	AxInterop.AlternateCtl...	Global Ass
✓ AxAnswerCtl	AxInterop.AnswerCtl	AxInterop.AnswerCtl (...	Global Ass
✓ AxBadLineCtl	AxInterop.BadLineCtl	AxInterop.BadLineCtl (...	Global Ass
✓ AxButtonCtl	AxInterop.ButtonControl	AxInterop.ButtonContr...	Global Ass

AccessDataSource
Language: Invariant Language (Invariant Country)
Version: 2.0.0.0

After you select the CTI OS ActiveX controls in the **.NET Framework Components** tab, you should see them in the Visual Basic .NET ToolBox. You can now drag and drop the CTI OS ActiveX RCWs components onto the Windows Form. For a softphone application, it is useful to start with the CallAppearanceCtl (see the following figure).

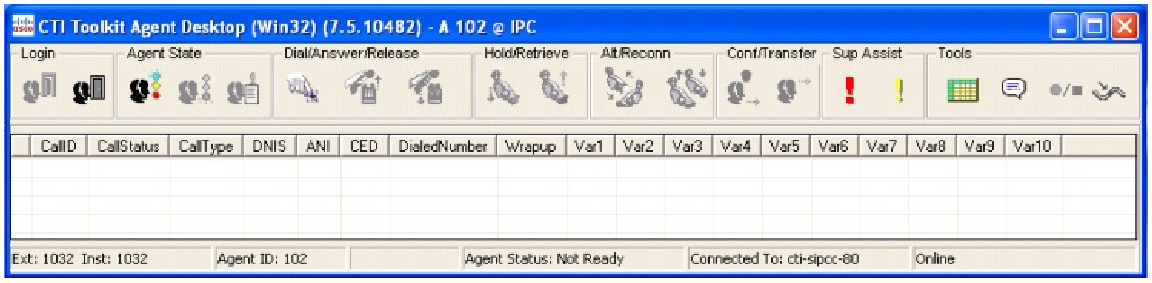
Figure 2: Microsoft Visual Basic .NET Screen with the CTI OS ActiveX Controls



On the very left, the Toolbox is visible showing some of the CTI OS ActiveX RCWs icons. On the form, the AxCallGrid has been dragged and dropped.

For a complete description of the ActiveX controls see CTI OS ActiveX Controls. The following figure shows the CTI OS Toolkit Agent Desktop application, which is also included as a sample on the CTI OS CD.

Figure 3: CTI OS Toolkit Agent Desktop (See CD) Built with CTI OS ActiveX Controls



CallID	CallStatus	CallType	DNIS	ANI	CED	DialedNumber	Wrapup	Var1	Var2	Var3	Var4	Var5	Var6	Var7	Var8	Var9	Var10

Ext: 1032 Inst: 1032 | Agent ID: 102 | Agent Status: Not Ready | Connected To: cti-sipcc-80 | Online

Once all ActiveX controls are placed on the phone, you can create an executable in Visual Basic .NET via **Build** > **Build Solution** or selecting <F7>.

Hook for Screenpops

This agent desktop application did not require any Visual Basic .NET coding. You can choose to add some custom code to add a hook for screenpops. For example, you may want to retrieve CallVariables, which are passed along with certain call events.

CTI OS SessionResolver

A CTI OS Client application connects to CTI OS with a Session object (see Session Object). Depending on the application, a client can use one or more Session objects. For most agent desktop applications, however, it is useful to employ only a single Session object.

If you choose to write a program not using ActiveX controls, you can create a Session object and use it directly (see CTI Toolkit AgentDesktop at the Win32 CIL samples).

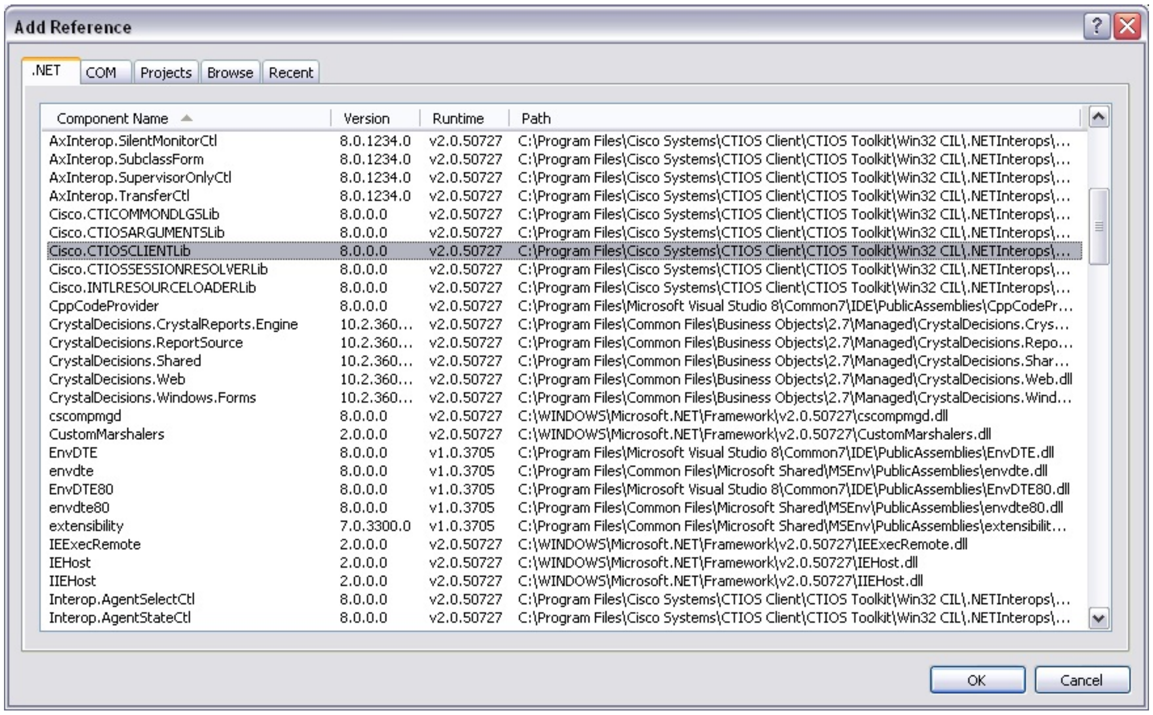
However, in the case of an application built with the ActiveX controls, all ActiveX controls must use the same session object. The ActiveX controls accomplish this by retrieving a pointer to the same session object via the SessionResolver. The program hosting the ActiveX can obtain the Same session object by using the SessionResolver.GetSession method to retrieve a session named “”.

VB .NET Code Sample to Retrieve Common Session

The following sample VB .NET code retrieves the common session and listens for a CallEstablishedEvent occurring in that session. If a CallEstablishedEvent occurs, it retrieves CallVariable 1 and puts it in the Windows Clipboard (from where you can retrieve it via CTRL-v or used by other applications).

This code uses the COM CIL Interfaces and therefore, needs the following references: Cisco.CTIOSCLIENTLib, Cisco.CTIOSARGUMENTSLib, Cisco.CTIOSSESSIONRESOLVERLib. The references are shown in the following figure (in Visual Basic .NET, select **Project** > **Add Reference**...).

Figure 4: CTI OS COM CIL RCWs References Needed for Visual Basic .NET COM Programming



Component Name	Version	Runtime	Path
AxInterop.SilentMonitorCtl	8.0.1234.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
AxInterop.SubclassForm	8.0.1234.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
AxInterop.SupervisorOnlyCtl	8.0.1234.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
AxInterop.TransferCtl	8.0.1234.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
Cisco.CTICOMMONDLGSLib	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
Cisco.CTIOSARGUMENTSLib	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
Cisco.CTIOSCLIENTLib	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
Cisco.CTIOSSESSIONRESOLVERLib	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
Cisco.INTLRESOURCELOADERLib	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
CppCodeProvider	8.0.0.0	v2.0.50727	C:\Program Files\Microsoft Visual Studio 8\Common7\IDE\PublicAssemblies\CppCodePr...
CrystalDecisions.CrystalReports.Engine	10.2.360...	v2.0.50727	C:\Program Files\Common Files\Business Objects\2.7\Managed\CrystalDecisions.Crys...
CrystalDecisions.ReportSource	10.2.360...	v2.0.50727	C:\Program Files\Common Files\Business Objects\2.7\Managed\CrystalDecisions.Repo...
CrystalDecisions.Shared	10.2.360...	v2.0.50727	C:\Program Files\Common Files\Business Objects\2.7\Managed\CrystalDecisions.Shar...
CrystalDecisions.Web	10.2.360...	v2.0.50727	C:\Program Files\Common Files\Business Objects\2.7\Managed\CrystalDecisions.Web.dll
CrystalDecisions.Windows.Forms	10.2.360...	v2.0.50727	C:\Program Files\Common Files\Business Objects\2.7\Managed\CrystalDecisions.Wind...
cscompmgd	8.0.0.0	v2.0.50727	C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\cscompmgd.dll
CustomMarshalers	2.0.0.0	v2.0.50727	C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\CustomMarshalers.dll
EnvDTE	8.0.0.0	v1.0.3705	C:\Program Files\Microsoft Visual Studio 8\Common7\IDE\PublicAssemblies\EnvDTE.dll
envdte	8.0.0.0	v1.0.3705	C:\Program Files\Common Files\Microsoft Shared\MSEnv\PublicAssemblies\envdte.dll
EnvDTE80	8.0.0.0	v1.0.3705	C:\Program Files\Microsoft Visual Studio 8\Common7\IDE\PublicAssemblies\EnvDTE80.dll
envdte80	8.0.0.0	v1.0.3705	C:\Program Files\Common Files\Microsoft Shared\MSEnv\PublicAssemblies\envdte80.dll
extensibility	7.0.3300.0	v1.0.3705	C:\Program Files\Common Files\Microsoft Shared\MSEnv\PublicAssemblies\extensibilit...
IEExecRemote	2.0.0.0	v2.0.50727	C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\IEExecRemote.dll
IEHost	2.0.0.0	v2.0.50727	C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\IEHost.dll
IIEHost	2.0.0.0	v2.0.50727	C:\WINDOWS\Microsoft.NET\Framework\v2.0.50727\IIEHost.dll
Interop.AgentSelectCtl	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...
Interop.AgentStateCtl	8.0.0.0	v2.0.50727	C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\Win32 CIL\.NETInterops\...

```
' VB sample for a simple CTIOS phone
' needs references to Cisco.CTIOSCLIENTLib
Cisco.CTIOSSESSIONRESOLVERLib and Cisco.CTIOSARGUMENTSLib
'
' dim CTIOS session interface
' the session interface handles connect, setagent and others
```

```
Dim WithEvents m_session As Cisco.CTIOSCLIENTLib.Session

' the sessionresolver is needed to retrieve the session pointer
Dim m_sessionresolver As Cisco.CTIOSSESSIONRESOLVERLib.SessionResolver

Private Sub Form_Initialize_Renamed()
    ' instantiate the sessionresolver
    Set m_sessionresolver = New Cisco.CTIOSSESSIONRESOLVERLib.SessionResolver

    ' CTI OS ActiveX controls use the session named "" - blank
    ' since the CTI OS ActiveX controls do the connection and login,
    ' all we do is listen for events
    Set m_session = m_sessionresolver.GetSession("")
End Sub

Private Sub Form_Terminate_Renamed()
    Call m_sessionresolver.RemoveSession("")
End Sub

Private Sub m_Session_OnCallEstablished(ByVal pIArguments
As Cisco.CTIOSCLIENTLib.Arguments)
' Handles m_Session.OnCallEstablished
    GetCallVariable1 pIArguments
End Sub

Function GetCallVariable1(ByVal pIArguments As CTIOSCLIENTLib.IArguments)

    Dim m_uid As String
    m_uid = pIArguments.GetValueString("Uniqueobjectid")
    Dim m_call As Cisco.CTIOSCLIENTLib.Call
    Set m_call = m_session.GetObjectFromObjectID(m_uid)

    ' retrieve callvar1
    Dim m_callvar1 As String
    m_callvar1 = m_call.GetValueString("Callvariable1")

    'copy call variable1 to the clipboard
    Clipboard.SetText m_callvar1
End Function
```

Note Visual Basic 6.0 is no longer supported.

COM CIL. in Visual Studio

COM CIL.

Use this API in development environments that support COM/DCOM and OLE Automation. Examples: Microsoft Visual Studio, Borland Delphi, Power Builder, etc. COM CIL is an adaptor interface that uses C++ CIL as kernel. The API is deployed as a group of Dynamic Linked Libraries (DLLs).

Note **You must use Microsoft Visual Studio to build C++ applications using COM CIL. Applications using COM CIL built with Visual C++ 8.0(1) are not supported.**

For building a custom Win32 (Console or Windows) CTI application in Microsoft Visual Studio with COM, you must create COM components in Microsoft Visual Studio.

Client applications of this type are more complex to build, and more powerful and faster in execution, than scripting clients (for example, Visual Basic). CIL components for COM are distributed as COM Dynamic Link Libraries (COM DLL).

COM components must be registered with Windows to be accessible to COM containers including Micsosoft Visual Studio. The components required for programming in Microsoft Visual Studio are:

- **CTI OS Client library** (CTIOSClient.dll). This is the main CIL library for COM. The objects available in this library are described in Chapters 8 through 11.
- **CTI OS Arguments Library** (arguments.dll). The Arguments helper class is used extensively in CTI OS, and is described in Helper Classes.
- **CTI OS Session Resolver** (ctiossessionresolver.dll). This object allows multiple applications or controls to use a single CTI OS Session object. You require this object when building an application that includes the CTI OS ActiveX controls.

Add COM Support to Your Application

Your application must support COM to use these objects in your CTI application. To add COM support to your application, you must use one of the following:

- Microsoft Foundation Classes (MFC). The following header files are required for MFC applications to use COM: *afxwin.h*, *afxext.h*, *afxdisp.h*, and *afxdtctl.h*. If you build an application using the Microsoft Visual C++ application wizard, these files are included automatically.
- Microsoft's ActiveX Template Library (ATL). To use ATL, include the standard COM header file: *atlbase.h*.

Important Note About COM Method Syntax

In this manual, the syntax used to describe method calls in COM shows standard COM data types such as BSTR, VARIANT and SAFEARRAY. Be aware that these data types can be encapsulated by wrapper classes proper to the environment depending on the development environment, tools, and how the COM CIL is included in your project application.

For example, in a Microsoft Visual C++ project a VARIANT type can be either a CComVariant or _variant_t, and a BSTR type can be either a CComBSTR or _bstr_t.

For more information, see the documentation for your development environment.

Use CIL Dynamic Link Libraries

Next, you must *import* the COM Dynamic Link Libraries into your C++ application. The following code sample (which you might put into your *StdAfx.h* file) depicts how to use a COM Dynamic Link Library in C++:

```
#import "..\..\Distribution\COM\ctiossessionresolver.dll" using namespace
CTIOSSESSIONRESOLVERLib;

#import "..\..\Distribution\COM\ctiosclient.dll" using namespace CTIOSCLIENTLib;
```

Note You must register three DLLs, but you do not need to import the *arguments.dll* into your project because it is imported by the *ctiosclient.dll* type library.

Create COM Object at Run Time

Note Only the apartment threading model is supported.

COM objects in C++ are created via the COM runtime library. To create a COM object at run time, your program must use the *CreateInstance()* method call.

```
// Create SessionResolver and Session object
hRes = m_pSessionResolver.CreateInstance
(OLESTR("CTIOSSessionResolver.SessionResolver"));

if (m_pSessionResolver)
{
    m_pSession = m_pSessionResolver->GetSession(_bstr_t(""));
}
```

Once the Session object is created, you can use it to make requests, and subscribe for events.

COM Events in C++

In this model, client applications subscribe for events by registering an instance of an event sink in the client with the event source. The COM Session object publishes several event interfaces (event sources), and clients can subscribe to any or all of them.

To receive COM events, you must first create an event sink class, which should derive from a COM event sink class. The Comphone sample application uses the MFC class *CCmdTarget*.

```
class CEventSink : public CCmdTarget
{
//...
};
```

This class must implement the method signatures for the events it expects to receive. When an event is fired from the event source, the corresponding method in your event sink class is invoked, and you can perform your custom event handling code at that time.

To subscribe for an event, the client must call the *AtlAdvise()* method, specifying a pointer to the interface of the event source:

```
// Add event sink as event listener for the _IallEvents interface

HRESULT hRes =
AtlAdvise(m_pSession, m_EventSink.GetIDispatch(FALSE),
__uuidof(_IAllEvents), &m_dwEventSinkAdvise);
```

When the program run is complete, the client must unsubscribe from the event source, using the AtlUnadvise() method:

```
// Unsubscribe from the Session object for the _IAllEvents interface

HRESULT hRes =
AtlUnadvise( m_pSession, __uuidof(_IAllEvents), m_dwEventSinkAdvise );
```

Additional Information

- For more information about the CTI OS client start up and shut down sequence, see section Disconnect from CTI OS Server Before Shutdown, on page 31.
- For more information about the CTI OS Client Interface Library objects, see Chapters 8 through 12.

  The C++ Client Interface Library (C++ CIL.) application is a programming interface (API) you can use to build high performance CTI enabled desktop or server-to-server integration that use Cisco CTI OS. The API is deployed as a set of C++ static libraries that you can use to build Win 32 or console based applications.
- For more information about a sample application that uses the CIL COM interface written in C++, see the Comphone sample application on the CTI OS CD.

C++ CIL and Static Libraries

The CTI OS Client Interface Library for C++ is the most powerful, object-oriented CTI interface for C++ developers. It provides the same interface methods and events as the COM interface for C++, but is more straightforward for C++ developers who are not experienced COM programmers, and provides faster code execution.

The CIL interface for C++ is a set of C++ header files (*.h*), and static libraries compiled for the Win32 platform (Windows 2010). The header files required to access the class definitions are located on the CTI OS SDK media in the `CTIOSToolkit\Include\` directory, and the static libraries are located in the CTI OS `Toolkit\Win32 CIL\Libs` directory.

Note Use Microsoft Visual Studio to build C++ applications using C++ CIL Visual Studio. Applications that are built using Visual Studio Enterprise 2015 are supported.

Header Files and Libraries

The header files you most likely require are all included in the main CIL header file, CIL.h, which you would include in your application:

```
#include <Cil.h>
```

To link your application code with the CIL for C++, you require the following C++ static libraries:

- **ConnectionLibSpd.lib**. This library contains the connection-layer services for CIL.
- **ServiceLibSpd.lib**. This library contains the service-layer services for CIL.

- **SessionLib.lib**. This library contains the object-interface services for CIL.
- **UtilLibSpd.lib**. This library contains helper classes for CIL.
- **ArgumentsLibSpd.lib**. This library contains the Arguments data structure for CIL.
- **SilentMonitorLib.lib**. This library contains all the services required to establish and control silent monitor sessions.
- **SecuritySpd.Lib**. This library contains the services required to establish secure connections with CTI OS Server.
- **SilentMonitorClient.lib**. This library is used by the CIL to communicate with the silent monitor service.
- **SilentMonitorCommon.lib** and **ServiceEventHandler.lib**. These libraries contain support classes for SilentMonitorClient.lib.

Note The preceding are the release versions of the libraries. The Debug equivalent libraries use the same library name with the appended "d" instead of Spd; for example, for ArgumentsLibSpd, the Debug library is ArgumentsLibd.lib.

In addition to the aforementioned CTI OS CIL libraries, your application requires:

- The standard Microsoft sockets library, Wsock32.lib
- The standard multimedia library, winmm.lib
- The OpenSSL standard libraries:
    - libeay32d.lib
    - ssleay32d.lib (Debug) and libeay32d.lib
    - ssleay32r.lib (Release)

A console C++ application with C++ CIL needs to use the following in stdafx.h:

```
#pragma once
#define WIN32_LEAN_AND_MEAN // Exclude rarely-used stuff from Windows headers
#include <iostream>
#include <tchar.h>
```

Use the following libraries in linker in addition to the CIL libraries:

- ws2_32.lib
- Winmm.lib
- odbc32.lib
- odbccp32.lib

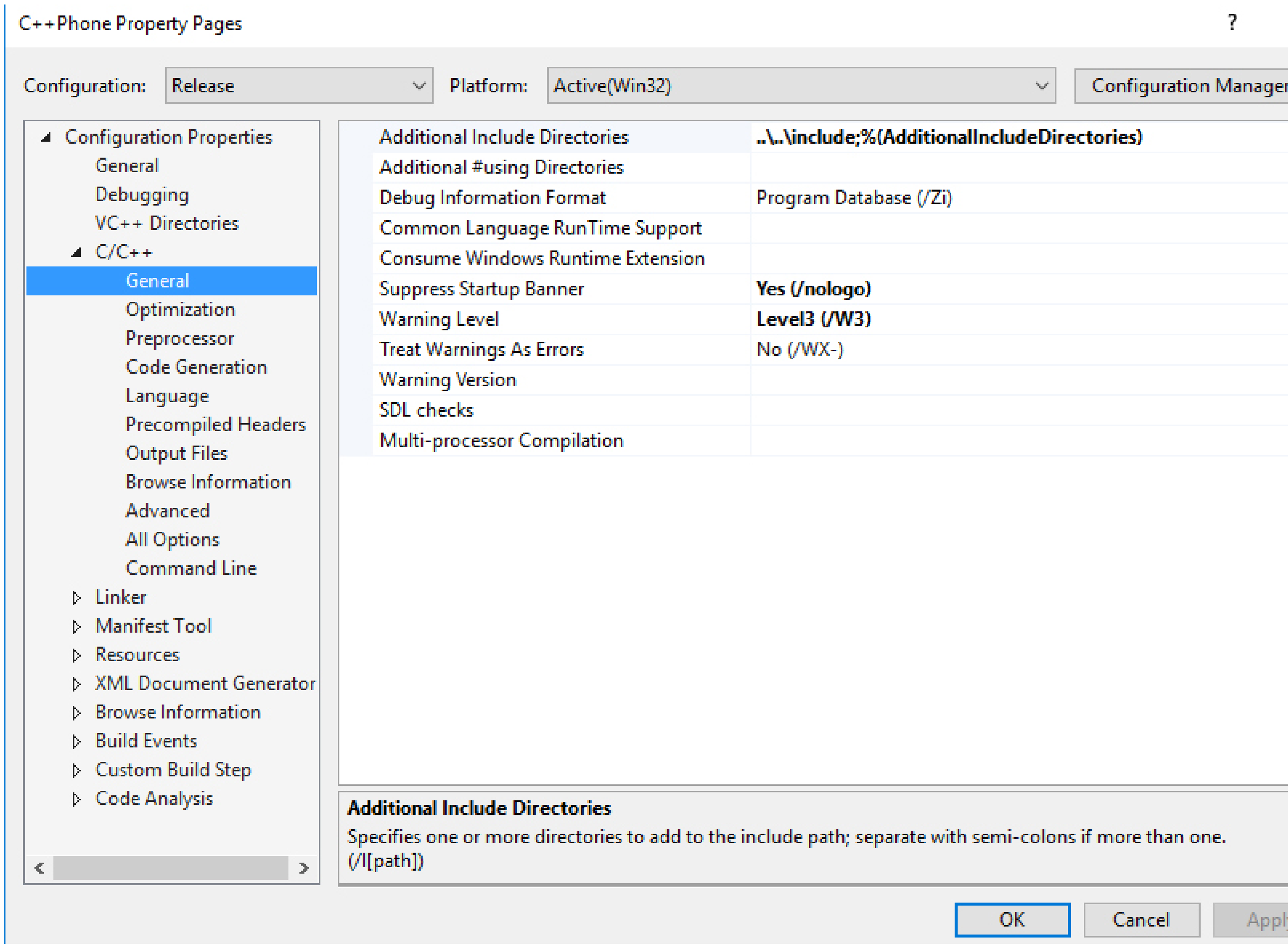
Configure Project Settings for Compiling and Linking

You must configure some program settings to set up your Visual C++ application.

