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Cisco CallManager Fax Integration

TN093

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1 Introduction

This technical note describes the fax integration between Objectworld UC Server and Cisco CallManager. UC Server integrates with Cisco CallManager using SIP Interoperability and T.38 Fax Relay.

UC Server can support the following applications of fax in a Cisco CallManager environment:

- Separate incoming voice and fax numbers (DID Fax)
- Shared incoming voice and fax application
- Outgoing faxing

Summary of fax deployment models:

- Direct SIP Integration using T.38 Relay
- Direct SIP Integration using T.38 Relay with CNG detection
- Direct T1/E1 Connection to Central Office
- Direct T1/E1 Connection via MGCP Gateway

The following table summarizes the deployment technologies and associated capabilities.

Capabilities	Dedicated DID fax numbers	Shared voice and fax numbers	Outgoing fax
Direct SIP Integration using T.38 relay	✓		✓
Direct SIP Integration using T.38 relay with CNG Detection		✓	✓
Direct T1/E1 Connection to Central Office	✓	✓	✓
Direct T1/E1 Connection via MGCP Gateway	✓	✓	✓

Shared incoming voice and fax application requires calls to be pre-answered for a brief period of time to determine if an incoming call is a fax call. The pre-answering service requires services to be added to Objectworld UC Server and configured on an answering identity for each user. The answering point plays ring back (optionally an audio prompt) to allow the system to determine if the call is a fax call. If the call is not a fax call, the call will be transferred to the associated extension number using a SIP trunk configured on Cisco CallManager.

The diagram shows an optional voice mail/unified messaging integration that can be deployed. This integration is documented in TN092 – Cisco CallManager Integration using SIP. Cisco integration using the SIP voice mail interface is not capable of supporting fax.

1.1 Required Components

The following are minimum requirements.

1. Objectworld UC Server – SIP Edition Release 4.3 or higher. UC Server SIP Edition is required to take advantage of advanced routing rules to support fax integration with Cisco CallManager.
2. Users that require pre-answering to determine if a call is a voice call or a fax call must be configured as a Personal Business Assistant (PBA) call answering mode.
3. Cisco CallManager 5.1 or higher (Cisco CallManager 6.0 has been interoperability tested)
4. Cisco IOS Minimum released version that supports SIP and SIP T.38 Fax. Information is available on the Cisco Web site.

1.2 Additional References

This document assumes that the reader has knowledge of Cisco CallManager and Cisco IOS Gateways.

It is advisable to also consult the following references for a detailed understanding of fax interoperability with Cisco CallManager.

1. Cisco Web site: "Cisco Fax Services over IP Application Guide"
2. Cisco Web site: "TCL IVR API Version 2.0 Programming Guide"
3. Objectworld Technical Note: "TN092 – Cisco CallManager Integration Guide using SIP"

2   Deployment Models

Objectworld UC Server can integrate with Cisco CallManager in a variety of ways, depending on the desired capabilities and the current voice and data environment.

2.1   Direct SIP Integration using T.38 Relay

Direct SIP Integration using T.38 relay provides direct T.38 fax integration with dedicated DID numbers routed via SIP to Objectworld UC Server. Cisco IOS Gateways do not provide CNG Detection in their default configurations. The Cisco router must be configured as a SIP dial peer with the dial peer routing configured to route incoming DID fax calls directly to UC Server while routing voice calls to Cisco CallManager. UC Server can also provide voice mail and unified messaging integration using a separate direct SIP connection.

A Cisco router is used to terminate calls from the central office (PSTN connection via T1/E1 PRI, BRI or FXO interfaces) and selectively redirects incoming fax telephone numbers to Objectworld UC Server. The called number (DID) will be used to route calls to either Cisco CallManager for voice or to Objectworld UC Server for fax. The Cisco IOS router must be configured to use SIP dial-peer routing. MGCP controlled gateways are not supported for faxing applications. Fax calls that terminate on UC Server must have both the G.711ulaw and T.38 fax codec enabled.
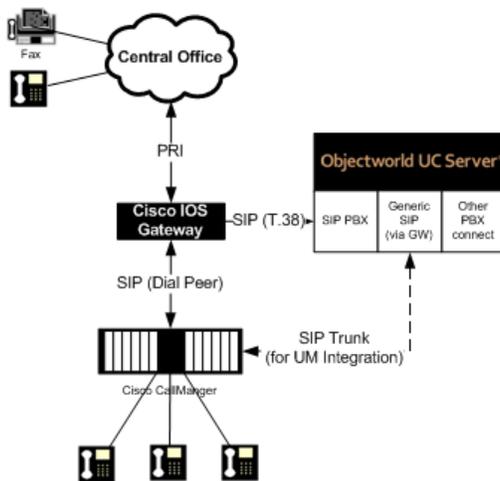
2.1.1   Configuration

Summary of configuration steps:

1. Configuring Cisco IOS Inbound POTS dial peer for separate voice and fax calls
2. Configuring Cisco IOS outbound VOIP dial peer for voice calls
3. Configuring Cisco IOS outbound VOIP dial peer for fax calls
4. Configuring Objectworld UC Server – create fax identity

2.1.1.1   *Configuring Cisco IOS inbound POTS dial peer for separate voice and fax calls*
Perform the following steps on the Cisco gateway to accept incoming calls on the PSTN interface.

1. Log onto the Cisco IOS Gateway
2. **dial-peer voice** tag **pots**
3. **direct-inward-dial**
4. **incoming called-number** *string*

5. exit

2.1.1.2   Configuring Cisco IOS outbound VoIP dial peer for voice calls

Perform the following steps on the Cisco gateway to route calls to the UC Server pre-answering behavior.

1. Log onto the Cisco Gateway
2. **destination pattern** *<voice routing prefix>....*

The configured voice routing prefix must match the parameter defined in the previously configured application service. The voice routing prefix will also be configured in UC Server.

3. **session protocol sipv2**
4. **session target ipv4**:*<IP Address of UC Server>*
5. **dtmf-relay rtp-nte**
6. **codec g711ulaw**