Procedure

Step 1 You access the Program Setting in Visual C++ under the **Project** > **Properties** menu.

Step 2 In the **Property Pages** dialog box, under **C/C++**, select **General** and then select the **Additional Include Directories**. Provide either the absolute or relative path to find the header files (.h) required for your application. This path points to the CTIOSToolkit\Win32 CIL\Include directory, where the CIL header files are installed.

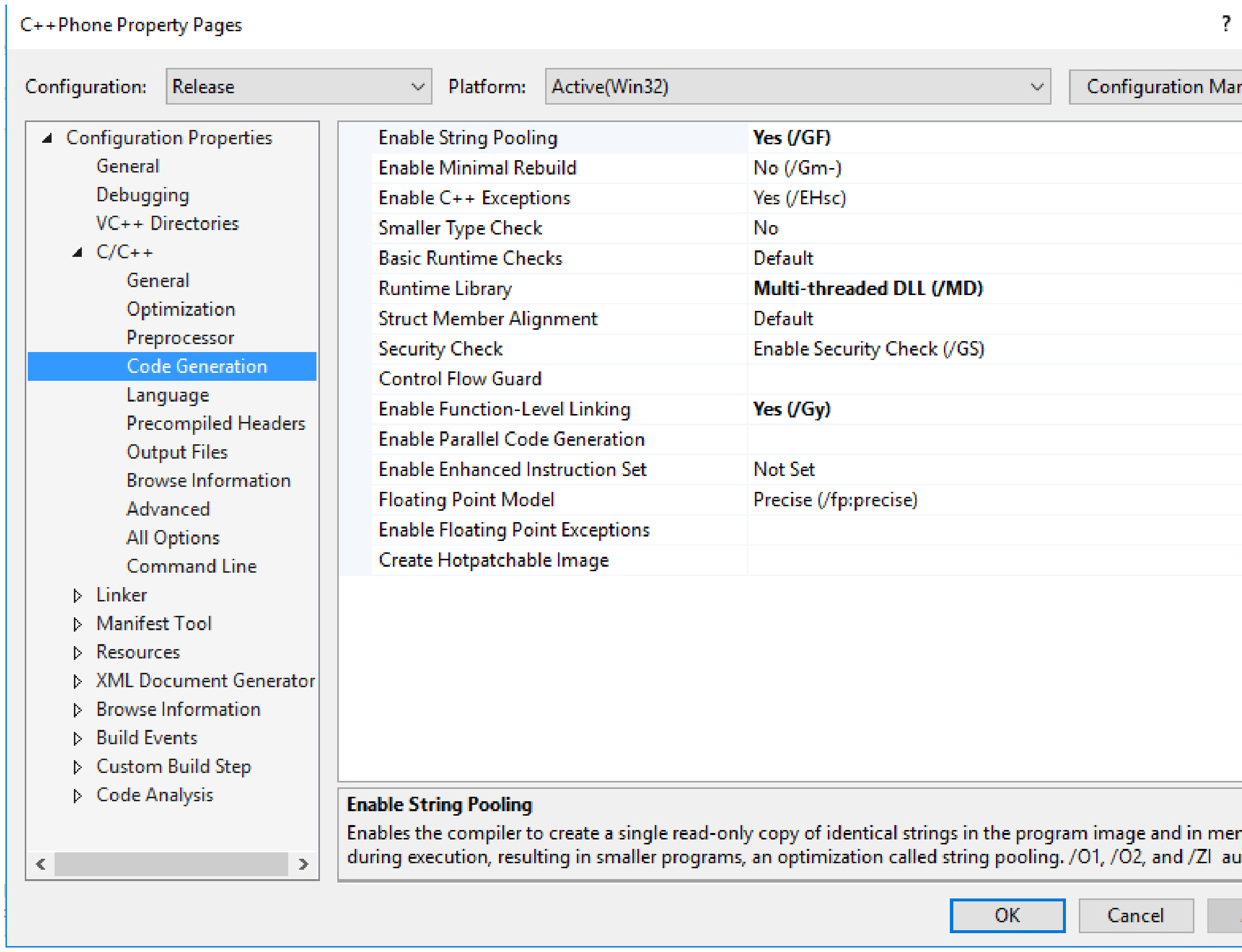


Configuration: Release   Platform: Active(Win32)

Additional Include Directories	..\..\include;%(AdditionalIncludeDirectories)
Additional #using Directories	
Debug Information Format	Program Database (/Zi)
Common Language RunTime Support	
Consume Windows Runtime Extension	
Suppress Startup Banner	Yes (/nologo)
Warning Level	Level3 (/W3)
Treat Warnings As Errors	No (/WX-)
Warning Version	
SDL checks	
Multi-processor Compilation	

Additional Include Directories
Specifies one or more directories to add to the include path; separate with semi-colons if more than one. (/I[path])

Step 3 Next, under **C/C++**, select **Code Generation**. For a Debug Mode program, the setting for Runtime Library is Multi-threaded Debug DLL (/MDd). For a Release Mode program, the setting is Multi-threaded DLL (/MD).



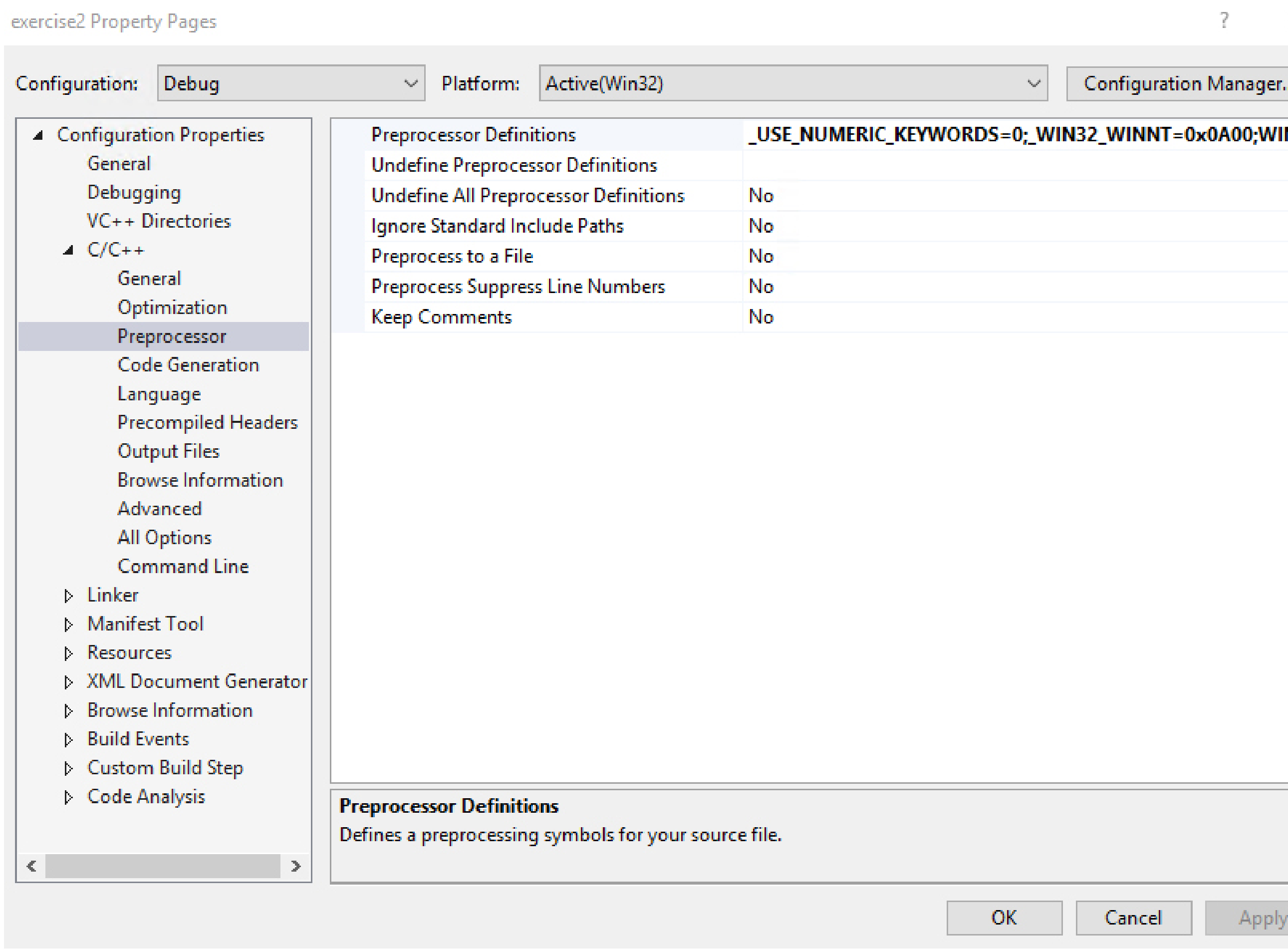
Enable String Pooling	**Yes (/GF)**
Enable Minimal Rebuild	No (/Gm-)
Enable C++ Exceptions	Yes (/EHsc)
Smaller Type Check	No
Basic Runtime Checks	Default
Runtime Library	**Multi-threaded DLL (/MD)**
Struct Member Alignment	Default
Security Check	Enable Security Check (/GS)
Control Flow Guard	
Enable Function-Level Linking	**Yes (/Gy)**
Enable Parallel Code Generation	
Enable Enhanced Instruction Set	Not Set
Floating Point Model	Precise (/fp:precise)
Enable Floating Point Exceptions	
Create Hotpatchable Image	

Enable String Pooling
Enables the compiler to create a single read-only copy of identical strings in the program image and in mer
during execution, resulting in smaller programs, an optimization called string pooling. /O1, /O2, and /ZI au

Step 4 Under **Preprocessor**, set the **Preprocessor Definitions**. You need to provide the compiler with the following define constants _USE_NUMERIC_KEYWORDS=0;_WIN32_WINNT=0x0500; WIN32_LEAN_AND_MEAN in addition to the defaults.

Step 5 In the Preprocessor Definitions for the C++ compiler, add these macros:

```
_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES=1
_CRT_SECURE_CPP_OVERLOAD_STANDARD_NAMES_COUNT=1
```


exercise2 Property Pages

Configuration: Debug Platform: Active(Win32) Configuration Manager.

Preprocessor Definitions	_USE_NUMERIC_KEYWORDS=0;_WIN32_WINNT=0x0A00;WI
Undefine Preprocessor Definitions	
Undefine All Preprocessor Definitions	No
Ignore Standard Include Paths	No
Preprocess to a File	No
Preprocess Suppress Line Numbers	No
Keep Comments	No

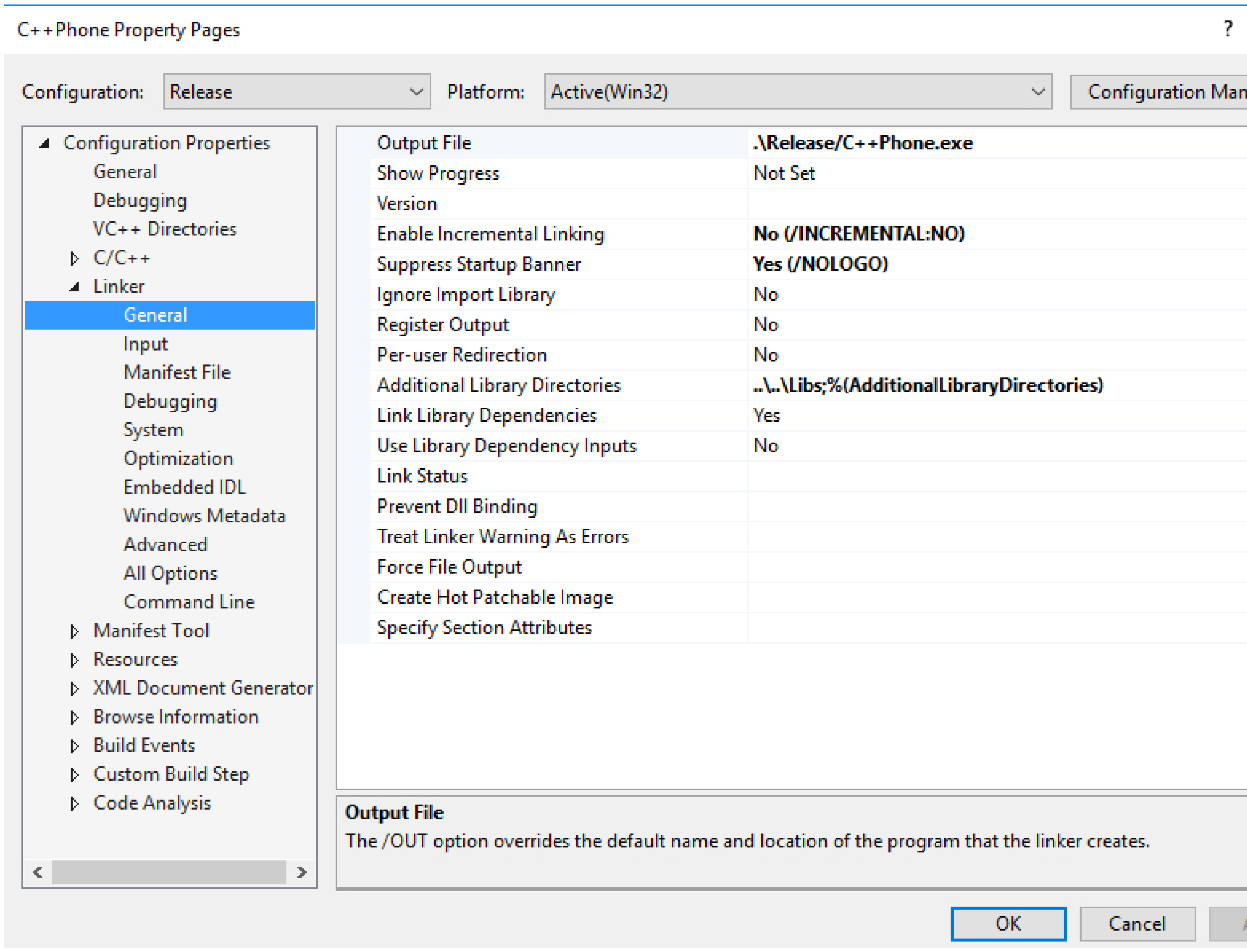
Preprocessor Definitions
Defines a preprocessing symbols for your source file.

Step 6 In the Language settings for the C++ compiler, set the parameter "Treat wchar_t as Built-in Type" to **No (/Zc:wchar_t-)** .

Step 7 For the Precompile Headers for the C++ compiler, set to **Not Using Precompile Headers**.

Step 8 Under **Linker**, set the link settings for your project. You must list all the static libraries for your program to link with the settings described in Configure Project Settings for Compiling and Linking. The libraries required for CIL (in addition to the default libraries) are described in Header Files and Libraries, on page 14.

Step 9 Finally, expand **Link** , select **General**. Set the **Additional Library Directories:** to the location of the CTIOSToolkit\Win32 CIL\Libs directory.


C++Phone Property Pages

Configuration: Release
Platform: Active(Win32)

Output File	.\Release/C++Phone.exe
Show Progress	Not Set
Version	
Enable Incremental Linking	No (/INCREMENTAL:NO)
Suppress Startup Banner	Yes (/NOLOGO)
Ignore Import Library	No
Register Output	No
Per-user Redirection	No
Additional Library Directories	..\..\Libs;%(AdditionalLibraryDirectories)
Link Library Dependencies	Yes
Use Library Dependency Inputs	No
Link Status	
Prevent Dll Binding	
Treat Linker Warning As Errors	
Force File Output	
Create Hot Patchable Image	
Specify Section Attributes	

Output File
The /OUT option overrides the default name and location of the program that the linker creates.

Step 10 After specifying all the Project Settings required for CTI OS, click **OK**, and save your project settings.

Event Subscription in C++

The publisher-subscriber model provides event interfaces in C++. To subscribe for events, you must create a callback class (event sink), or implement the event interface in your main class. You can derive the callback class from the Adapter classes defined in CIL.h, such as AllInOneEventsAdapter.h.

To register for an event, use the appropriate AddEventListener method on the Session object:

```
// Initialize the event sink
m_pEventSink = new CEventSink(&m_ctiSession, &m_ctiAgent, this);

// Add event sink as an event listener
m_ctiSession.AddAllInOneEventListener((IAllInOne *) m_pEventSink);
```

To remove an event listener (upon program termination), use the appropriate RemoveEventListener on the Session object:

```
// Tell session object to remove our event sink
m_ctiSession.RemoveSessionEventListener((IAllInOne *) m_pEventSink);
```

Removal of STLPort Requirement

The Cisco CTI OS Toolkit no longer uses STLPort. The toolkit now uses Microsoft's version of STL, which removes any special configuration of the build environment.

Additional Information

- For more information about the CTI OS client start up and shut down sequence, see the section Disconnect from CTI OS Server Before Shutdown, on page 31.
- For more information about the CTI OS Client Interface Library objects, see Chapters 6 through 11.
- For a complete sample application that uses the CIL interface with C++ static libraries, see the C++ phone sample application on the CTI OS CD.

Java CIL Libraries

The Java CIL provides a powerful cross-platform library for developing Java CTI applications. This Java API allows the creation of multiplatform client application that you can execute either in MS Windows or Linux. JavaTM CIL is built to support the 1.8 Java Development Kit (JDK) and JRE. It is built using a similar architecture to the C++ CIL. The interface is similar to C++ with minor differences. A developer porting a C++ CIL application to Java or working between a Java and C++ should find it easy to switch between the two.

The Java CIL consists of two packages contained in a single JAR file called JavaCIL.jar. The packages are com.cisco.cti.ctios.util and com.cisco.cti.ctios.cil. You can use CTI OS Client Install to install the Java CIL on Windows or you can copy it directly from the CTIOS_JavaCIL directory on the CTI OS media under Installs\CTIOSClient. The Java CIL also includes JavaDoc with the distribution. No install is provided for Linux. Mount the CDROM and copy the CTIOS_JavaCIL directory from the media. You can check the Java CIL version by using the CheckVersion.bat program in Windows or the checkversion shell script on Linux. Both of these are in the same directory as the JAR file.

Sun JRE installers are also included on the media as a convenience for developers who obtain the correct version of the JRE.

The Java CIL ships with a GUI TestPhone application that provides most of the functionality found on the CTI OS Agent and Supervisor Desktops. The distribution also includes samples that are Java versions of some of the C++/COM/VB sample applications. For more information, see Developer Sample Applications, on page 6.

The CTI OS Java Test Phone was updated and compiled with CTI OS Java CIL 8.0(1) using the JDK/JRE 1.6_01 for Linux and was functionally tested on Red Hat Linux Enterprise.

Additional Information

- For more information about differences between the C++ and Java event publishing, see Event Interfaces and Events and Keywords.
- For more information about differences in method calls and syntax for those classes between C++ and Java, see CtiOs Object.

- For more information about differences between C++ and Java tracing, see CTI OS Client Logs (COM and C++).

.NET CIL Libraries

The .NET CIL provides native .NET class libraries for developing native .NET Framework applications. It is built using the same architecture as the Java CIL and the interface is similar to C++. A developer porting a C++ CIL application to .NET CIL between a .NET and Win32 should find it easy to switch between the two. The .NET Client Interface Library (.NET CIL.) API provides native support for the Microsoft .NET Framework Common Language Runtime 4.7 (CLR). You can use the API with all major .NET Programming languages (C#, VB.NET, Managed C++, ASP.NET, etc). The API is deployed as .NET Assemblies that are registered in the system Global Assembly Cache (GAC).

The .NET CIL consists of two class libraries: NetCil.dll and NetUtil.dll that must be added as references on the build project. See the CTI OS Toolkit Combo Desktop sample.

To deploy the client application, use the Global Assembly Cache Tool (gacutil.exe) that is included with Microsoft Visual Studio. Use the Microsoft .NET Framework 4.7 Configuration Manager to install the NetCil.dll and NetUtil.dll class libraries on the host Global Assembly Cache (GAC). The .NET CIL libraries include sample programs that explain how to use APIs in a .NET programming environment. For more information, see Developer Sample Applications, on page 6.

Note In addition to NetCil.dll and NetUtil.dll, the .NET Combo sample requires the CTIOSVideoCtl.dll, which is in: `C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\dotNet CIL\Controls`.

Additional Information

- For more information about the differences between the C++, and .NET and Java event publishing, see Event Interfaces and Events and CTI OS Client Logs (COM and C++).
- For more information about the differences in method calls and syntax for those classes between C++ and Java, see CtiOs Object.

CTI OS Server Connection

To connect a desktop application to the CTI OS server, you must:

1. Create a session instance, described below.
2. Set the event listener and subscribe to events, described below.
3. Set connection parameters, described below.
4. Call the Connect() method, described on Connect Session to CTI OS Server, on page 23.
5. Set the connection mode, described on Connection Mode, on page 25. This section also describes how to deal with connection failures, on Connection Failures, on page 23.

Although the Cisco Security Agent (CSA) is now in end-of-life status and no longer supported, if your system is a duplexed Unified CCE PG with a CSA installed and one side of the CTI OS server is not running, CSA does not respond to login requests on the CTI OS server port. This triggers a time-out (20 second delay) before you attempt to connect to the active CTIOS server in the CTI OS client machine TCP stack. On start-up or login, the CTI OS client randomly chooses a CTI OS server side to connect and it may connect to the server side that is **not** running.

To avoid this delay/time-out, you must:

- Start the inactive CTI OS server side.
- Disable CSA (temporarily) and reconfigure the CTI OS desktop for a simplex operation.
- Upgrade the version of the CTI OS server to CTI OS 12.0 (the desktop does not appear frozen though the delay persists).

Connect to CTI OS Server

To connect to the CTI OS Server, you must first create an instance of the CtiOsSession object.

The following line shows this in **Java**:

```
CtiOsSession rSession = new CtiOsSession();
```

Session Object Lifetime (C++ Only)

In C++, you must create a Session object on the heap memory store so that it can exist beyond the scope of the method creating it. (In COM, VB, and Java, this is handled automatically.)

For example:

```
CCtiOsSession * m_pSession = NULL;
m_pSession = new CCtiOsSession();
```

The client application holds a reference to the Session object as long as it is in use, but the client programmer must release the last reference to the object to prevent a memory leak when the object is no longer needed.

During application cleanup, you must dispose the Session object only by invoking the CCtiOsSession::Release() method. This ensures proper memory cleanup.

For example:

```
m_pSession->Release();
```

Set Event Listener and Subscribe to Events

Before making any method calls with the Session instance, you must set the session as an event listener for the desktop application and subscribe to events.

The following lines show this in **Java**:

```
rSession.AddEventListener(this, CtiOs_Enums.SubscriberList.eAllInOneList);
```

In this example, the session is adding the containing class, the desktop application as the listener, and using the eAllInOneList field in the CtiOs_Enums.SubscriberList class to subscribe to all events.

Set Connection Parameters for Session

To set connection parameters:

Procedure

Step 1 Create an instance of the Arguments class.

Step 2 Set values for the CTI OS servers, ports, and the heartbeat value.

Note When setting values, use the String key fields in the CtiOs_IKeywordIDs interface, as shown in the example below.

The following example demonstrates this task in **Java**:

```
/* 1. Create Arguments object.*/
Arguments rArgs = new Arguments();

/* 2. Set Connection values.*/
rArgs.SetValue(CTIOS_enums.CTIOS_CTIOSA, "CTIOSServerA");
rArgs.SetValue(CTIOS_enums.CTIOS_PORTA, 42408);
rArgs.SetValue(CTIOS_enums.CTIOS_CTIOSB, "CTIOSServerB");
rArgs.SetValue(CTIOS_enums.CTIOS_PORTB, 42408);
rArgs.SetValue(CTIOS_enums.CTIOS_HEARTBEAT, 100);
```

Note The Arguments.setValue() methods return a boolean value to indicate whether the method succeeded (true) or not (false).

Connect Session to CTI OS Server

After successfully creating the Session instance, you must connect it to the CTI OS Server using the Session.Connect() method, using the Arguments instance you constructed when setting connection parameters, as described in the previous section.

The following line shows this in **Java**:

```
int returnCode = session.Connect(rArgs);
```

For more information about the possible values and meanings of the int value returned by the Connect() method in the Java CIL, see Connection Attempt Error Codes in Java and .NET CIL, on page 24.

When successful, the Connect() method generates the OnConnection() event. Code within the OnConnection() event sets the connection mode, as described in the next section.

Connection Failures

This section contains the following information:

- Connection Failure Events, on page 24
- Connection Attempt Error Codes in Java and .NET CIL, on page 24
- Configure Agent to Automatically Log In After Failover, on page 25
- Stop Failover Procedure, on page 25

Also see Deal with Failover in Monitor Mode, on page 29.

Connection Failure Events

If the Connect() method does not succeed, one of the following events is generated:

- OnConnectionRejected() event indicates that an unsupported version mismatch was found.
- OnCTIOSFailure() indicates that the CTI OS Server requested in the Connect() method is down. If an OnConnectionFailure() event is generated, the application is in Failover and the CIL continues to attempt to connect until the connection succeeds or until the application calls Disconnect(). The Arguments parameter for the event includes the following keywords:
  - FailureCode
  - SystemEventID
  - SystemEventArg1
  - ErrorMessage

For more information on the contents of the OnConnectionFailure() event, see the description in Chapter 6.

Connection Attempt Error Codes in Java and .NET CIL

The following field values can be returned by the Connect() method. See the documentation for the CtiOs_Enums.CilError interface in the CIL JavaDoc for information on these fields.

- **CIL_OK** - The connection process has successfully begun. The CIL either fires the OnConnection() event to indicate that the CIL successfully connected or fires the OnConnectionFailure() event and go into failover mode. If the latter occurs, the CIL continues to attempt to connect, alternating between hosts CTIOS_CTIOSA and CTIOS_CTIOSB, until the connection succeeds, at which point the CIL fires the OnConnection() event.
- **E_CTIOS_INVALID_ARGUMENT** - A null Arguments parameter was passed to the Connect() method. The connection failed. No events are fired.
- **E_CTIOS_MISSING_ARGUMENT** - The Arguments parameter did not contain values for both CTIOS_CTIOSA and CTIOS_CTIOSB. At least one of these values must be provided. The connection failed. No events are fired.
- **E_CTIOS_IN_FAILOVER** - A previous connection attempt failed and the CIL is currently in failover and attempting to establish a connection. This continues until a connection is established, at which point the CIL fires an OnConnection() event indicating that the previous Connect() method succeeded. To attempt to connect again with different parameters, the application must first use the Disconnect() method.
- **E_CTIOS_SESSION_NOT_DISCONNECTED** - The Session is not disconnected (i.e. a previous Connect() method is in progress, or the Session is already connected). The application must call the Disconnect() method before attempting to establish another connection. The CIL may fire an

OnConnection() event for the to previous call to the Connect() method if the connection was in progress, but will not fire one corresponding to this method call.

- **E_CTIOS_UNEXPECTED** - There was an unanticipated error. The connection failed. No events are fired.

Note After the application receives a Connect return code of CIL_OK, it does not call Connect again on that session until it receives an OnConnectionClosed event after a call to Disconnect.

Configure Agent to Automatically Log In After Failover

If you are using CTI OS in an Unified Contact Center Enterprise (Unified CCE) environment, you can configure the agent to automatically relogin in the event of a failover.

To configure the agent to log back in automatically, add the CTIOS_AUTOLOGIN keyword with the value "1" to the Arguments instance used to configure the agent:

```
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AUTOLOGIN, "1");
```

For more information on logging in an agent, see Log In an Agent, on page 32.

Stop Failover Procedure

To stop the failover procedure, call the Disconnect(args) method, with the Arguments instance containing the CTIOS_FORCEDDISCONNECT keyword as a parameter.

Connection Mode

After you create the session, you must specify the connection mode for the session. You must use one of two modes:

- Agent mode
- Monitor mode

Set Connection Mode in OnConnection() Event Handler

To ensure that you only try to set the connection mode on valid connections, place the code to set the connection mode within the OnConnection() event handler. The OnConnection() event is generated by a successful Connect() method.

Caution The application contains logic within the OnConnection() event handler to ensure it attempts to set the connection mode only during the initial connection, and not in an OnConnection() event due to failover.

Agent Mode

You use Agent mode for connections when the client application must log in and control a specific agent. When in Agent mode, the connection also receives call events for calls on that agent's instrument, as well as system events.

Select Agent Mode

To select Agent mode for the connection, in the OnConnection() event:

Procedure

Step 1 Set properties for the agent.

Note The properties required for the agent depend on the type of ACD you use. The following example demonstrates the required properties for Unified CCE users.

Step 2 Set the agent for the Session object to that Agent object.

Note In the **Java CIL only**: If the SetAgent() method is called on a session in which the current agent is different than the agent parameter in the SetAgent() method, the Java CIL automatically calls the Disconnect() method on the current session instance, generating an OnCloseConnection() event, then attempts to reconnect, generating an OnConnection() event. Then the new agent is set as the current agent.

The following example, which assumes the Session object has been created and connected to the CTI OS Server, demonstrates this task in **Java**:

```
void OnConnection(Arguments rArgs) {

   /* 1. Create and agent and set the required properties. */
   Agent agent = new Agent();
   agent.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTID, "275");
   agent.SetValue(CtiOs_IKeywordIDs.CTIOS_PERIPHERALID, "5002");

   /* 2. Set the session's agent */
   int returnValue = session.SetAgent(agent);

}
```

When successful, the SetAgent() method generates the following events:

- OnQueryAgentStateConf()
- OnSetAgentModeConf()
- OnSnapshotDeviceConf(), if the agent is already logged in
- OnSnapshotCallConf(), if there is a call and the agent is already logged in
- OnCTIOSFailureEvent()

Monitor Mode

Use Monitor Mode for applications that need to receive all events that CTI OS Server publishes or a specified subset of those events. Monitor Mode applications may receive events for calls, multiple agents, or statistics. The session receives specific events based on the event filter specified when setting the session to Monitor Mode.

Caution Monitor Mode, as the name implies, is intended for use in applications that passively listen to CTI OS server events. Monitor Mode is not intended for use in applications that actively control the state of calls or agents. Such applications include but are not limited to the following:

- Applications that log in agents and change their state
- Applications that make or receive calls and change their state
- Applications that silently monitor agents

Caution When a Monitor Mode session is initialized, the CTI OS Server performs a CPU intensive sequence of operations to provide the application with a snapshot of the state of the system. A large number of Monitor Mode applications connecting to CTI OS server at the same time, such as in a fail-over scenario, can cause significant performance degradation on CTI OS Server. Therefore, minimize the number of Monitor Mode applications connecting to CTI OS Server to two (2).

Warning You can only use the button enablement feature in agent mode sessions and is not intended for Monitor Mode applications.

Monitor Mode Filters

Overview Monitor Mode Filters

To set a connection to Monitor Mode, you must create a filter that specifies which events to monitor over that connection. The filter is a String; that String is the value for the CtiOs_IKeywordIDs.CTIOS_FILTER key in an Arguments instance. That Arguments instance is the argument for the SetMessageFilter() method.

Note By default the CTIOS server does a snapshotting which results in sending the info about all agents to the monitor mode connection. You control the behavior using the CTIOS_MONITORSESSIONSNAPSHOTMODE argument in the messagefilter args.

Use filter arg Enum_CtiOs.CTIOS_MONITORSESSIONSNAPSHOTMODE, 1 to turn off the snapshot.

Filter String Syntax

The filter String you create to specify events to monitor must adhere to a specific syntax to accurately instruct the CTI OS Server to send the correct events.

The general syntax for the filter String is as follows:

```
“key1=value1, value2, value3;key2=value4, value5, value6”
```

Note The filter String may also contain an asterisk (*), which is used as a wildcard to indicate any possible value. In addition, you can use a prefix to * to narrow the results. For example, using 10* matches 1001, 1002, 10003. However, CTI OS ignores any characters that follow the asterisk. For example, using 10*1 matches both 1001and 1002.

The filter String must contain at least one key, and there must be at least one value for that key. However, a key can take multiple values, and the filter String can contain multiple keys.

Multiple values for a single key must be separated by commas (,). Multiple keys must be separated by semicolons (;).

Note Multiple keys in a single filter combine using a logical AND. That is, the filter is instructing CTI OS to send to this connection only events that meet all the criteria included in the filter.

For example, a filter String could be as follows:

```
S_MESSAGEID + "=" + CtiOs_Enums.EventID.eAgentStateEvent + ";" + S_AGENTID + "=5128";
```

This example works as follows:

- The first key-value pair, `S_MESSAGEID + "=" + CtiOs_Enums.EventID.eAgentStateEvent`, serves to request events with a message ID equal to eAgentStateEvent; that is, it requests agent state events.
- The second key-value pair, `S_AGENTID + "=5128"`, specifies that the request is for the agent with the ID 5128.
- The result of the filter then is that the connection receives agent state events for agent 5128.

Filter Keys

Filter keys can be any known key value used by CTI OS. These keys have corresponding fields in the CtiOs_IKeywords interface.

Note When constructing the filter String, use the fields that begin with "S_", as these are the String values for the key.

For example, in **Java**:

```
String sFilter = S_AGENTID + "=5128,5129,5130";
```

In this example, S_AGENTID is the String representation of the key indicating an Agent ID.

Filters for Events for Monitored Calls

If a client filter mode application wants to filter for events for monitored calls, the applications does the following:

- Creates the filter
- Checks events to verify that the CTIOS _MONITORED parameter is present and is TRUE

- Ignores events if the CTIOS_MONITORED parameter is missing or FALSE

Select Monitor Mode

To select Monitor mode for the connection:

Procedure

Step 1 Specify the filter String. See the previous section for filter details.

Step 2 Create an Arguments instance and add an item with CtiOs_IKeywordIDs.CTIOS_FILTER as the keyword and the filter String as the value.

Step 3 Use the CtiOsSession.SetMessageFilterArgs(args) method to select Monitor mode and to set the event filter.

Note Always include the OnCtiOsFailure() event in the message filter so that the application can detect when a system component is online or offline.

Caution A Monitor mode application that monitors any Call-related events must also monitor the OnCallEnd() event, as described on OnCallEnd() Event Monitoring, on page 46.

The following example, which assumes the Session object has been created, demonstrates this task in Java:

```
/* 1. Constructing message filter string /

String filter = "messageid=" + eAgentStateEvent + "," + eAgentInfoEvent
+ "," + eCTIOSFailureEvent;

/* 2. Create the Arguments object*/
Arguments rArgs = new Arguments();

/* 3. Add the filter to the Arguments instance.*/
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_FILTER, filter);

/* 3. Set the message filter.*/
int returnValue = session.SetMessageFilter(rArgs);
```

When successful, the SetMessageFilter() method generates the following events:

- With Unified CCE only, OnQueryAgentStateConf() for each team and each agent logged in
- OnSnapshotDeviceConf() for each device
- OnSnapshotCallConf()
- OnMonitorModeEstablished()

Deal with Failover in Monitor Mode

The CTI OS CIL does not support failover for Monitor Mode. Agents in Monitor Mode cannot recover their state after a failover. Furthermore, after a failover, the CTI OS CIL may leak Call objects.

To deal with failover in Monitor Mode:

Procedure

Step 1 When the application detects a failover, for example, in a CTIOSFailure() event indicating a connection failure or an offline component, wait until the CIL has failed over and everything is back online and the CIL is connected to CTI OS.

The Monitor Mode application determines when all required servers are online. You can do this by monitoring OnCtiosFailure() events and keeping track of system status changes as they occur.

Step 2 Use the Disconnect() method to disconnect the session from CTI OS.

Step 3 Follow the steps starting at the beginning of the section Silent Monitoring, on page 55 to:

a) Create a session instance.
b) Set the event listener.
c) Set connection parameters.
d) Call the Connect() method.
e) Set the connection mode in the OnConnection() event handler.

Settings Download

One of the many useful features of CTI OS is the ability to configure Agent Desktop settings after what is on the server and have them available to all agent desktops via the `RequestDesktopSettings()` method. You can make any changes after what is on the server instead of changing each and every desktop. Settings download are considered as part of the process of setting up a connection that the client application uses.

Desktop settings are stored in the registries on the machines running CTI OS Server. Centralizing the desktop settings on the server streamlines the process of changing or updating the agent desktop. A settings download occurs every time a client application connects and ensures that all the desktops are based on the same settings.

You can downloading settings from CTI OS Server after connecting and setting the mode via the `RequestDesktopSettings()` method on the Session object. The `OnGlobalSettingsDownloadConf` event indicates success and also returns the settings which are now available to the client application in the form of properties on the Session object. You can access these properties via the `GetValue()` methods. Refer to Chapter 9 for a list of all the properties of the Session object.

You can make the request for desktop settings either in the OnConnection event or in the OnSetAgentModeEvent event (if Agent mode has been specified). Sample code:

```
Private Sub m_Session_OnConnection(ByVal pDispParam As Object)
'Issue a request to the server to send us all the Desktop 'Settings
m_Session.RequestDesktopSettings eAgentDesktop

End Sub
```

The `OnGlobalSettingsDownloadConf` event passes back the settings and you can access them via the Session object. For example, the following snippet checks for Sound Preferences and specifically to see if the Dial Tone is Mute or not:

```
Private Sub m_session_OnGlobalSettingsDownloadConf(ByVal pDispParam As Object)

Dim SoundArgs As CTIOSARGUMENTSLib.Arguments
```

```
' check if "SoundPreferences is a valid property

If m_session.IsValid("SoundPreferences ") = 1 Then
  Set SoundArgs = m_session.GetValue("SoundPreferences")
  Dim DialToneArgs As CTIOSARGUMENTSLib.Arguments
   If Not SoundArgs Is Nothing Then
      If SoundArgs.IsValid("DialTone") = 1 Then
          Set DialToneArgs = SoundArgs.GetValue("DialTone")
      End If
   End If

   Dim Mute As Integer
   If Not DialToneArgs Is Nothing Then
     If DialToneArgs.IsValid("Mute") = 1 Then
       Mute = DialToneArgs.GetValueInt("Mute")
       If Mute = 1 Then
         MsgBox "Dial Tone MUTE"//Your logic here
       Else
         MsgBox "Dial Tone  NOT MUTE"//Your logic here
       End If
     End If
End If
End If
End Sub
```

Disconnect from CTI OS Server Before Shutdown

Disconnecting from CTI OS Server (via the `Disconnect()` method) before shutting down is an important part of the client application functionality. The `Disconnect()` method closes the socket connection between the client application and CTI OS. On most switches, it does not log the agent out. If no logout request was issued before the `Disconnect()`, then on most switches the agent stays logged into the instrument even after the client application has shut down.

Note Disconnect is a higher priority method than all others. Before calling Disconnect, ensure that all prior requests have completed lest the call to Disconnect abort these requests. For example, calling Disconnect immediately after calling Logout can result in an agent not being logged out.

Upon `Disconnect()`, each object maintained by the Session (Call, Skillgroup, Wait) is released and no further events are received. Cleaning up the Agent object is the developer's responsibility because it was handed to the Session (via the `SetAgent()`) method.

Code sample:

In the C++ and COM CIL only, to disconnect from CTI OS Server when the session mode has not yet been established by means of calling either CCtiOsSsession::SetAgent(...) or CCtiOsSsession::SetMessageFilter(...), you must call for disconnect with an Arguments array containing the CTIOS_FORCEDDISCONNECT set to True.

```
m_session.Disconnect
// Perform disconnect
       if(m_ctiSession->GetValueInt(CTIOS_CONNECTIONMODE) == eSessionModeNotSet )
       {  // If the session mode has not yet been set by SetAgent or
                          // SetSessionMode at the time of the disconnect.
         // we need to indicate the session that a disconnect needs to
         // be forced
         bool   bAllocOk = true;
         Arguments * pDisconnectArgs = NULL;
```

```
        bAllocOk = Arguments::CreateInstance(&pDisconnectArgs);

        if ((false==bAllocOk) || (pDisconnectArgs == NULL))
        {
           CDialog::OnClose();
           argsWaitParams.Release();
           return;
        }

        pDisconnectArgs->AddItem(CTIOS_FORCEDDISCONNECT,true);
        m_ctiSession->Disconnect(*pDisconnectArgs);
        pDisconnectArgs->Release();
      }
      else
      {
        m_ctiSession->Disconnect();
      }
```

Agent Login and Logout

Log In an Agent

When the connection to the CTI OS Server is established and the mode set, you log in the agent.

Note Before attempting to log in an agent, you typically request global configuration data to correctly handle a duplicate log in attempt. For more information, see Get Registry Configuration Values to Desktop Application, on page 35.

To log in the agent, in the SetAgentModeEvent() event:

Procedure

Step 1 Create an instance of the Arguments class.

Step 2 Set log in values for the agent in the Arguments instance.

Note The properties required for the agent depend on the type of ACD you are using. The following example demonstrates the required properties for Unified CCE.

Step 3 Log in the agent.

The following example, which assumes the Agent object has been created, demonstrates this task in Java:

```
public void SetAgentMode(Arguments rArgs) {
             /* 1. Create Arguments object*/
             Arguments rArgs = new Arguments();

             /* 2. Set log in values.*/
             rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTID, "275");
             rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PERIPHERALID, "5002");
             rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTINSTRUMENT, "5002")
             rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTPASSWORD, "********");
             rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AUTOLOGIN,  "1");
             /* 3. Log in the agent.*/
             int returnValue = agent.Login(rArgs);
}
```

Note It is the client application's responsibility to keep track of whether the log in attempt is the first attempt or during failover, and branch accordingly in the SetAgentMode() event to avoid calling the Login() method during failover.

The Login() method generates the following events:

- QueryAgentStateConf()
- AgentStateEvent(), if the agent is unknown or is logged out.

Note The client application receiving the these events must check both the ENABLE_LOGOUT and ENABLE_LOGOUT_WITH_REASON bitmasks. For more information, see In the OnButtonEnablementChange() Event, on page 42.

When not successful, the Login() method generates the eControlFailureConf() event.

Duplicate Login Attempts

Overview of Duplicate Login Attempts

A duplicate log in attempt occurs when an agent who is already logged in tries to log in a second time using the same ID. Desktop applications must account for such a possible situation and have a plan for dealing with it.

You can handle duplicate log in attempts in three ways:

- Allow the Duplicate Log In with No Warning
- Allow the Duplicate Log In with a Warning
- Do not allow a duplicate log in

You control how duplicate log in attempts are handled in two ways:

- By configuring how duplicate log in attempts are handled on a global basis by creating custom values in the CTI OS Server Registry. By using custom values in the CTI OS Server registry to control how duplicate log in attempts are handled and downloading these settings to your desktop application as described in Log Out an Agent, on page 37, you can enable flexibility without having to modify your desktop application code.
- By implementing code in your desktop application to detect and to handle the duplicate log in attempt error according to the custom values in the CTI OS Server Registry. You can write code to handle duplicate log in attempts in each of the three ways listed above. When you need to change how such attempts are handled, you simply change the registry settings; you would not have to change the desktop application code.

Create Values in CTI OS Server Registry to Control Duplicate Sign In Attempts

You can create keys in the CTI OS Server Registry that instruct desktop applications to handle duplicate log in attempts in a specific way.

Warning The CTI OS CIL Two has keys that exist by default in the registry: WarnIfAlreadyLoggedIn and RejectIfAlreadyLoggedIn. You must not use these keys in your desktop application. You must instead create other keys as described in this section.

Create two custom values:

- custom_WarnIfAgentLoggedIn
- custom_RejectIfAgentLoggedIn

The custom keys you create can be set to 0 (False) or 1 (True).

The following table lists the settings to control how duplicate log in attempts are handled:

Table 2: CTI OS Server Registry Settings (to Control Duplicate Login)

Goal	custom_WarnIfAgentLoggedIn	custom_RejectIfAgentLoggedIn
To warn the agent of the duplicate log in attempt, but to allow the agent to proceed.	1	0
To allow the agent to proceed with the duplicate log in attempt with no warning.	0	0
To not allow the agent to proceed with a duplicate log in attempt.	0 or 1	1

To create keys to control duplicate log in attempts:

Procedure

Step 1 Open the registry and navigate to: `HKEY_LOCAL_MACHINE\Software\Cisco Systems, Inc.\CTIOS\[CTI Instance Name]\CTIOS1\EnterpriseDesktopSettings\AllDesktops\Login\ConnectionProfiles\Name\[Profile Name]`.

Step 2 Right click in the registry window and select **New** > **DWord Value**. The new value appears in the window.

Step 3 Change the value name to **custom_WarnIfAgentLoggedIn**.

Step 4 Double-click the value to open the Edit DWORD Value dialog box.

Step 5 Enter 1 in the Value data field to set the value to true, or 0 to set it to false.

Step 6 Repeat steps 2 through 5 for the value **custom_RejectIfAgentLoggedIn**.

Agent Login with Incorrect Credentials

To prevent another agent log in with incorrect credentials, use the **SendIdentifyClientRequest** method to identify and detect the log in request.

Set the Method Argument to **Nil**. To invoke this method, use the session object.

The following examples demonstrate the method in:

C++: int SendIdentifyClientRequest()

.NET: CilError SendIdentifyClientRequest()

Java: int SendIdentifyClientRequest()

Following is an example of how to use the method:

```
if (CIL_OK != SessionObj.SendIdentifyClientRequest())
{
    LOG(CRITICAL, "CCtiOsSession::SetAgent(...), SendIdentifyClientRequest: authentication
 will fail, aborting..");
    ReportError(CIL_FAIL);
    return CIL_FAIL;
}
```

Get Registry Configuration Values to Desktop Application

To get CTI OS registry configuration values to your desktop application to handle duplicate log in attempts correctly, you must request global configuration settings, then extract the custom settings from the event. You typically do this task before attempting to log in an agent, in the OnConnection() event.

Procedure

Step 1 Create an instance of the Arguments class.

Step 2 In the Arguments instance, set the value for the CTIOS_DESKTOPTYPE key to either:

- CtiOs_Enums.DesktopType.eAgentDesktop
- CtiOs_Enums.DesktopType.eSupervisorDesktop

Note Although the Arguments object must have one of these fields as a value for the CTIOS_DESKTOPTYPE key, this version of CTI OS does not utilize the desktop type parameter when sending global configuration data to a desktop application. Regardless of which field you use in defining the Arguments object, CTI OS returns all global configuration data with the OnGlobalSettingsDownloadConf() event. The desktop type indicators, through currently required, are reserved for future use.

Step 3 Request desktop settings for the session using the RequestDesktopSettings() method. This results in a OnGlobalSettingsDownloadConf() event.

The following example demonstrates steps 1 through 3 in Java:

```
/* 1. Create Arguments object*/
Arguments rArgs = new Arguments();
```

```
/* 2. Set the desktop type.*/
rArgs.SetValue("CTIOS_DESKTOPTYPE",
 CtiOs_Enums.DesktopType.eAgentDesktop);

/* 3. Request desktop settings. This should cause CTI OS to send the
OnGlobalSettingsDownloadConf event.*/
int returnValue = session.RequestDesktopSettings(rArgs);
```

Step 4 In the OnGlobalSettingsDownloadConf() event, get the Arguments instance for Login configuration from the event Arguments parameter. Use the S_LOGIN key from the CtiOs_IKeywordIDs interface.

Step 5 Get the Arguments instance for the correct switch from the Login Arguments instance. The example below uses the "SoftACD" login configuration information, the key for which is established by the CTI OS Server installation.

Step 6 Get the Integer instances for the custom values you established for the key in the CTI OS Server registry.

Step 7 For convenience, get the int values for those Integers to test with, as described in the section Duplicate Login Attempts, on page 33.

The following example demonstrates steps 4 through 7 in Java:

```
void OnGlobalSettingsDownloadConf(Arguments rArgs) {

     /* 4. Get the Arguments instance for the Login configuration
     information from the event Arguments parameter.*/

 Arguments logInArgs = rArgs.getValueArray(CTIOS_LOGIN);

/* 5. Get the Arguments instance for the Connection Profile
from the Login Arguments instance. */

Arguments connectionProfilesArgs = logInArgs.GetValueArray(CTIOS_CONNECTIONPROFILES);

/* 6. Get the Arguments instance for the specific switch from the Connection
Profiles instance */

Arguments IPCCLogInArgs = connectionProfilesArgs.GetValueArray("SoftACD")

/* 7. Get the Integer instances for the custom values you entered in the CTI OS Server
registry.*/

      Integer warningIntObj = IPCCLogInArgs.GetValueIntObj("custom_WarnIfAgentLoggedIn");

      Integer rejectIntObj =IPCCLogInArgs.GetValueIntObj("custom_RejectIfAgentLoggedIn");

/* 8. Get the int values for those object to test later.*/

      custom_WarnIfAgentLoggedIn = warnIntObj.intValue();
      custom_RejectIfAgentLoggedIn = rejectIntObj.intValue();
}
```

Detect Duplicate Login Attempt in Desktop Application

You detect the duplicate log in attempt in the OnQueryAgentStateConf() event, which is sent after the application calls SetAgent():

Procedure

Step 1 Get the agent state value from the Arguments instance passed to the event.

Step 2 Test the agent state value in the CtiOs_Enums.AgentState interface, as follows.

```
(state != eLogout) && (state != eUnknown)
```

Step 3 If the test is true, handle the duplicate log in attempt as described in the next section.

The following example demonstrates this task in Java:

```
public void eQueryAgentStateConf(Arguments rArgs) {
             /* 1. Get the agent state value*/
             Short agentState = rArgs.getValueShortObj(CTIOS_AGENTSTATE)

             /*Test the agent state*/
             if (agentState.intValue() != eLogout
                     && agentState.intValue() != eUnknown) {

            /*If the agent is logged in, handle duplicate log in attempt.*/
             }
}
```

Handle Duplicate Login Attempts in Desktop Application

If you detect from the OnQueryAgentStateConf() event that the agent is already logged in as described in the previous section, do the following:

- If your custom_WarnIfAgentLoggedIn = 1 and custom_RejectIfAgentLoggedIn = 0, notify the user that the agent is already logged in and proceed with Login() depending on the user response.
- If your custom_RejectIfAgentLoggedIn = 1, notify the user that the agent is already logged in and Disconnect.

Log Out an Agent

To log out an agent:

Procedure

Step 1 Create an instance of the Arguments class.

Step 2 Set log out values for the agent in the Arguments instance.

Note Unified CCE requires a reason code to log out. Other switches may have different requirements.

Step 3 Log out the agent.

The following example demonstrates this task in Java:

```
/* 1. Create Arguments object*/
Arguments rArgs = new Arguments();

/* 2. Set log out values.*/
```

```
rArgs.SetValue(CTIOS_EVENTREASONCODE, 1);

/* 3. Log out the agent.*/
int returnValue = agent.Logout(rArgs);
```

Typical Logout Procedure

When the Logout button is clicked the following actions need to happen:

1. Call Logout request on your current agent.

   You need to call Logout and not use SetAgentState(eLogout), because Logout provides additional logic to support pre-Logout notification, Logout failure notification, and resource cleanup.

   Here is the sample code for the same:

   ```
   if(m_ctiAgent)
   {
      Arguments &rArgAgentLogout = Arguments::CreateInstance();

      //add reason code if needed
      rArgAgentLogout.AddItem(CTIOS_EVENTREASONCODE, reasonCode);
      int nRetVal = m_ctiAgent->Logout(rArgAgentLogout);
      rArgAgentLogout.Release();
   }
   ```

2. Receive a response for the Logout request.

   You can expect the following events in response to a Logout request:

   - OnAgentStateChange (with Logout agent state).

     or

     OnControlFailure (with the reason for the failure).

   - OnPostLogout (you additionally receive this event if the Logout request succeeds).

     Note You can disable statistics either prior to issuing the Logout request or upon receipt of the OnAgentStateChange to logout state. Use the OnPostLogout event to trigger session disconnect. This guarantee that all event listeners can make CTI OS server requests in response to the logout OnAgentStateChange event.

     See the following example code:

     ```
     void CMyAppEventSink::OnPostLogout(Arguments & rArguments )
     {
        // Do not Disconnect if the reason code is Forced Logout
        // (particular failover case):
        int nAgentState = 0;
        if ( rArguments.GetValueInt(CTIOS_AGENTSTATE, &nAgentState) )
        {
           if (nAgentState == eLogout)
           {
              int nReasonCode = 0;
              if ( rArguments.GetValueInt(CTIOS_EVENTREASONCODE,
     ```

```
                                                                   &nReasonCode) )
                {
                   if (CTIOS_FORCED_LOGOUT_REASON_CODE ==
                                             (unsigned short)nReasonCode)
                   {
                      return;
                   }
                }
             }
          }

          //Disconnect otherwise
          if( IsConnected() ) //if session is connected
          {
             if(m_ctiSession)
             {
                m_ctiSession->Disconnect();
             }
          }
       }
```

3. If you are not concerned with whether the agent is successfully logged out prior to disconnect, issue a session Disconnect request without a Logout request.
4. Additionally, you must wait for OnConnectionClosed before destroying Agent and Session objects. This guarantee that the CIL has completed cleanup of the Session object prior to your calling Release on these objects.
5. Ensure that the Agent Object is set to NULL in the session before you Release the session object. For example, whenever your application is exiting and you are disconnecting the session object (for example, when the user closes your application window) do something similar to the code below:

```
if (m_ctiSession)
{
    m_ctiSession->Disconnect();

    // stop all events for this session
    int nRetVal =
        m_pctiSession->RemoveAllInOneEventListener((IAllInOne *)
                                                  m_pmyEventSink);


//The application is closing, remove current agent from session
    CAgent * pNullAgent = NULL;
    m_Session->SetAgent(*pNullAgent);
    m_Session->Release();
    m_Session = NULL;
}

if(m_ctiAgent)
{
    m_ctiAgent->Release();
    m_ctiAgent = NULL;
}

if (m_pmyEventSink)
{
    m_pmyEventSink->Release();
    m_pmyEventSink = NULL;
}
```

Calls

Multiple Call Handling

It is critical that you design an Agent Mode desktop application to store all the calls on the specific device to do the following:

- Apply incoming events to the correct call
- Select the correct call on which to make method calls (for example, telephony requests)

It is not necessary to maintain a set of Call objects to do this. Instead, the application can store the string UniqueObjectID of each call (keyword CTIOS_UNIQUEOBJECTID). CTIOS_UNIQUEOBJECTID is always included in the args parameter for each call event. You can obtain the actual Call object with the Session object's GetObjectFromObjectID() method to make a method call.

Current Call

The CIL maintains a concept of a *Current Call*, which is the call for which the last OnButtonEnablementChange() event was fired. Knowing which call is the Current Call is useful when there are multiple components which set and act on the Current Call, such as telephony ActiveX Controls.

The CTI OS ActiveX controls included in the CTI OS Toolkit use the concept of the Current Call. The CallAppearance grid control sets the Current Call when the user clicks on a particular call in the grid. When the user clicks the Answer control, this control must get the Current Call to call the Answer() method on the correct call.

The Current Call is set according to the following rules:

- When there is only 1 call on a device, the CIL sets it to the Current Call.
- When there are multiple calls on a device and an application wants to act on a call that is not the Current Call, it sets a different call to the Current Call with the SetCurrentCall() method.
- When the call which is the Current Call ends, leaving multiple calls on the device, the application must set another call to be the Current Call.
- Whenever the Current Call is set to a different call, OnCurrentCallChanged() event is fired as well as an OnButtonEnablementChange() event.

Get Call Object from Session

You can get the Call object from the session using the GetObjectFromObjectID() method.

The following code fragment, which assumes that existing Call Unique Identifiers are stored in an array called UIDArray, shows how to get a specific Call object in Java:

```
String sThisUID = UIDArray[Index];
Call ThisCall =  (Call) m_Session.GetObjectFromObjectID(sThisUID);
```

Set Current Call for Session

To set the current call you use the SetCurrentCall() method for the Session. The following code fragment, which assumes you retrieved the Call object as described in the previous section, shows how to set the current call.

The following line shows this in Java:

```
m_Session.SetCurrentCall(ThisCall);
```

Call Wrapup

The agent/supervisor desktop behaves differently at the end of a call depending on the following factors:

- The direction of the call (inbound or outbound)
- Configuration of Unified CCE or the ACD (whether wrapup data is required, optional, or not allowed)
- Configuration of CTI OS server

The CTI Toolkit Combo Desktop .NET sample shows how to use this information to display a wrapup dialog box that allows the agent to select from a set of pre-configured wrapup strings after an inbound call goes into wrapup state (see ProcessOnAgentStateEvent in SoftphoneForm.cs). On an agent state change event, if the state changes to WorkReady or WorkNotready state, this indicates that the agent has transitioned to call wrapup state. The CTI OS server provides the following key/value pairs in the event arguments to determine whether wrapup data is associated with the call and whether that data is required or optional.

CTIOS_INCOMINGOROUTGOING indicates the direction of the call. The defined values are:

0 = the direction of the call is unknown

1 = the call is an incoming call and the agent may enter wrapup data

2 = the call is an outgoing call and the agent may not enter wrapup data

You can use the GetValueInt method to obtain this value on the Agent object.

CTIOS_WRAPUPOKENABLED indicates whether wrapup data is required for the recently ended call. A value of false indicates that wrapup data is not required. A value of true indicates that wrapup data is required. (In the Combo Desktop sample, this value is used as a boolean to determine whether the "Ok" button on the wrapup dialog box is enabled when no wrapup information is selected.) You can use the GetValueBool method to obtain this value on the Agent object.

The wrapup strings that are configured on CTI OS server are sent to the client during the login procedure and are stored under the keyword CTIOS_INCOMINGWRAPUPSTRINGS as an Arguments array within the Agent object. You can use the GetValueArray method to obtain the wrapup strings on the Agent object. For more information about how to configure wrapup strings on CTI OS server see the *CTI OS System Manager Guide for Cisco Unified ICM*.

Logout and NotReady Reason Codes

Depending on the configuration of Unified CC or the configuration of CTI OS server, the agent/supervisor desktop may be required to supply a reason code when requesting an agent state change to Logout or NotReady state. The CTI Toolkit Combo Desktop .NET sample provides examples of how to implement reason codes in an agent/supervisor desktop. (See the btnLogout_Click and btnNotReady_Click methods in SoftphoneForm.cs.)

CTI OS server informs the CTI OS client of this configuration during the login process and the information is stored in the following properties on the Agent object:

CTIOS_LOGOUTREASONREQUIRED - This boolean value indicates whether a reason code is required for logout. A value of true indicates that a reason code is required. A value of false indicates that a reason code is not required. You can use the GetValueBool method to get this value on the Agent object.

CTIOS_LOGOUTREASONCODES - This Arguments array provides a list of the logout reason codes configured on CTI OS server. You can use the GetValueArray method to get this value on the Agent object.

CTIOS_NOTREADYREASONREQUIRED - This boolean value indicates whether a reason code is required when setting an agent to NotReady state. A value of true indicates that a reason code is required. A value of false indicates that a reason code is not required. You can use the GetValueBool method to obtain the value on the Agent object.

CTIOS_NOTREADYREASONCODES - This Arguments array provides a list of the not ready reason codes configured on CTI OS server. You can use the GetValueArray method to obtain the value on the Agent object.

Applications and OnButtonEnablementChange() Event

An application receives an OnButtonEnablementChange() event in the following situations:

- When the Current Call is changed.
- When the call that is the Current Call receives an event, which includes a CTIOS_ENABLEMENTMASK argument. Usually the included enablement mask is changed from what it was set to, but occasionally it is the same. This mask is used to indicate which functions are allowed for this Call in its current state.

  For example, when a Call receives an OnCallDelivered() event with a Connection State of LCS_ALERTING, its enablement mask is changed to set the Answer bit. When this Call is answered, and it receives the OnCallEstablished() event, the mask no longer sets the Answer bit, but instead enables the Hold, Release, TransferInit and ConferenceInit bits.

In the OnButtonEnablementChange() Event

To see if a button should be enabled, do a bitwise “AND” with the appropriate value listed in the Table included under the OnButtonEnablementChange event in Chapter 6.

The following examples shows this in Java:

```
Integer IMask = rArgs.GetValueIntObj(CTIOS_ENABLEMENTMASK);
if (null != IMask) {
            int iMask = IMask.intValue();
     if (iMask & ENABLE_ANSWER) {
            //Enable the AnswerCall button
              }
     else {
           //Disable the AnswerCall button
            }
}
     // else do nothing
```

Not Ready Bitmasks in OnButtonEnablementChange() Event

A client application receiving the OnButtonEnablementChange() event must check both the ENABLE_NOTREADY and ENABLE_NOTREADY_WITH_REASON bitmasks in the event.

Caution Failure to check both the ENABLE_NOTREADY and ENABLE_NOTREADY_WITH_REASON bitmasks can lead to problems properly displaying a NotReady control to the agent.

The following example shows this in Java:

```
void OnButtonEnablementChange(Arguments rArguments) {
     m_appFrame.LogEvent("OnButtonEnablementChange", rArguments);

            // Get mask from message
            Long LMask = rArguments.GetValueUIntObj(CTIOS_ENABLEMENTMASK);
            if (null==LMask)
                         return;

     final long bitMask = LMask.longValue();

     /* Transfer modification of the GUI objects to the
EventDispatchThread or we could have a thread sync issue.  We're
currently on the CtiOsSession's event thread.*/

            SwingUtilities.invokeLater(new Runnable() {
                        public void run() {

    /* Enable a button if it's bit is
turned on.  Disable it if not.*/

                  m_appFrame.m_btnAnswer.setEnabled (((bitMask & ENABLE_ANSWER) > 0));
                  m_appFrame.m_btnConference.setEnabled
                           (((bitMask & ENABLE_CONFERENCE_COMPLETE) > 0));
                  m_appFrame.m_btnCCConference.setEnabled
                           (((bitMask & ENABLE_CONFERENCE_INIT) > 0));
                  m_appFrame.m_btnHold.setEnabled (((bitMask & ENABLE_HOLD) > 0));
                  m_appFrame.m_btnLogin.setEnabled (((bitMask & ENABLE_LOGIN)> 0));
                  m_appFrame.m_btnLogout.setEnabled
                     (((bitMask & (ENABLE_LOGOUT |

CtiOs_Enums.ButtonEnablement.ENABLE_LOGOUT_WITH_REASON)) >
                                                   0));
                    m_appFrame.m_btnMakeCall.setEnabled
                            (((bitMask & ENABLE_MAKECALL) > 0));
                    m_appFrame.m_btnNotReady.setEnabled(((bitMask & (ENABLE_NOTREADY |
                                    ENABLE_NOTREADY_WITH_REASON)) > 0));
                    m_appFrame.m_btnReady.setEnabled(((bitMask & ENABLE_READY) > 0));
                    m_appFrame.m_btnRelease.setEnabled(((bitMask & ENABLE_RELEASE)> 0));
                    m_appFrame.m_btnRetrieve.setEnabled
                                (((bitMask & ENABLE_RETRIEVE) > 0));
                    m_appFrame.m_btnSSTransfer.setEnabled
                                (((bitMask & ENABLE_SINGLE_STEP_TRANSFER)> 0));
                    m_appFrame.m_btnSSConference.setEnabled
                                   (((bitMask & ENABLE_SINGLE_STEP_CONFERENCE) > 0));
                    m_appFrame.m_btnTransfer.setEnabled
                                   (((bitMask & ENABLE_TRANSFER_COMPLETE)> 0));
                                   m_appFrame.m_btnCCTransfer.setEnabled
                        (((bitMask & ENABLE_TRANSFER_INIT) > 0));
                        }
         });
} // OnButtonEnablementChange
```

OnButtonEnablementChange() Event in Supervisor Desktop Applications

When a supervisor desktop application processes an OnButtonEnablementChange() event, the application checks for the CTIOS_MONITORED parameter and ignores this parameter if it is present and is TRUE. In a supervisor desktop application, the OnButtonEnablementChange() event can reflect button enablement for either a monitored team member or the supervisor.

Making Requests

Telephony requests are made through either an Agent object or a Call object by calling the appropriate API methods listed in Chapters 9 and 10. It is important to ensure that a user cannot make multiple duplicate requests before the first request has a chance to be sent to the switch and the appropriate events sent back to the application, because this results in either multiple failures or unexpected results.

Multiple Duplicate Requests

Because it is important for a custom application to prevent a user from making a number of duplicate requests, the user should not be able to click the same button multiple times. A custom application should disable a clicked button until it is all right for the user to click it again.

Some examples of when Sample softphones re-enable a button that was clicked and disabled are listed below:

- Re-enable Connect/LoginBtn when:
  - LoginDlg canceled
  - ControlFailure or CTIOSFailure when login is in progress
  - In ProcessOnConnectionClosed()
- Re-enable Logout/DisconnectBtn when:
  - Logout ReasonCodes are required & Dlg pops up, but user clicks Cancel
- Re-enable NotReadyBtn when:
  - NotReady ReasonCodes are required & Dlg pops up, but user clicks Cancel
- Re-enable DialBtn, TransferBtn or ConferenceBtn when:
  - DialPad was closed with Cancel rather than Dial, depending on which was originally clicked
- Re-enable TransferBtn & ConferenceBtn when:
  - Received ControlFailure with MessageType parameter set to eConsultationCallRequest
- Re-enable EmergencyBtn when:
  - Received ControlFailure with MessageType parameter set to eEmergencyCallRequest
- Re-enable SupervisorAssistBtn when:
  - Received ControlFailure with MessageType parameter set to eSupervisorAssistRequest

- Re-enable any AgentStateBtn when:
    - Received ControlFailure with MessageType parameter set to eSetAgentStateRequest & lastAgentStateBtnClicked was the appropriate one
- Re-enable any of the buttons when:
    - Received OnButtonEnablementMaskChange indicating the button should be enabled.

Events

Event Order

A desktop application using the CTI OS API must handle events in the order they are sent by CTI OS.

Warning Because many events include agent state data and button enablement data indicating valid agent state transitions, if events are handled out of order agents may not be presented with valid options.

Coding Considerations for CIL Event Handling

The CTI OS CIL fires events to the application in a single thread. Keep the amount of time spent in a particular CIL event handler to a minimum to ensure timely delivery of subsequent CIL events. If a screenpop based on a call event (such as the OnCallDelivered event or the OnCallDataUpdate event) takes longer than a few seconds (for example, remote database lookup), delegate this operation to a separate thread or separate process so as not to block CTI OS event handling.

Note The order of arrival of CIL events is highly dependent on the ACD that is in use at the customer site. Therefore, CIL event order is not guaranteed. Do not write your event handling code in a manner that relies on a particular event order.

If an application calls a CIL API method from a CIL event callback routine it must ensure that the method call is made on the same thread as the CIL event callback. This rule applies to the following methods:

- SetCurrentCall
- SetAgent

This rule must be followed in order to guarantee that events are fired from the CIL to the application in the proper sequence.

When handling events in the browser using JavaScript, keep event processing time to a minimum because all other JavaScript execution (e.g., handling of button clicks) may be blocked during handling of the event.

OnCallEnd() Event Monitoring

A Monitor Mode application that monitors any Call-related events must also monitor the OnCallEnd() event.

Warning The Call object in the CTI OS CIL is only deleted when the OnCallEnd() event is received. If the OnCallEnd() and OnCallDataUpdate() events are not monitored, Call objects accumulate and cause a memory leak.

Agent Statistics

Overview of Agent Statistics

This section describes how to work with agent statistics and contains the following subsections:

- Set Up Agent Application to Receive Agent Statistics, on page 46
- Set Up Monitor Mode Application to Receive Agent Statistics, on page 47
- Agent Statistics Access, on page 50
- Agent Statistics Configuration, on page 51
- Agent Statistics Computed by Sample CTI OS Desktop, on page 51

Set Up Agent Application to Receive Agent Statistics

To set up an Agent application to receive agent statistics:

Procedure

Step 1 Create an instance of the Session class, as described on Connect to CTI OS Server, on page 22.

Step 2 Subscribe for events for the session, as described on Set Event Listener and Subscribe to Events, on page 22.

Note You must register to receive agent and session events; therefore, in the AddEventListener() method you must use as parameters the field `CtiOs_Enums.SubscriberList.eAgentList` and `CtiOs_Enums.SubscriberList.eSessionList`. Or you can use the `CtiOs_Enums.SubscriberList.eAllInOneList`.

Step 3 Set connection parameters, as described on Set Connection Parameters for Session, on page 23.

Step 4 Connect the desktop application to the CTI OS Server, as described on Connect Session to CTI OS Server, on page 23.

Step 5 In the OnConnection() event handler, set the Agent for the session, as described on Select Agent Mode, on page 26.

Step 6 Log in the agent, as described on Log In an Agent, on page 32.

Step 7 Enable agents statistics using the EnableAgentStatistics() method.

Note Though the EnableAgentStatistics() method requires an Arguments parameter, there are no parameters to set for agent statistics; you can therefore send an empty Arguments instance as a parameter.

Caution The agent must be logged in before you can use the EnableAgentStatistics() method.

Step 8 To disable agents statistics, use the DisableAgentStatistics() method.

The following example demonstrates this task in Java:

```
/* 1. Create session.*/
CtiOsSession rSession = new CtiOsSession();

/* 2. Add event listener.*/
rSession.AddEventListener(this,
      CtiOs_Enums.SubscriberList.eAgentList);

/* 3. Set Connection values.*/
Arguments rArgs = new Arguments();
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_CTIOSA, "CTIOSServerA");
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PORTA, 42408);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_CTIOSB, "CTIOSServerB");
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PORTB, 42408);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_HEARTBEAT, 100);

/*4. Connect to server.*.
returnCode = rSession.Connect(rArgs);

public void OnConnection(Arguments rArgs) {

        /*5. Set agent for the session. */
        returnCode = rSession.SetAgent(agent);

        /* 6. Log in the agent.*/
        Arguments rArgs = new Arguments();
        rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTID, "275");
        rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PERIPHERALID, "5002");
        rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTINSTRUMENT, "5002")
        rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_AGENTPASSWORD, "********");
        returnCode = agent.Login(rArgs);

        /* 7. Enable Agent statistics. */
        if (returnCode == CIL_OK) {
        agent.EnableAgentStatistics(new Arguments());
        }
}
```

Set Up Monitor Mode Application to Receive Agent Statistics

To set up a Monitor-mode application to receive agent statistics, follow the instructions below.

Note The agent to monitor must be logged in Agent mode before a Monitor-mode application can receive statistics for that agent.

CTI OS has a limitation in providing monitor-mode support to build agent desktop call-control applications, as well as having the ability to rely on button enablement messages.

Procedure

Step 1 Create an instance of the Session class, as described on Connect to CTI OS Server, on page 22.

Step 2 Subscribe for events for the session, as described on Set Event Listener and Subscribe to Events, on page 22.

Note You must register to receive agent events; therefore, in the AddEventListener() method you must use as a parameter the field `CtiOs_Enums.SubscriberList.eAgentList`.

Step 3 Set connection parameters, as described on Set Connection Parameters for Session, on page 23.

Step 4 Connect the desktop application to the CTI OS Server, as described on Connect Session to CTI OS Server, on page 23.

Step 5 Set a String variable to store the ID of the agent for which you want statistics.

Note The application must be aware of the Agent ID and the agent's Peripheral ID for any agent to monitor; the application cannot dynamically get these values from CTI OS Server.

Step 6 Set the message filter as described on Filters for Events for Monitored Calls, on page 28.

a) Create String for the filter using the keyword `CTIOS_MESSAGEID` as the name, and "*;*agentID*" as the value.

Note The "*;" indicates all events for that agent.

b) Create an instance of the Arguments class.
c) Set the value in the filter for the CTIOS_FILTER keyword to the String created in Step a.
d) Use the SetMessageFilter() method in the Session class to set the filter for the session, using the Arguments instance you created in Step b as a parameter.

Step 7 Wait for any event for the agent, to ensure that the Agent instance exists for the Session.

Caution The application must wait for the first event for this agent before continuing, to ensure that the Agent instance is part of the current session.

Note This example uses a Wait object to wait.

Step 8 Get the Agent instance from the Session using GetObjectFromObjectID() method.

Step 9 Enable agents statistics using the EnableAgentStatistics() method.

Note Although the EnableAgentStatistics() method requires an Arguments parameter, there are no parameters to set for agent statistics; you can therefore use an empty Arguments instance as a parameter.

Caution The agent must be logged in before you can use the EnableAgentStatistics() method.

Step 10 To disable agents statistics, use the DisableAgentStatistics() method.

The following example demonstrates this task in Java:

```
/* 1. Create session.*/
CtiOsSession rSession = new CtiOsSession();

/* 2. Add event listener.*/
rSession.AddEventListener(this,
    CtiOs_Enums.SubscriberList.eAgentList);

/* 3. Set Connection values.*/
Arguments rArgs = new Arguments();
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_CTIOSA, "CTIOSServerA");
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PORTA, 42408);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_CTIOSB, "CTIOSServerB");
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PORTB, 42408);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_HEARTBEAT, 100);

/*4. Connect to server.*.
int returnCode = rSession.Connect(rArgs);

/*5. Set String to AgentID*/
String UIDAgent = "agent.5000.5013";

/*6. Set the message filter. */
String filter = "MessageId=*;AgentId=5013;
rArgs = new Arguments();
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_FILTER, filter);
returnCode = rSession.SetMessageFilter(rArgs);

/*7. Wait for agent events.*/

rArgs = new Arguments();

// Create a wait object in the session
WaitObject rWaitObj = rSession.CreateWaitObject(rArgs);

// Load the events into the Args for the wait object
rArgs.SetValue("Event1", eAgentStateEvent);
rArgs.SetValue("Event2", eQueryAgentStateConf);
rArgs.SetValue("Event3", eControlFailureConf);
rArgs.SetValue("Event4", eCTIOSFailureEvent);

// Set the mask for the WaitObject
rWaitObj.SetMask(rArgs);

// Wait for up to 9 seconds, and then give up
if (rWaitObj.WaitOnMultipleEvents(9000) != EVENT_SIGNALED)
{
    // Handle error ...
    return;
}

// Find out what triggered the wait
int iEventID = rWaitObj.GetTriggerEvent();
if (iEventID == eControlFailureConf|| iEventID == eCTIOSFailureEvent)
{
    // Handle error ...
    return;
}
```

Agent Statistics Access

Overview of Agent Statistics Access

After you set up the applications to receive agent statistics, as described in the preceding section, you can access agent statistics in two ways:

- By implementing the eOnNewAgentStatisticsEvent() (in Java) or the OnAgentStatistics() event (in C++, COM, or VB 6.0)

Caution The name of the event to access agent statistics is different in Java when compared to other languages supported by CTI OS.

- Through the Agent instance itself

The rest of this section describes these methods for accessing agent statistics.

eOnNewAgentStatisticsEvent() in Message Filter (JAVA)

To register to receive agent statistics, you must include the eOnNewAgentStatisticsEvent() in the message filter.

For example, in Java, the message filter to receive agent statistics is:

```
String filter = S_MESSAGEID + "=" +

CtiOs_Enums.EventID.eNewAgentStatisticsEvent;
```

For more information about message filters, see Monitor Mode Filters, on page 27.

OnAgentStatistics() Event in Message Filter (C++ COM and VB)

To register to receive agent statistics, you must include the OnAgentStatistics() event in the message filter.

For more information about message filters, see Monitor Mode Filters, on page 27.

Get Agent Statistics Through Agent Instance

After you use the EnableAgentStatistics() method for the agent, agent statistics are available through that Agent instance.

To get the agent statistics perform the following procedure:

Procedure

Step 1 Get the Arguments instance containing statistics from the Agent instance using the GetValueArray() method.

Step 2 Parse the Arguments instance as needed to get specific statistics.

The following example demonstrates this task in Java:

```
/* 1. Get Arguments instance.*/
Arguments rArgs = agent.GetValueArray(CtiOs_IKeywordIDs.CTIOS_STATISTICS);
```

```
/* 2. Parse as necessary. For example:*/
int availTimeSession = rArgs.GetValueIntObj(CtiOs_IKeywordIDs.CTIOS_AVAILTIMESESSION);
```

Agent Statistics Configuration

You can change which agent statistics are sent to applications by modifying the registry on the CTI OS Server.

For more information about how to change which agent statistics are sent to applications by default, see the *CTI OS System Manager Guide for Cisco Unified ICM*.

Agent Statistics Computed by Sample CTI OS Desktop

The sample CTI OS Desktop computes many agent statistics from data received from CTI Server. You may choose to develop applications that compute these same statistics. Therefore, these computed statistics (in *italics*) and the data and formulas used to derive them are listed below:

- *AvgTalkTimeToday* = (AgentOutCallsTalkTimeToday + HandledCallsTalkTimeToday) / (AgentOutCallsToday + HandledCallsToday)
- *CallsHandledToday* = AgentOutCallsToday + HandledCallsToday
- *TimeLoggedInToday* = LoggedOnTimeToday
- *TimeTalkingToday* = AgentOutCallsTalkTimeToday + HandledCallsTalkTimeToday
- *TimeHoldingToday* = AgentOutCallsHeldTimeToday + IncomingCallsHeldTimeToday
- *TimeReadyToday* = AvailTimeToday
- *TimeNotReadyToday* = NotReadyTimeToday
- *AvgHoldTimeToday* = (AgentOutCallsHeldTimeToday + IncomingCallsHeldTimeToday) / (AgentOutCallsToday + HandledCallsToday)
- *AvgHandleTimeToday* = (AgentOutCallsTimeToday + HandledCallsTimeToday) / (AgentOutCallsToday + HandledCallsToday)
- *AvgIdleTimeToday* = NotReadyTimeToday / (AagentOutCallsToday + HandledCallsToday)
- *PercentUtilitizationToday* = (AgentOutCallsTimeToday + HandledCallsTimeToday) / (LoggedOnTimeToday + NotReadyTimeToday)

Skill Group Statistics

Overview of Skill Group Statistics

This section describes how to receive and work with skill group statistics in a server-to-server integration environment and contains the following subsections:

- Set Up Monitor Mode Application to Receive Skill Group Statistics, on page 52

- Skill Group Statistics Access, on page 54
- Skill Group Statistics Sent to Desktop Application, on page 54
- Skill Group Statistics Computed by Sample CTI OS Desktop, on page 54

Set Up Monitor Mode Application to Receive Skill Group Statistics

To set up a Monitor-mode application to receive skill group statistics:

Procedure

Step 1 Create an instance of the Session class, as described on Connect to CTI OS Server, on page 22.

Step 2 Subscribe for events for the session, as described on Set Event Listener and Subscribe to Events, on page 22.

Note You must register to receive session and skill group events. In the AddEventListener() method you must use as a parameter the field `CtiOs_Enums.SubscriberList.eAllInOneList`, or you must call the method twice using the fields `CtiOs_Enums.SubscriberList.eSessionList` and `CtiOs_Enums.SubscriberList.eSkillGroupList`.

Step 3 Set connection parameters, as described on Set Connection Parameters for Session, on page 23.

Step 4 Connect the desktop application to the CTI OS Server, as described on Connect Session to CTI OS Server, on page 23.

Step 5 Set the message filter as described on Filters for Events for Monitored Calls, on page 28.

a) Create String for the filter using the keyword `S_FILTERTARGET` as the name and the event keyword (enum or number) `eOnNewSkillGroupStatisticsEvent (numeric value 536871027)` as the value.
b) Create an instance of the Arguments class.
c) Set the value in the filter for the CTIOS_FILTER keyword to the String created in Step a.
d) Use the SetMessageFilter() method in the Session class to set the filter for the session, using the Arguments instance you created in Step b as a parameter.

Step 6 Enable individual statistics as needed.

a) Create an instance of the Arguments class.
b) Set values in the Arguments instance. You must provide the skill group number and the peripheral number for each skill group for which you want to receive statistics. Use the SetValue(keyword, int) method signature.

   For example: use SetValue(CTIOS_SKILLGROUPNUMBER, sgNumber) where sgNumber is an integer for the skill group for which you want to receive statistics, and SetValue(CTIOS_PERIPHERALID, peripheralNumber) where sgNumber is an integer for the skill group for which you want to receive statistics.

   Attention You must pass a value of "0" for the Skill Group Priority.

   Caution The application must know the Skill Group ID, and the skill group's Peripheral ID, for any skill group to monitor. The application cannot dynamically get these values from CTI OS Server.

c) Use the Arguments instance as a parameter for the session's EnableSkillGroupStatistics() method.
d) Repeat steps b and c for each skill group for which you want to receive events.

Step 7 When the desktop application no longer requires the statistics for a certain skill group, the application can disable those statistics.

a) Create an instance of the Arguments class.
b) Set values in the Arguments instance. You must provide the skill group number and the peripheral number for each skill group for which you want to receive statistics. Use the SetValue(keyword, int) method signature.

   For example, use SetValue(CTIOS_SKILLGROUPNUMBER, sgNumber) where sgNumber is an integer for the skill group for which you want to receive statistics, and SetValue(CTIOS_PERIPHERALID, sgNumber) where sgNumber is an integer for the skill group for which you want to stop receiving statistics.

c) Use the Arguments instance as a parameter for the session's DisableSkillGroupStatistics() method.

   The following example demonstrates this task in Java:

```
/* 1. Create session.*/
CtiOsSession rSession = new CtiOsSession();

/* 2. Add event listener.*/
rSession.AddEventListener(this,
     CtiOs_Enums.SubscriberList.eSessionList);
rSession.AddEventListener(this,
     CtiOs_Enums.SubscriberList.eSkillGroupList);

/* 3. Set Connection values.*/
Arguments rArgs = new Arguments();
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_CTIOSA, “CTIOSServerA”);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PORTA, 42408);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_CTIOSB, “CTIOSServerB”);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PORTB, 42408);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_HEARTBEAT, 100);

/*4. Connect to server.*.
int returnCode = session.Connect(rArgs);

/*5. Set the message filter. */
String filter = S_FILTERTARGET + "=" + "SkillGroupStats";
rArgs = new Arguments();
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_FILTER, filter);
returnCode = session.SetMessageFilter(rArgs);

/*6. Enable statistics. */
rArgs = new Arguments();
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_SKILLGROUPNUMBER, sgNumber);
rArgs.SetValue(CtiOs_IKeywordIDs.CTIOS_PERIPHERALID, peripheralID);
rSession.EnableSkillGroupStatistics(rArgs);
```

Skill Group Statistics Access

Overview of Skill Groups Statistics Access

After you set up the application to receive skill group statistics, as described in the preceding section, you access skill group statistics through an event handler. The name of the event depends on the language of the application:

- In Java, eOnNewSkillGroupStatisticsEvent()
- In C++, COM, or VB, OnSkillGroupStatisticsUpdated()

Caution The name of the event through which to access skill group statistics is different in Java from other languages supported by CTI OS.

eOnNewSkillGroupStatisticsEvent() in Message Filter (JAVA)

To register to receive skill group statistics, you must include the eOnNewSkillGroupStatisticsEvent() in the message filter.

For example, in Java, the message filter to receive skill group statistics is:

```
String filter = S_MESSAGEID + "=" +

CtiOs_Enums.EventID.eNewSkillGroupStatisticsEvent;
```

For more information about message filters, see Monitor Mode Filters, on page 27.

eOnNewSkillGroupStatisticsEvent() in Message Filter (C++ COM and VB)

To register to receive skill group statistics, you must include the OnSkillGroupStatisticsUpdated() event in the message filter.

For more information about message filters, see Monitor Mode Filters, on page 27.

Skill Group Statistics Sent to Desktop Application

You can change which skill group statistics are sent to desktop applications by modifying the registry on the CTI OS Server.

For more information about how to change which skill group statistics are sent to desktop applications, see the *CTI OS System Manager Guide for Cisco Unified ICM*.

Skill Group Statistics Computed by Sample CTI OS Desktop

The sample CTI OS Desktop computes many skill group statistics from data received from CTI Server. You may choose to develop applications that compute these same statistics. These computed statistics (in italics) and the data and formulas used to derive them are listed below:

- *AvgCallsQTimeNow* = CallsQTimeNow/CallsQNow

- *AvgAgentOutCallsTalkTimeToHalf* = AgentOutCallsTalkTimeToHalf/AgentOutCallsToHalf
- *AvgAgentOutCallsTimeToHalf* = AgentOutCallsTimeToHalf/AgentOutCallsToHalf
- *AvgAgentOutCallsHeldTimeToHalf* = AgentOutCallsHeldTimeToHalf/AgentOutCallsHeldToHalf
- *AvgHandledCallsTalkTimeToHalf* = HandledCallsTalkTimeToHalf/HandledCallsToHalf
- *AvgHandledCallsAfterCallTimeToHalf* = HandledCallsAfterCallTimeToHalf/HandledCallsToHalf
- *AvgHandledCallsTimeToHalf* = HandledCallsTimeToHalf/HandledCallsToHalf
- *AvgIncomingCallsHeldTimeToHalf* = IncomingCallsHeldTimeToHalf/IncomingCallsHeldToHalf
- *AvgInternalCallsRcvdTimeToHalf* = InternalCallsRcvdTimeToHalf/InternalCallsRcvdToHalf
- *AvgInternalCallsHeldTimeToHalf* = InternalCallsHeldTimeToHalf/InternalCallsHeldToHalf
- *AvgCallsQTimeHalf* = CallsQTimeHalf/CallsQHalf
- *AvgAgentOutCallsTalkTimeToday* = AgentOutCallsTalkTimeToday/AgentOutCallsToday
- *AvgAgentOutCallsTimeToday* = AgentOutCallsTimeToday/AgentOutCallsToday
- *AvgAgentOutCallsHeldTimeToday* = AgentOutCallsHeldTimeToday/AgentOutCallsHeldToday
- *AvgHandledCallsTalkTimeToday* = HandledCallsTalkTimeToday/HandledCallsToday
- *AvgHandledCallsAfterCallTimeToday* = HandledCallsAfterCallTimeToday/HandledCallsToday
- *AvgHandledCallsTimeToday* = HandledCallsTimeToday/HandledCallsToday
- *AvgIncomingCallsHeldTimeToday* = IncomingCallsHeldTimeToday/IncomingCallsHeldToday
- *AvgInternalCallsRcvdTimeToday* = InternalCallsRcvdTimeToday/InternalCallsRcvdToday
- *AvgInternalCallsHeldTimeToday* = InternalCallsHeldTimeToday/InternalCallsHeldToday
- *AvgCallsQTimeToday* = CallsQTimeToday/CallsQToday

Silent Monitoring

There are two (mutually exclusive) silent monitoring methods:

- CTI OS based silent monitoring
- Cisco Unified Communications Manager (Unified CM) based silent monitoring

For more information, see the *CTI OS System Manager Guide for Cisco Unified ICM*. For more information about how to enable silent monitor in your application, see CTI OS Based Silent Monitoring, on page 56 or Unified CM-Based Silent Monitoring in Your Application, on page 60, as applicable.

CTI OS Based Silent Monitoring

Note CTI OS Silent Monitor functionality is only available in the C++ and COM CILs.

The silent monitor manager object is responsible for establishing and maintaining the state of a silent monitor session.

The first thing a client application should do is to create a silent monitor object instance. The application should then set this object instance as the current manager in the session object. The CIL provides the interface to this functionality. A client application can work in one of two possible modes:

- **Monitoring mode**. The client receives audio from a remote monitored target (device/agent).
- **Monitored mode**. The client sends audio to a remote monitoring client.

Note Silent Monitor does not work until you set the session mode using one of the following function calls:

- Session.SetAgent() for an Agent mode application
- Session.SetMessageFilters() for a Monitor mode application

Create a Silent Monitor Object

The first step towards setting up a silent monitor session is creating a SilentMonitorManager using the Session object CreateSilentMonitorManager method. Then, set the new manager object as the current silent monitor manager using the Session object SetCurrentSilentMonitor method.

The following VB 6.0 code sample demonstrates how to create a SilentMonitorManager object with COM CIL and make it the current manager in the Session object:

```
Dim errorcode As Long
Dim m_nSMSessionKey As Integer
Dim m_SMManager As CTIOSCLIENTLib.SilentMonitorManager
Dim m_Args As New Arguments
'Create the silent monitor manager
Set m_SMManager = m_session.CreateSilentMonitorManager(m_Args)
'Make the object the current manager
errorcode = m_Session.SetCurrentSilentMonitor(m_SMManager)
```

Session Mode

After you set this new object as the current object, set the manager's work mode to Monitoring for the monitoring client and Monitored for the monitored client. The following sections provide code examples. For more information about syntax of the StartSMMonitoringMode and SMMonitoredMode methods, see SilentMonitorManager Object.

Monitoring Mode

In this mode, the client receives audio confirmation and session status events for a specific silent monitor session. This mode is intended for use by client applications developed for Supervisor desktop functionality. The StartSMMonitoringMode method on the SilentMonitorManager object selects this mode.

Following is a code sample for specifying the mode for the client application.

```
Dim m_Args As New Arguments
'Assemble arguments to set the work mode
m_Args.AddItem("HeartbeatInterval", 5)
m_Args.AddItem("HeartbeatTimeout", 15)
'Address or hostname of the silent monitor service
m_Args.AddItem("SMSAddr", "localhost")
'Port on which silent monitor service is listening
m_Args.AddItem("SMSListenPort", 42228)
'QoS setting when sending messages to the silent monitor service
m_Args.AddItem("SMSTOS", 0)
'Milliseconds between heartbeats
m_Args.AddItem("SMSHeartbeats", 5000)
'Number of missed heartbeats before the connection to the
'silent monitor service is considered disconnected
m_Args.AddItem("SMSRetries", 3)
'Port number where audio will be listened for
m_Args.AddItem("MediaTerminationPort", 4000)
'Set the working mode to monitoring
m_SMManager.StartSMMonitoringMode(args)
```

Monitored Mode

In this mode, the client sends audio and status reports on silent monitor session and receives requests for start and stop silent monitor session. This mode is intended for client applications developed for Agent desktop functionality. The StartSMMonitoredMode method on the SilentMonitorManager object selects this mode.

Following is a code sample for specifying the mode for the client application:

```
Dim m_Args As New Arguments
'Assemble arguments to set the work mode
m_Args.AddItem("HeartbeatInterval", 5)
m_Args.AddItem("HeartbeatTimeout", 15)
'Address or hostname of the silent monitor service
m_Args.AddItem("SMSAddr", "localhost")
'Port on which silent monitor service is listening
m_Args.AddItem("SMSListenPort", 42228)
'QoS setting when sending messages to the silent monitor service
m_Args.AddItem("SMSTOS", 0)
'Milliseconds between heartbeats
m_Args.AddItem("SMSHeartbeats", 5000)
'Number of missed heartbeats before the connection to the
'silent monitor service is considered disconnected
m_Args.AddItem("SMSRetries", 3)
'Extension number of the IP Phone to monitor
m_Args.AddItem("MonitoringDeviceID", 1234)
'Set the working mode to monitored
m_silentMonitor.StartSMMonitoredMode(args)
```

Silent Monitor Session

Initiating a silent monitor session starts with the client in monitoring mode, calling the StartSilentMonitorRequest method. This indicates that the CTI OS server send an

OnSilentMonitorStartRequestedEvent to a remote client in monitored mode. The remote client, upon receiving the OnSilentMonitorStartRequestedEvent, chooses whether or not accept the request. The remote client acknowledges its approval or rejection by sending a status report back to the monitoring client. The monitoring client receives the acceptance or rejection via the OnSilentMonitorStatusReportEvent. When the session is accepted by the remote client, it immediately starts forwarding voice to the monitoring client. The monitoring client can terminate the silent monitoring session only by calling the StopSilentMonitorRequest method. CTI OS server issues the OnSilentMonitorStopRequestedEvent to the remote client. The monitored client stops sending audio immediately when OnSilentMonitorStopRequestedEvent is received by its SilentMonitorManager object.

Following are code samples for initiating and ending a silent monitor session:

Monitoring Client Code Sample

```
Private Sub btnStartSM_OnClick()
Dim m_Args As New Arguments

'Agent to monitor
 m_Args.AddItem("AgentID", "23840")
 m_Args.AddItem("PeripheralID", "5000")
 m_Args.AddItem("HeartbeatInterval", 5)
 m_Args.AddItem("HeartbeatTimeout", 15)

'If MonitoringIPPort is not specified, port 39200 will be used by 'default.
 m_Args.AddItem("MonitoringIPPort", 39200)

'Request silent monitor session to start
m_SMManager.StartSilentMonitorRequest(m_Args, m_nSMSessionKey)
End Sub

Private Sub m_session_OnSilentMonitorStatusReportEvent(By Val pIArguments As
CTIOSCLIENTLib.IArguments)
         Dim strAgent As String
         Dim nMode As Integer

         nMode pIArguments.GetValueInt("StatusCode)

If nMode = eSMStatusMonitorStarted Then strAgent =
pIArguments.GetValueString("MonitoredUniqueObjectID")
            MsgBox "Silent Monitor Status",,
"Started Monitoring Agent: " & strAgent
         Else
            MsgBox "Silent Monitor Status",,
"Request Failed with code = " & nMode
         End If
End Sub

Private Sub tmrScreening_Timer()
'After listening the conversation for 30 sec, drop monitoring session

'Assemble arguments for stop  request
'Agent to monitor
m_Args.AddItem "SMSessionKey", m_nSMSessionKey

'Request silent monitor session to stop
m_SMManager.StopSilentMonitorRequest(m_Args, m_nSMSessionKey)

End Sub
```

Monitored Client Code Sample

```
Private Sub m_session_OnSilentMonitorStartRequestedEvent(By Val pIArguments As
CTIOSCLIENTLib.IArguments)
     Dim strRequestInfo As String

     strRequestInfo =  pIArguments.DumpArgs
MsgBox "Request to Start Silent Monitor Received",, strRequestInfo
End Sub

Private Sub m_session_OnSilentMonitorStopRequestedEvent(By Val pIArguments As
CTIOSCLIENTLib.IArguments, bDoDefaultProcessing)
     Dim strRequestInfo As String

     strRequestInfo =  pIArguments.DumpArgs
MsgBox "Request to Stop Silent Monitor Received",, strRequestInfo
End Sub
```

Silent Monitor Manager Shutdown

Shutting down the Silent monitor object requires that the monitoring client call the StopSilentMonitorMode method when it is done monitoring an agent, and that the monitored client call the StopSilentMonitorMode method during cleanup. Each client must then remove the silent monitor manager from the Session object by calling SetMonitorCurrentSilentMonitor with a NULL pointer. Finally each client must destroy the silent monitor object using Session's DestroySilentMonitorManager method.

Following is a code sample for initiating and ending a silent monitor session:

```
'Stop Silent Monitor ModeRequest
m_SMManager.StopSilentMonitorMode
'Remove silent monitor manager object from session
errorcode = m_session_SetCurrentSilentMonitor(Nothing)
'Destroy silent monitor manager object
errorcode = m_session.DestroySilentMonitorManager()
```

CTI OS Silent Monitor Management in Monitor Mode

CTI OS Silent Monitor is configured, initiated, and ended the same in monitor mode as it is in agent mode. There is one additional step in monitor mode. You must include the OnCallRTPStarted and OnCallRTPStopped events in the filter used by the monitor mode application. An example follows.

```
// 116 = OnCallRTPStarted
// 117 = OnCallRTPStopped
m_session.SetMessageFilter("MessageID = 116, 117")
```

Note For more information, see Session Modes.

Unified CM-Based Silent Monitoring in Your Application

CCM-Based Silent Monitor Overview

CCM based silent monitor is the Call Manager implementation of silent monitor. When CCM based silent monitor is used, silent monitor is implemented as a call. After initiating silent monitor, the supervisor is able to hear agent conversations using their phone.

Agents can only be silent monitored by one supervisor at a time.

CCM based silent monitor is supported in all CILs.

The CTI Toolkit Combo Desktop .Net sample includes CCM based silent monitor source code.

The following section describes how to enable CCM based silent monitor in custom CTI OS applications.

CTI OS Monitor Mode Applications

CCM based silent monitor is not supported for CTI OS monitor mode applications.

CCM-Based Silent Monitor Request

Before you initiate CCM based silent monitor, ensure that you configure CCM based silent monitor. For more information, see Determine if CCM-Based Silent Monitoring Is Enabled, on page 63.

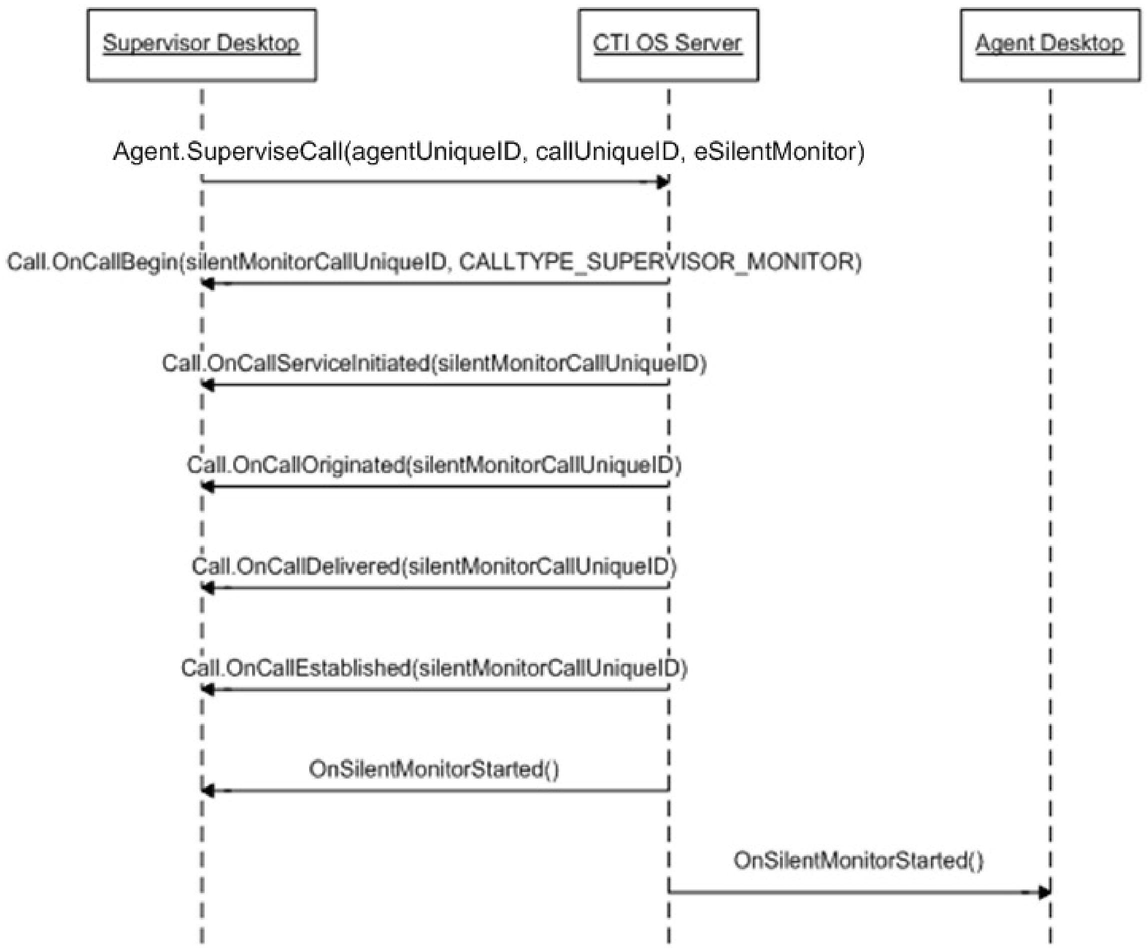
CCM based silent monitoring is initiated through the SuperviseCall() method associated with the supervisor's Agent object. To start silent monitor:

- Set the SupervisoryAction parameter to eSupervisorMonitor.
- Set the AgentReference parameter to the unique object ID of the agent to be silent monitored.
- Set the AgentCallReference parameter to the unique object ID of the call to be silent monitored.

When the request is successfully initiated and the silent monitor call is established, the supervisor and agent applications receive the OnSilentMonitorStartedEvent. You can use this event to trigger application specific logic.

The following figure illustrates the messaging that occurs between the CIL and CTI OS Server after an application initiates a CCM based silent monitor request using Agent.SuperviseCall().

Figure 5: CIL-to-CTI OS Server Messaging When CCM-Based Silent Monitor Initiated Using Agent.SuperviseCall()


Supervisor Desktop
CTI OS Server
Agent Desktop
Agent.SuperviseCall(agentUniqueID, callUniqueID, eSilentMonitor)
Call.OnCallBegin(silentMonitorCallUniqueID, CALLTYPE_SUPERVISOR_MONITOR)
Call.OnCallServiceInitiated(silentMonitorCallUniqueID)
Call.OnCallOriginated(silentMonitorCallUniqueID)
Call.OnCallDelivered(silentMonitorCallUniqueID)
Call.OnCallEstablished(silentMonitorCallUniqueID)
OnSilentMonitorStarted()
OnSilentMonitorStarted()

C# Code Sample for Initiating Silent Monitor Session

```
Agent curAgent = session.GetCurrentAgent() ;
Agent monAgent = curAgent.GetMonitoredAgent() ;
Call monCall = curAgent.GetMonitoredCall() ;

string monAgentID;
monAgent.GetValueString(
    Enum_CtiOs.CTIOS_UNIQUEOBJECTID,
    out monAgentID);

string monCallID;
monCall.GetValueString(
    Enum_CtiOs.CTIOS_UNIQUEOBJECTID,
    out monCallID);

Arguments args = new Arguments() ;
args.SetValue(Enum_CtiOs.CTIOS_AGENTREFERENCE, monAgentID) ;
args.SetValue(Enum_CtiOs.CTIOS_AGENTCALLREFERENCE, monCallID) ;
args.SetValue(
    Enum_CtiOs.CTIOS_SUPERVISORYACTION,
    SupervisoryAction.eSupervisorMonitor) ;
```

```
CilError ret = curAgent.SuperviseCall(args) ;
```

Current Agent Being Silently Monitored

If an application needs to determine if the current agent is being silently monitored, then compare the current agent unique object ID against the silent monitor target agent unique ID carried in the SilentMonitorStartedEvent.

Code Sample for Determining if Current Agent Is Target of Silent Monitor Call

Note The parameter args carries the payload of an OnSilentMonitorStartedEvent.

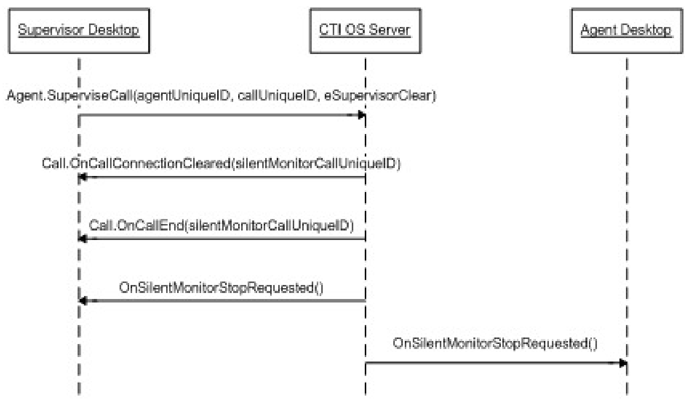
```
public bool IsCurrentAgentTargetAgent(Arguments args)
{
        bool isTarget = false ;

        if ( m_ctiSession != null )
        {
               Agent rAgent = m_ctiSession.GetCurrentAgent() ;
               if ( rAgent != null )
               {
                    string curAgentUID ;
                 rAgent.GetValueString(Enum_CtiOs.CTIOS_UNIQUEOBJECTID,
                                      out curAgentUID) ;
                      if ( curAgentUID != null )
                      {
                             string targetAgentUID ;

args.GetValueString(Enum_CtiOs.CTIOS_SILENTMONITOR_TARGET_AGENTUID,
                         out targetAgentUID) ;

                              if ( targetAgentUID != null )
                              {
                                      isTarget = curAgentUID == targetAgentUID;
                              }
                      }
                }
        }

        return isTarget ;
}
```

CCM-Based Silent Monitor Request End

CCM based silent monitoring is stopped using the SuperviseCall method associated with the supervisor's Agent object. To stop silent monitor, set the SupervisoryAction parameter to eSupervisorClear. Set the AgentReference parameter to the unique object ID of the agent currently silent monitored. Set the AgentCallReference parameter to the unique object ID of the call that resulted from the initiation of silent monitor (Agent.SuperviseCall[eSupervisorMonitor]). The application receives the SilentMonitorStopRequestedEvent event when the stop silent monitoring request is processed.

The following figure illustrates the message flow.

Figure 6: Message Flow When Ending a CCM-Based Silent Monitor Request


Supervisor Desktop
CTI OS Server
Agent Desktop
Agent.SuperviseCall(agentUniqueID, callUniqueID, eSupervisorClear)
Call.OnCallConnectionCleared(silentMonitorCallUniqueID)
Call.OnCallEnd(silentMonitorCallUniqueID)
OnSilentMonitorStopRequested()
OnSilentMonitorStopRequested()

You can also release the silent monitor call using the Call.Clear() method.

Code Sample for Ending Silent Monitor Session

```
Agent curAgent = session.GetCurrentAgent();

string monAgentID;
curAgent.GetValueString(
   Enum_CtiOs.CTIOS_SILENTMONITOR_TARGET_AGENTUID,
   out monAgentID);

string monCallID;
curAgent.GetValueString(
   Enum_CtiOs.CTIOS_SILENTMONITOR_CALLUID,
   out monCallID);

Arguments args = new Arguments() ;
args.SetValue(Enum_CtiOs.CTIOS_AGENTREFERENCE, monAgentID) ;
args.SetValue(Enum_CtiOs.CTIOS_AGENTCALLREFERENCE, monCallID) ;

args.SetValue(
   Enum_CtiOs.CTIOS_SUPERVISORYACTION,
   SupervisoryAction.eSupervisorClear) ;

CilError ret = curAgent.SuperviseCall(args) ;
```

Determine if CCM-Based Silent Monitoring Is Enabled

To determine if CCM based silent monitoring is enabled, use the Session.IsCCMSilentMonitor() method if the application uses the C++, Java, or .Net CIL. Use the CCMBasedSilentMonitor value stored in the session object if the application uses the COM CIL:

```
/// <summary>
/// Determines if CCM Based Silent Monitor is enabled
/// </summary>
public bool IsCCMSilentMonitor()
{
    if ( m_ctiSession == null )
    {
       return false ;
    }
    return m_ctiSession.IsCCMSilentMonitor() ;
}
```

Agent Greeting

There are several ways to control the behavior of the Agent Greeting feature. You can enable or disable Agent Greeting for the duration of the Agent's login session. Note that when an Agent logs in, the feature is automatically enabled.

Code example:

```
Arguments &rArgAgentAction = Arguments::CreateInstance();
rArgAgentAction.AddItem("AgentAction", commandRequested);
int nRetVal = m_pCtiAgent->SetAgentGreetingAction(rArgAgentAction);
rArgAgentAction.Release();

Where "commandRequested" is an int with the value 1 (to disable) or 2 (to enable).
```

Deployment of Custom CTI OS Applications

This section discusses the deployment of CTI OS applications in the various programming languages and interfaces.

Application Deployment Using ActiveX Controls

ActiveX controls need all the components for COM deployment plus the components listed in the following table.

Table 3: ActiveX Control DLLs

DLL	Description
Agentselectctl	AgentSelect ActiveX control
agentstatectl.dll	Agentstate ActiveX control
AlternateCtl.dll	Alternate ActiveX control
answerctl.dll	Answer/Release ActiveX control
arguments.dll	Arguments COM class
badlinectl.dll	Badline ActiveX control
buttoncontrol.dll	Basic Button ActiveX control
ccnsmt.dll	Cisco EVVBU Media Termination ActiveX control
chatctl.dll	Chat ActiveX control
conferencectl.dll	Conference ActiveX control

DLL	Description
cticommondlgs.dll	Common Dialogs utility COM object
CTIOSAgentStatistics.dll	AgentStatistics ActiveX control
ctioscallappearance.dll	CallAppearance ActiveX control
ctiosclient.dll	COM cil interfaces
ctiossessionresolver.dll	COM sessionresolver
CTIOSSkillGroupStatistics.dll	SkillgroupStatistics ActiveX control
ctiosstatusbar.dll	StatusBar ActiveX control
EmergencyAssistCtl.dll	EmergencyAssist ActiveX control
gridcontrol.dll	GridControl ActiveX control
holdctl.dll	Hold/Retrieve ActiveX control
IntlResourceLoader.dll	Internationalization COM object
makecallctl.dll	MakeCall ActiveX control
ReconnectCtl.dll	Reconnect ActiveX control
recordctl.dll	Record ActiveX control
SilentMonitorCtl.dll	Standalone Silent Monitor ActiveX control
SubclassForm.dll	COM utility control
SupervisorOnlyCtl.dll	Supervisor ActiveX control
transferctl.dll	Transfer ActiveX control

You must copy and register ActiveX controls using the regsvr32 Windows utility. Some ActiveX controls are dependent on others. For example, all Button type controls (for example, AgentStatectl.dll) depend on (buttoncontrol.dll) and all Grid type controls (for example, CtiosCallappearance.dll) depend on Gridcontrol.dll. The following table means that for a dll listed in the left column to work properly, all dlls listed in the right column (Dependencies) need to be available (copied and registered).

The following table lists the dependencies of CTI OS ActiveX controls.

Table 4: Dependencies of CTI OS ActiveX Controls

DLL File	Dependencies
Agentselectctl	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.AgentSelectCtl.dllInterop.AgentSelectCtl.dll

DLL File	Dependencies
agentstatectl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, cticommondlgs.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.AgentStateCtl.dllInterop.AgentStateCtl.dll
AlternateCtl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.AlternateCtl.dllInterop.AlternateCtl.dll
answerctl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.AnswerCtl.dllInterop.AnswerCtl.dll
arguments.dll	ATL80.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:Cisco.CTIOSARGUMENTSLib.dll
badlinectl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.BadLineCtl.dllInterop.BadLineCtl.dll
buttoncontrol.dll	ATL80.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.ButtonControl.dllInterop.ButtonControl.dll
ccnsmt.dll	Traceserver.dll, LIBG723.dll
chatctl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.ChatCtl.dllInterop.ChatCtl.dll
conferencectl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, cticommondlgs.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.ConferenceCtl.dllInterop.ConferenceCtl.dll
cticommondlgs.dll	ATL80.dll, ctiosclient.dll, arguments.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:Cisco.CTICOMMONDLGSLib.dll

DLL File	Dependencies
CTIOSAgentStatistics.dll	ATL80.dll, ctiosclient.dll, arguments.dll, Gridcontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.CTIOSAgentStatistics.dllInterop.CTIOSAgentStatistics.dll
ctioscallappearance.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, cticommondlgs.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.CTIOSCallAppearance.dllInterop.CTIOSCallAppearance.dll
ctiosclient.dll	ATL80.dll, arguments.dll, ctiosracetext.exe, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:Cisco.CTIOSCLIENTLib.dll If the client application uses silent monitoring in monitoring mode, ccnsmt.dll is also a dependency. If the client application uses silent monitoring in monitored mode, wpcap.dll is also a dependency.
ctiossessionresolver.dll	ATL80.dll, ctiosclient.dll, arguments.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:Cisco.CTIOSSESSIONRESOLVERLib.dll
CTIOSSkillGroupStatistics.dll	ATL80.dll, ctiosclient.dll, arguments.dll, Gridcontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.CTIOSSkillGroupStatistics.dllInterop.CTIOSSkillGroupStati
ctiosstatusbar.dll	ATL80.dll, ctiosclient.dll, arguments.dll, cticommondlgs.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.CTIOSStatusBar.dllInterop.CTIOSStatusBar.dll
EmergencyAssistCtl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.EmergencyAssistCtl.dllInterop.EmergencyAssistCtl.dll
gridcontrol.dll	ATL80.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.GridControl.dllInterop.GridControl.dll

DLL File	Dependencies
holdctl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.HoldCtl.dllInterop.HoldCtl.dll
IntlResourceLoader.dll	ATL80.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:Cisco.INTLRESOURCELOADERLib.dll
makecallctl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, cticommondlgs.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.MakeCallCtl.dllInterop.MakeCallCtl.dll
ReconnectCtl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.ReconnectCtl.dllInterop.ReconnectCtl.dll
recordctl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.RecordCtl.dllInterop.RecordCtl.dll
SilentMonitorCtl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, ccnsmt.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.SilentMonitorCtl.dllInterop.SilentMonitorCtl.dll
SubclassForm.dll	ATL80.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.SubclassForm.dllInterop.SubclassForm.dll
SupervisorOnlyCtl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.SupervisorOnlyCtl.dllInterop.SupervisorOnlyCtl.dll
transferctl.dll	ATL80.dll, ctiosclient.dll, arguments.dll, buttoncontrol.dll, cticommondlgs.dll, MSVCP80.dll, MSVCR80.dll **Note** When used in a.NET application must include:AxInterop.TransferCtl.dllInterop.TransferCtl.dll

Application Deployment Using COM (but Not ActiveX Controls)

Custom applications using COM from VB or C++ or any other Com supported development platform need the following COM Dynamic Link Libraries:

- CTIOSClient.dll

  When used in a.NET application must include: Cisco.CTIOSCLIENTLib.dll

-
- Arguments.dll

  When used in a.NET application must include: Cisco.CTIOSARGUMENTSLib.dll

-
- CtiosSessionresolver.dll (only if used – see previous discussion)

  When used in a.NET application must include: Cisco.CTIOSSESSIONRESOLVERLib.dll

-
- ATL80.dll (only if not already available on target system)
- If the client application uses silent monitoring in monitoring mode, ccnsmt.dll is needed. If the client application uses silent monitoring in monitored mode, wpcap.dll is also a dependency.

You must copy and register the dll files on the target system. To register, use the Windows utility regsvr32.exe providing the dll name (for example, regsvr32 ctiosclient.dll).

ATL80.dll is a Microsoft Dynamic Link Library implementing the Active Template Library used by CTI OS. It is usually available on most Windows client systems in a windows system directory (for example, \winnt\syste32 on Windows 2000). Because CTI OS depends on this DLL, you must copy and register it if it is not already available at the target system.

Application Deployment Using C++ CIL

Custom C++ applications link to the static CTI OS libraries. With your custom application, you should also distribute ctiostracetext.exe. For the tracing component to work, you need to register it on the system where your application will run. To register the trace tool, run ctiostracetext /RegServer. Besides ctiostracetex.exe, there is no need to ship additional components.

Application Deployment Using .NET CIL

Applications built with the .NET CIL class libraries require the following assemblies to be distributed with the custom application.

Table 5: .NET CIL Libraries

Library	Description
NetCil.dll	.NET CIL Class library, contains the CTI OS object classes
NetUtil.dll	.NET Util Class library, contains helper and utility classes used in conjunction with .NET CIL

Note In addition to NetCil.dll and NetUtil.dll, the .NET Combo sample requires the CTIOSVideoCtl.dll, which is located in C:\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\dotNet CIL\Controls.

You can install both assembly libraries in the Global Assembly Cache (GAC) at the application host computer or they can be at the working directory of the custom client application.

Custom Application and CTI OS Security

A custom application that launches the SecuritySetupPackage.exe program to create CTI OS client certificate request needs to add the **InstallDir** registry value under the following registry key:

```
SOFTWARE\Cisco Systems\CTI Desktop\CtiOs
```

If the **InstallDir** registry value does not exist, then the setup program fails and aborts the installation process, otherwise the program uses the **InstallDir** registry value to create and copy the security files to the right place after it appends Security directory to it.

For example, if the **InstallDir** registry value is

```
<drive>:\Program Files\Cisco Systems\CTIOS Client
```

then the security files should be under

```
<drive>:\Program Files\Cisco Systems\CTIOS Client\Security
```

Supervisor Applications

This section describes how to build a supervisor desktop for Unified CCE. The following documentation references the source of the CTI OS Toolkit Combo Desktop when describing how to build a supervisor desktop. This section also references a class called CTIObject. The CTI OS Toolkit Combo Desktop uses this class to wrap CIL functionality.

The source code for the Combo Desktop is found in the following directories.

- <Install Drive>\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\dotNet CIL\Samples\CTI Toolkit Combo Desktop.NET
- <Install Drive>\Program Files\Cisco Systems\CTIOS Client\CTIOS Toolkit\dotNet CIL\Samples\CtiOs Data Grid.NET

In the following section, string keys are used as keys to method calls. This is for the sake of readability. A developer writing an application can use either string or integer based keys.

General Flow

The general flow of a supervisor application is as follows:

1. Request the supervisor's teams.
2. Start monitoring the supervisor's team.

3. Select a team member and start monitoring the selected team member's activity.
4. Perform supervisory actions on the currently monitored call.

These steps illustrate the layers of a supervisor application. First, the application gets the team. After the team is retrieved, the supervisor application can monitor agents. This generates more events/information allowing the supervisor application to monitor agent calls.

Monitored and Unmonitored Events

When writing a supervisor application, developers are confronted with two types of events: monitored events and unmonitored events.

Unmonitored events are received for agent, call, and button enablement events associated with the supervisor. Monitored events are received to notify the supervisor of agent, call, and button enablement events corresponding to an agent or call that is currently monitored by the supervisor. These events carry a field named CTIOS_ISMONITORED. This field is set to true.

For example, if a supervisor changes state to ready, the supervisor receives an AgentStateEvent. If a supervisor is monitoring an agent and the monitored agent changes state, the supervisor receives an OnMonitoredAgentState event. Call events behave in a similar manner. When the supervisor puts a call on hold, the supervisor receives an OnCallHeld event. When the supervisor is monitoring an agent and that agent puts a call on hold, the supervisor receives an OnMonitoredCallHeld event.

Button enablement events behave differently. When the supervisor is monitoring agents on the supervisor's team, the agent receives OnButtonEnablementChange events for the monitored agent. It is important for the application not to apply these events to elements of the application that control the supervisor's or any of the supervisor's calls state. For example, if a monitored agent changes state to ready, the supervisor receives a ButtonEnablementChange event. The supervisor should not apply this event since the event does not apply to the supervisor's state.

To determine if an event is monitored, check the payload of the event for the “Monitored” field. If the field exists and is set to true, the event is a monitored event.

Supervisor Application Flow to Request and Monitor Team

This section discusses steps 1 and 2 in the flow of a supervisor application. The methods and events listed below are used to request and monitor the team.

Methods Called:

Agent.RequestAgentList(Arguments args)

Agent.StartMonitoringAgentTeams(Arguments args)

Events Processed:

OnNewAgentTeamMember

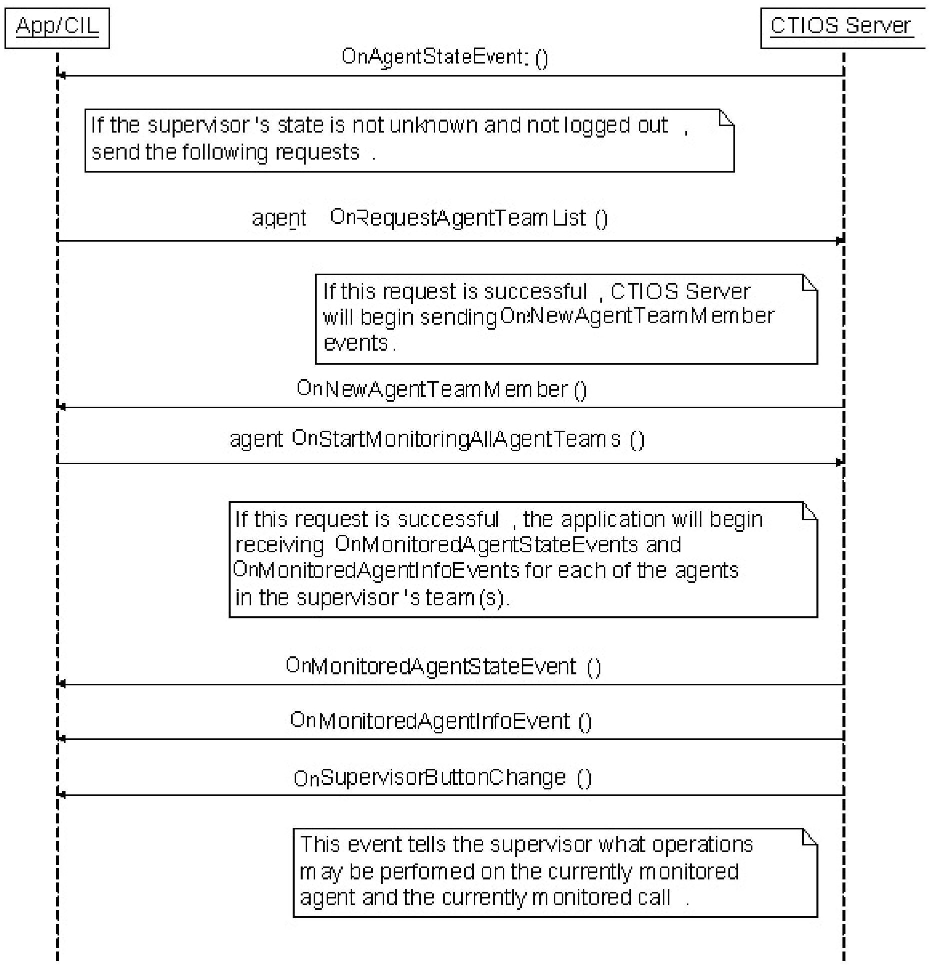
OnMonitoredAgentStateChange

OnMonitoredAgentInfo

OnSkillInfo

The following diagram illustrates the flow of messages between the application and CTI OS Server when the supervisor application requests its team and then requests to monitor the team. Because logging in a supervisor is the same as logging in an agent, this diagram picks up at the first AgentStateEvent after the agent has logged in.

Figure 7: Message Flow Between the Application and the CTI OS Server


App/CIL
CTIOS Server
OnAgentStateEvent: ()
If the supervisor 's state is not unknown and not logged out , send the following requests .
agent OnRequestAgentTeam List ()
If this request is successful , CTIOS Server will begin sending OnNewAgentTeamMember events .
OnNewAgentTeamMember ()
agent OnStartMonitoringAllAgentTeams ()
If this request is successful , the application will begin receiving OnMonitoredAgentStateEvents and OnMonitoredAgentInfoEvents for each of the agents in the supervisor 's team (s).
OnMonitoredAgentStateEvent ()
OnMonitoredAgentInfoEvent ()
OnSupervisorButtonChange ()
This event tells the supervisor what operations may be perfomed on the currently monitored agent and the currently monitored call .

The requests leading up to and including Agent.StartMonitoringAgent() is in CTIObject.StartMonitoringAgent(). When writing a supervisor application, the developer should call Agent.RequestAgentTeamList() and Agent.StartMonitoringAllAgentTeams(). The developer should call these methods after the supervisor logs in. In the CTI OS Toolkit Combo Desktop, this is done when processing the eAgentStateEvent in the SupervisorUIManager class' ProcessAgentStateEvent() method. SupervisorUIManager checks to see that the current agent is a supervisor. If so and if CTIObject.StartMonitoringTeams() has not already been called, CTIObject.StartMonitoringTeams() is called. CTIObject.StartMonitoringTeams() then calls Agent.RequestAgentTeamList() and Agent.StartMonitoringAllAgentTeams().

If these requests are successful, the desktop begins receiving OnNewAgentTeamMember, OnMonitoredAgentStateChange, and MonitoredAgentInfoEvent events. The next sections describe how to handle each of these events.

OnNewAgentTeamMember Events

Process OnNewAgentTeamMember events as follows.

The OnNewAgentTeamMember event is received for two possible reasons:

1. After the application calls Agent.RequestAgentTeamList(), OnNewAgentTeamMember events are sent for each member of the supervisor's team.

2. An agent has been added or removed from the supervisor's team.

To address point 2 above, examine the field “ConfigOperation” in the payload of the OnNewAgentTeamMember event. If this flag does not exist or exists and is set to TeamConfigFlag.CONFIG_OPERATION_ADDAGENT (1), add the agent to the grid. If the flag exists and is not set to TeamConfigFlag.CONFIG_OPERATION_ADDAGENT, remove the agent from the grid.

In supervisor applications, use the value in the UniqueObjectID field of the event to uniquely reference/track each agent in the supervisor's team. This ID uniquely identifies each agent cached on the CIL.

OnNewAgentTeamMember Events and Supervisors

Note Because the supervisor is considered part of the team, an OnNewAgentTeamMember event is sent for the supervisor logged in to the application. If the developer does not want to include the supervisor in the agent team grid, compare the current agent ID to the ID of the agent carried in the OnNewAgentTeamMember event. If the values are equal, do not add the supervisor to the grid.

If the developer does not want to add primary supervisors to the grid, retrieve the Agent object stored in the CIL using the Session.GetObjectFromObjectID() method. When calling Session.GetObjectFromObjectID(), set the value in the “UniqueObjectID” (Enum_CtiOs.CTIOS_UNIQUEOBJECTID) field of the OnNewAgentTeamMember event as the key (first parameter to this method). This method returns an Agent object. Check the properties of the Agent object for the field “AgentFlags” (Enum_CtiOs.CTIOS_AGENTFLAGS). If the field exists with the TeamConfigFlag.AGENT_FLAG_PRIMARY_SUPERVISOR (0x01) bit set, the agent is a primary supervisor and should not be added to the grid.

It is possible for an agent to be team supervisor while not being a member of the team. Some supervisor applications, including the combo desktop, may not want to add this type of supervisor to the agent select grid. This is tricky because supervisors that are not part of the team generate OnMonitoredAgentStateChange events. The agent select grid normally updates when the OnMonitoredAgentStateChangeevent is received. To prevent this, supervisors who are not members of the team that they are supervising need to be marked as such. You can use this information to avoid updates when an OnMonitoredAgentStateChange event is received for a supervisor that is not part of the team. To accomplish this, the application leverages the following:

1. OnNewAgentTeamMember events are not received for supervisors that are not part of the team.

2. The CIL keeps a cache of all the agents and supervisors that it knows about. Agents in this cache have properties that can be modified by applications built on top of the CIL.

Knowing this, the application marks every agent that is included in a OnNewAgentTeamMember event as a member of this supervisor's team. When OnMonitoredAgentStateChange events are received, the agent select grid only updates when the agent that is represented by the event is marked as a member of the team. In short, any agent that does not send a OnNewAgentTeamMember event to the CIL is not displayed in the agent select grid. This is illustrated in the SupervisorUIManager.ProcessMonitoredAgentStateChange() method.

OnMonitoredAgentStateChange Events

OnMonitoredAgentStateChange events are sent when an agent in the supervisor's team changes state. Supervisor applications, like the CTI OS Toolkit Combo Desktop, use this event to update structures that store the supervisor's team (the agent team grid). This event is processed similar to OnNewAgentTeamMember. However, there is one subtle difference. Instead of using the Arguments object carried with the event, the application uses the arguments associated with the Agent object cached by the CIL. This is done to correctly handle skill group membership changes related to dynamic reskilling. The CIL contains logic that processes the OnMonitoredAgentStateChange and determines whether or not an agent has been added or removed from a skill group. The changes in the agent's skill group membership are reflected in the Agent object's properties.

OnMonitoredAgentInfo Event

You can use this event to populate the following agent information:

- AgentID
- AgentFirstName
- AgentLastName
- LoginName

Time in State

If your application needs to track an agent's time in state, it can be done as follows. The algorithm is contained in AgentSelectGridHelper.cs. The first part of the algorithm resides in the AgentData.UpdateData() method. This method decides if the agent's state duration is known or unknown. An agent's state duration is unknown if the agent was just added to the grid or if the agent's state has not changed since being added to the grid. If a state change is detected after the agent was added to the grid, the time of the state change is marked.

Second, there is a timer callback that the AgentSelectGridHelper class starts when the grid is initialized. The timer callback fires every ten seconds. When the callback fires, the method AgentSelectGridHelper.m_durationTimer_Tick() cycles through all of the rows in the grid. Each row whose Time in State column is not unknown has its value set to the time the agent changed state minus the current time.

OnSkillInfo Event

OnSkillInfo events are sent to the CIL when skillgroup statistics are enabled using the Agent.EnableSkillGroupStatistics() method. These events are used to populate the fields in the Skill Name column of the team grid. OnSkillInfo events carry the ID of a skill group and its corresponding name. The AgentSelectGridHelper processes this event by storing a mapping of skill group IDs to skill group names. After the map is updated, each field in the Skill Name column is updated to reflect the new skill name.

Agent Team Information Displayed in Grid Format

If your application would like to display agent team information in a grid similar to the one used by the CTI OS Toolkit Combo Desktop, the following table illustrates which events supply information for each column.

Please refer to CtiOsDataGrid.AgentSelectGridHelper as an example of handling the OnNewAgentTeamMember event.

Table 6: Agent Grid Data Population

Column	Event	Field
Name	OnNewAgentTeamMember OnMonitoredAgentStateChange OnMonitoredAgentInfoEvent	Enum_CtiOs.CTIOS_AGENTFIRSTNAME Enum_CtiOs.CTIOS_AGENTLASTNAME
Login Name	OnMonitoredAgentStateChange OnMonitoredAgentInfoEvent	Enum_CtiOs.CTIOS_LOGINNAME
Agent ID	OnNewAgentTeamMember OnMonitoredAgentStateChange OnMonitoredAgentInfoEvent	Enum_CtiOs.CTIOS_AGENTID
Agent State	OnNewAgentTeamMember OnMonitoredAgentStateChange	Enum_CtiOs.CTIOS_STATE
Time in State	OnMonitoredAgentStateChange	For more information, see Time in State, on page 74.
Skill Group	OnMonitoredAgentStateChange	Enum_CtiOs.CTIOS_NUMSKILLGROUPS
Skill Name	OnSkillInfoEvent	For more information, see OnSkillInfo Event, on page 74.
Available for Call	OnNewAgentTeamMember	Enum_CtiOs.CTIOS_AGENTAVAILABILITYSTATUS

Note The Skill Group column lists the field from the Arguments object as CTIOS_NUMSKILLGROUPS. This field tells the developer how many skill groups the agent belongs to. To obtain information about each of the agent's skill groups the developer should construct the following loop to get information about each of the agent's skill groups (code taken from the sample source file CtiOsDataGrid\AgentSelectGridHelper.cs).

```
// Check to see if the event carries an array of skillgroups
// (OnNewAgentTeamMember)
//
int numGroups ;
if ( args.GetValueInt(Enum_CtiOs.CTIOS_NUMSKILLGROUPS, out numGroups) )
{
    CtiOsDataGrid.Trace(
        Logger.TRACE_MASK_METHOD_AVG_LOGIC,
        methodName,
        "Found skillgroup numbers") ;

    m_skillGroupNumbers.Clear() ;

    for ( int j = 1 ; j <= numGroups ; j++ )
    {
        CtiOsDataGrid.Trace(
            Logger.TRACE_MASK_METHOD_AVG_LOGIC,
                methodName,
                string.Format("Looking for skillgroup at position {0}", j)) ;

            string unknownStr = string.Format(
                AgentSelectGridHelper.STRING_UNKNOWN_SG_FORMAT, j) ;

            // Keys for individual skillgroups are formatted as SkillGroup[{index}]
            //
            string sgKey = string.Format(
                AgentSelectGridHelper.STRING_SKILLGROUP_FORMAT, j) ;

            // Each element of the array is an argument containing
            // skillgroup information.
            //
            Arguments sgInfo ;
            if ( !args.GetValueArray(sgKey, out sgInfo) )
            {
                CtiOsDataGrid.Trace(
                    Logger.TRACE_MASK_WARNING,
                    methodName,
                    string.Format("No skillgroup info at position {0}", j)) ;

                m_skillGroupNumbers.Add(unknownStr) ;
            }
            else
            {
                string sgStr ;
                if ( sgInfo.GetValueString(
                         Enum_CtiOs.CTIOS_SKILLGROUPNUMBER,
                         out sgStr) )
                {
                    CtiOsDataGrid.Trace(
                        Logger.TRACE_MASK_METHOD_AVG_LOGIC,
                        methodName,
                        string.Format(
                            "Found skillgroup number {0} at position {1}", sgStr, j)) ;

                    m_skillGroupNumbers.Add(sgStr) ;
                }
                else
                {
                    CtiOsDataGrid.Trace(
                        Logger.TRACE_MASK_WARNING,
                        methodName,
                        string.Format("No skillgroup number at position {0}", j)) ;

                    m_skillGroupNumbers.Add(unknownStr) ;
                }
            }
        }
    }
```

Supervisor Application Flow to Monitor an Agent

This section discusses step 3 in the flow of a supervisor application. The methods and events listed below are used to monitor an agent.

Methods Called:

Agent.StartMonitoringAgent(Arguments args)

Events Processed:

OnSupervisorButtonChange

OnStopMonitoringAgent

OnMonitoredAgentStateChange

OnMonitoredCallBegin

OnMonitoredCallCleared

OnMonitoredCallConferenced

OnMonitoredCallConnectionCleared

OnMonitoredCallDataUpdate

OnMonitoredCallDelivered

OnMonitoredCallDequeued

OnMonitoredCallDiverted

OnMonitoredCallEstablished

OnMonitoredCallFailed

OnMonitoredCallHeld

OnMonitoredCallOriginated

OnMonitoredCallQueued

OnMonitoredCallReachedNetwork

OnMonitoredCallRetrieved

OnMonitoredCallServiceInitiated

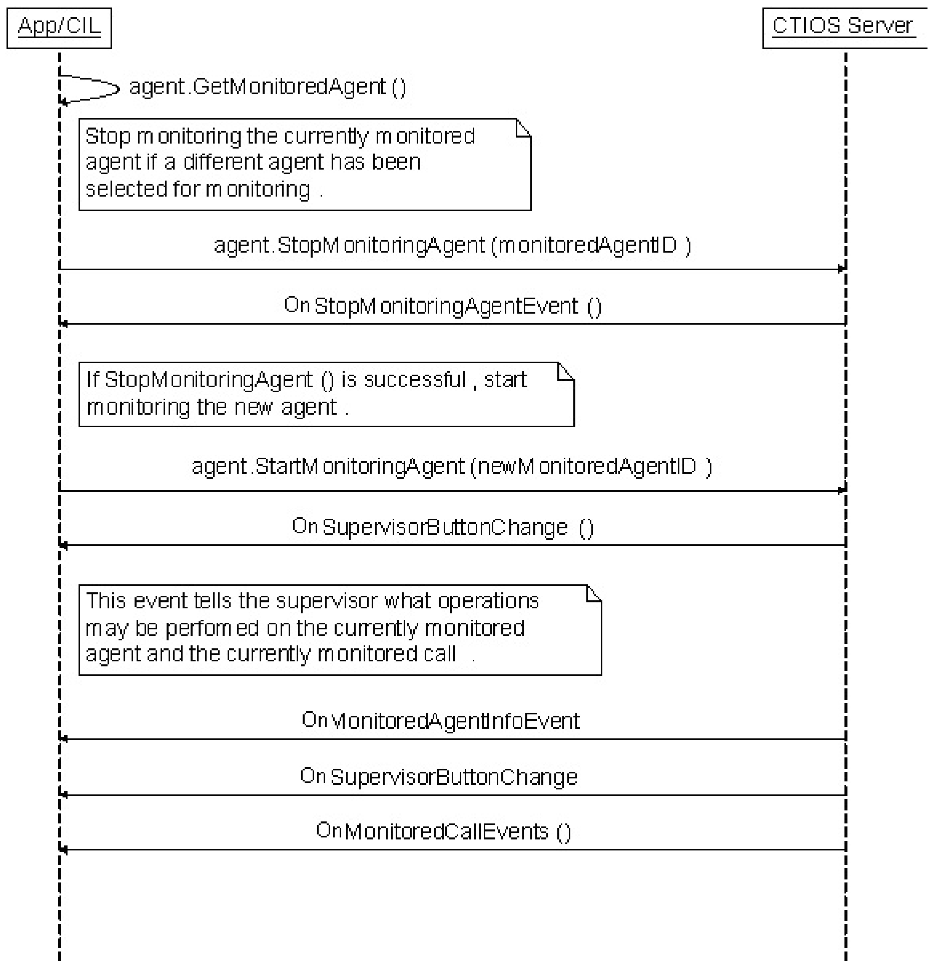
OnMonitoredCallTransferred

OnMonitoredCallTranslationRoute

OnMonitoredCallEnd

After a supervisor application is informed of an agent team member via the OnNewAgentTeamMember event, the supervisor can monitor the agent via the Agent.StartMonitoringAgent() method. The following sequence diagram illustrates the call to StartMonitoringAgent() and the events sent upon successful completion of the call.

Figure 8: Sequence Diagram for StartMonitoringAgent() and Successful Call Completion


App/CIL
CTIOS Server
agent.GetMonitoredAgent ()
Stop monitoring the currently monitored agent if a different agent has been selected for monitoring .
agent.StopMonitoringAgent (monitoredAgentID)
On StopMonitoringAgentEvent ()
If StopMonitoringAgent () is successful , start monitoring the new agent .
agent.StartMonitoringAgent (newMonitoredAgentID)
On SupervisorButtonChange ()
This event tells the supervisor what operations may be perfomed on the currently monitored agent and the currently monitored call .
On MonitoredAgentInfoEvent
On SupervisorButtonChange
On MonitoredCallEvents ()

The requests leading up to and including Agent.StartMonitoringAgent() is in the CTIObject.StartMonitoringAgent() method. When calling the Agent.StopMonitoringAgent(), the Agent object associated with the supervisor (the current agent) is the target of the method. The parameter is an Arguments object set as follows:

Table 7: Agent.StopMonitoringagent Parameter

Key	Value
AgentReference	The UniqueObjectID of the currently monitored agent.

When calling Agent.StartMonitoringAgent(), the Agent object associated with the supervisor (the current agent) is the target of the method. The parameter is an Arguments object set as follows:

Table 8: Agent.StartMonitoringAgent Parameter

Key	Value
AgentReference	The UniqueObjectID of the agent to begin monitoring.

OnSupervisorButtonChange

This event is delivered to define the operations that the supervisor can successfully execute. The operations included in this event are as follows:

- Log out an agent on the team
- Make an agent on the team ready
- Enable silent monitor
- Enable barge-in on agent
- Enable intercept call

The application uses the bitmask carried by this event to enable or disable the functionality listed above. The ProcessSupervisorButtonChange() method in SupervisorUIManager illustrates how to process this event.

Monitored Call Events

The majority of events listed with StartMonitoringAgent() are monitored call events. These events inform the supervisor of monitored agent calls beginning, ending, and changing. The combo desktop uses these events to populate its monitored calls grid.

Supervisor Application Makes Agent Ready or Logs Agent Out

When StartMonitoringAgent() is called for a given agent, the supervisor application begins receiving SupervisorButtonChange events. This event can indicate that the monitored agent is in a state where the supervisor can make the agent ready or log the agent out. The following section describes how a supervisor application can make an agent on the supervisor's team ready or log the agent out.

To make an agent ready, the desktop calls the method Agent.SetAgentState(). When calling this method, the Agent object representing the monitored agent is used as the target of the method. The parameter is an Arguments object populated with the following key/value pairs:

Table 9: Agent.SetAgentState Parameter

Key	Value
SupervisorID	The ID of the supervisor who is making the agent ready. This value is the value of the AgentID key associated with the current agent (the current agent is the agent passed into the call to Session.SetAgent() when first logging in the agent).
AgentState	The state to which to set the agent. In this case, the state is ready (integer with value 3).

To log out an agent, the desktop calls the method Agent.SetAgentState(). When calling this method, the Agent object representing the monitored agent is used as the target of the method. The parameter is an Arguments object populated with the following key/value pairs:

Table 10: Agent.SetAgentState Parameter (Logout) A

Key	Value
SupervisorID	The ID of the supervisor who is making the agent ready. This value is the value of the AgentID key associated with the current agent (the current agent is the agent passed into the call to Session.SetAgent() when first logging in the agent).
AgentState	The state to which to set the agent. In this case, the state is ready (integer with value 3).
EventReasonCode	The value associated with this key is 999. The value 999 indicates to the rest of Unified CCE that the agent was logged out by their supervisor.

An agent involved in a call is not logged out until the agent is disconnected from the call. Both the out-of-the-box desktop and the combo desktop warn the supervisor of this behavior. To do this, check the state of the currently monitored agent. If the agent's state is talking, hold, or reserved, the monitored agent is involved in one or more calls and is not logged out until the agent is disconnected from all calls. This is illustrated in SupervisorUIManager.m_btnMonLogoutAgentClick().

Successfully calling Agent.SetAgentState() should be followed by one or more SupervisorButtonChange and MonitoredAgentEvents reflecting the change in the monitored agent's state.

Supervisor Application Flow to Monitor a Call

This section discusses step 4 in the flow of a supervisor application. The methods and events listed below are used to monitor a call.

Methods Called

Agent.StartMonitoringCall()

Agent.SuperviseCall()

Events Processed

Events Processed

OnSupervisorButtonChange

AgentStateEvents

CallEvents

MonitoredCallEvents

MonitoredCallEvents

As stated in the “Monitoring Agents” section, calling Agent.StartMonitoringAgent() triggers MonitoredCallEvents for the agent specified in Agent.StartMonitoringAgent(). The MonitoredCallEvents received by the supervisor desktop inform the desktop of the state of the monitored agent's calls. The combo desktop uses these events to populate and update the monitored calls grid. For more information see the SupervisorUIManager and CallAppearanceHelper classes.

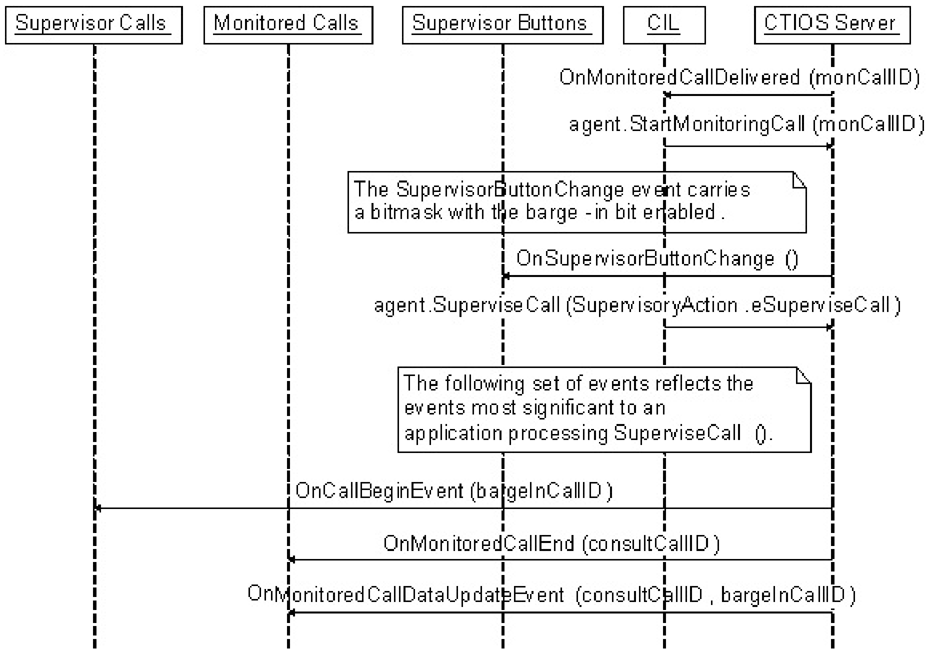
To monitor a call, the supervisor calls the Agent.StartMonitoringCall() method. The target of the call is the current agent (Agent object representing the supervisor). StartMonitoringCall() takes an Arguments object with the CallReference key set to the UniqueObjectID of the call to be monitored. This is illustrated in the CTIObject.StartMonitoringCall()method.

Barging into Calls

The following sequence diagram illustrates a request to barge into an agent's call. In this sequence diagram, the supervisor application is divided into four components to illustrate the different events that affect the different pieces of a supervisor application.

Figure 9: Sequence Diagram for Barging into a Call

Figure 10:


Supervisor Calls
Monitored Calls
Supervisor Buttons
CIL
CTIOS Server
OnMonitoredCallDelivered (monCallID)
agent.StartMonitoringCall (monCallID)
The SupervisorButtonChange event carries a bitmask with the barge -in bit enabled .
OnSupervisorButtonChange ()
agent.SuperviseCall (SupervisoryAction .eSuperviseCall)
The following set of events reflects the events most significant to an application processing SuperviseCall ().
OnCallBeginEvent (bargeInCallID)
OnMonitoredCallEnd (consultCallID)
OnMonitoredCallDataUpdateEvent (consultCallID , bargeInCallID)

After Agent.StartMonitoringCall() is called for a specific call, the application begins receiving SupervisorButtonChange events. When a call is being monitored, the SupervisorButtonChange event can carry a bitmask indicating that the call can be barged into. To barge-in on a call, the application calls the Agent.SuperviseCall() method. The target of the SuperviseCall() method is the current agent (the Agent object that represents the supervisor). The parameter to the method is an Arguments object with the following key/value pairs:

Table 11: Agent.StartMonitoringCall Parameter

Key	Value
AgentReference	The UniqueObjectID of the currently monitored agent
CallReference	The UniqueObjectID of the currently monitored call
SupervisoryAction	The value 3. For the .NET CIL, this is SupervisoryAction.eSupervisorBargeIn

When successfully calling this method, the application receives many events because this method not only changes the state of the monitored call, but also delivers a call to the supervisor which changes the supervisor's state. When an OnButtonEnablementChange event is received, be sure to check the monitored flag. If the flag does not exist or exists and is set to false, apply the event to any application specific logic or UI to control the supervisor's state. This is illustrated in SoftphoneForm.OnEvent(). Notice that this method discards any event that is monitored.

One or more OnSupervisorButtonChange events are received by the application. These events notify the application that it is now possible to intercept the agent's call.

The trickiest piece of handling the events that result from a successful call to Agent.SuperviseCall() is handing the resulting Call and MonitoredCall events. You should apply all CallEvents to whatever application specific object and/or UI element is managing calls directly connected to the supervisor's device (SoftphoneForm in the combo desktop). You should apply all MonitoredCallEvents to whatever application specific object and/or UI element is managing calls connected to the supervisor's team members/monitored agents (SupervisorUIManager in the combo desktop).

Calling SuperviseCall() with the SupervisoryAction set to barge-in initiates a consultative conference between the caller, agent, and supervisor. This means that whatever UI elements and/or objects that handle monitored calls has to be able to handle the set of events that set up a consultative conference. In general, this is not too difficult. The consultative call is joined to the conference call by sending a MonitoredCallEndEvent to end the consultative call. Then a MonitoredCallDataUpdateEvent is used to change the ID of the call to the conference. The MonitoredCallEndEvent takes care of cleaning up the consultative call. The trick is to check OnMonitoredCallDataUpdateEvents for the OldUniqueObjectID key. If this key exists, it means that the UniqueObjectID of a call has changed. OldUniqueObjectID stores the old/obsolete ID of the call. UniqueObjectID stores the new ID of the call. This new ID is carried in all future events for the call. Application logic must be updated based on this information or new events for the call are not tracked correctly.

Intercepting Calls

After a supervisor has barged into an agent's call, the supervisor can intercept the call. This is done by calling the Agent.SuperviseCall() method. The target of the SuperviseCall() method is the current agent (the Agent object that represents the supervisor). The parameter to the method is an Arguments object with the following key/value pairs:

Table 12: Agent.SuperviseCall Parameter

Key	Value
AgentReference	The UniqueObjectID of the currently monitored agent
CallReference	The UniqueObjectID of the currently monitored call
SupervisoryAction	The value 4. For the .NET CIL, this is SupervisoryAction.eSupervisorIntercept

Calling this method removes the agent from the call. This means that OnMonitoredEndCall events are received for the agent. Also, OnSupervisorButtonChange events are sent to reflect the current state of the monitored agent.

Monitored Call Data

Setting monitored call data is similar to setting call data on an agent's call. The only difference is that the monitored call is the target of the Call.SetCallData() method. You can retrieve the currently monitored call by calling Agent.GetMonitoredCall() where the current agent (the Agent object that represents the supervisor) is the target of the Agent.GetMonitoredCall() method.

Sample Code in CTI OS Toolkit

The CTI OS Toolkit provides several samples that illustrate how to use the various CTI OS CILs in custom applications. These samples are categorized according to the CIL (.NET, Java, or Win32) that they use.

.NET Samples

Note Of all the samples provided in the CTI OS toolkit, the .NET sample applications provide the most complete set of coding examples. Therefore, use the .NET samples as the reference implementation for custom CTI OS application development regardless of which language you plan to use in your custom development.

Use the Java and Win32 samples as secondary references to highlight syntactic differences as well as minor implementation differences between the CILs.

CTI Toolkit Combo Desktop.NET

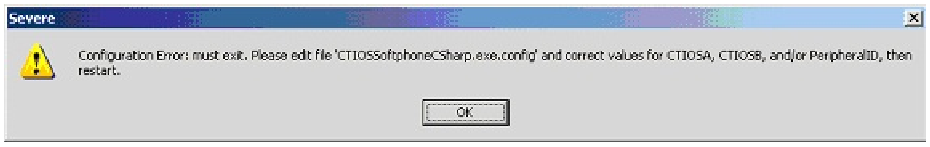
The CTI Toolkit Combo Desktop.NET sample illustrates how to use the .NET CIL to build a fully functional agent or supervisor desktop. Though this sample is written in C#, it is a good reference for how to make CIL requests and handle CIL events in an agent mode CIL application. This sample illustrates the following CIL programming concepts:

- Agent mode connection to CTI OS
- Agent desktop functionality (call control, agent state control, statistics)
- Supervisor desktop functionality (team state monitoring, barge-in, intercept)
- Outbound option functionality
- Button enablement
- Failover

CTI Toolkit Combo Desktop Configuration

The .NET CTI Combo desktop is configured via an XML file found in the current working directory of the desktop.

The name of the file used to configure the CTI Toolkit Combo Desktop is “CTIOSSoftphoneCSharp.exe.config”. The desktop attempts to find the file in the current directory. If the file is not found, the desktop creates the file and displays the following error message.


Severe

Configuration Error: must exit. Please edit file 'CTIOSSoftphoneCSharp.exe.config' and correct values for CTIOSA, CTIOSB, and/or PeripheralID, then restart.

The user can now edit the file to fill in the appropriate values.

Following is an example configuration file.

```
<?xml version="1.0" encoding="utf-8"?>
<configuration>
 <configSections>
    <section name="JoeUser" type="System.Configuration.SingleTagSectionHandler" />
<appSettings>
    <add key="LogFilePath" value=".\CtiOsClientLog" />
    <add key="CtiOsA" value="CtiOsServerA" />
    <add key="CtiOsB" value="CtiOsServerB" />
    <add key="PortA" value="42028" />
    <add key="PortB" value="42028" />
  </appSettings>
</configSections>
  <JoeUser TraceMask="0xf" AgentID="1003" AgentInstrument="3009" PeripheralID="5000"
DialedNumbers="3011,3010" />
</configuration>
```

The configuration file is composed of the following elements. These elements are as follows:

configuration – This elements contains the configuration for the desktop.

appSettings – This section defines configuration settings that are shared by every Windows user that logs in to the system. A system administrator needs to configure these values for the appropriate CTI OS Servers and ports. Each of this element's sub-elements defines key value pairs used to configure the desktop.

- **LogFilePath** – The value for this key is the path to the log file as well as the prefix of the name of the log file. The name of the Windows user, the log file's creation time, and the extension ".log" are appended to form the complete name of the log file. For example, if the desktop was run at 11:58 AM on May 23, 2005, the log file would have the name CtiOsClientLog.JoeUser.050523.11.58.04.5032.log.
- **CtiOsA** – The name or IP address of one of the CTI OS Server peers.
- **CtiOsB** – The name or IP address of the other CTI OS Server peer.
- **PortA** – The port used to connect to the CTI OS Server specified by the CtiOsA key.
- **PortB** – The port used to connect to the CTI OS Server specified by the CtiOsB key.
- **configSections** – This section defines Windows user specific sections of the configuration file.

These sections are defined using the section element. Note that in the sample configuration file there is a section element under configSections corresponding to the element tagged with the Window's user name "JoeUser" under the configuration element. You should not have to manually modify this section. As different Windows users use the desktop, this section is modified to include section elements for each of the users.

The rest of the configuration file comprises elements that define configuration specific to different Windows users. For each section element in the configSections element, there is a corresponding element under the configuration element. These elements are used to store information specific to given users such as trace mask, agent login ID, dialed numbers, and so on. Most of the attributes in this element do not need to be modified. The one attribute that may need modification is the **TraceMask** attribute. This attribute is used to control the amount of information logged to the log file.

CtiOs Data Grid.NET

This sample is a set of helper classes that are used in other .NET CIL samples.

All Agents Sample.NET

This sample illustrates how to use the .NET CIL to build a monitor mode application that monitors agents. Though this sample is written in C#, it is a good reference in general for how to create a monitor mode CIL application. This sample illustrates the following CIL programming concepts:

- Monitor mode connection to CTI OS
- When to enable connect and disconnect buttons for a monitor mode application
- How to handle failover in monitor mode.
- Filtering for agent events

All Calls Sample.NET

This sample illustrates how to use the .NET CIL to build a monitor mode application that monitors calls. This sample illustrates the following CIL programming concepts:

- Monitor mode connection to CTI OS
- Connect and Disconnect error handling
- Filtering for call events
- Filtering for silent monitor call events

Note For CCM based silent monitoring only. Filtering for silent monitor calls is only applicable to CCM based silent monitoring.

Java CIL Samples

AllAgents - This sample illustrates how to use the Java CIL to build a monitor mode application that monitors calls.

JavaPhone - This sample illustrates how to use the Java CIL to create a rudimentary agent mode application.

Win32 Samples

CTI Toolkit AgentDesktop - This sample illustrates how to use the Win32 COM CIL's ActiveX controls to create an agent desktop using VisualBasic .NET.

CTI Toolkit SupervisorDesktop - This sample illustrates how to use the Win32 COM CIL's ActiveX controls to create a supervisor desktop using VisualBasic .NET.

CTI Toolkit Outbound Desktop - This sample illustrates how to use the Win32 COM CIL's ActiveX controls to create an outbound option desktop using VisualBasic .NET.

CTI Toolkit C++Phone - This sample illustrates how to use the C++ CIL to create a rudimentary agent mode application.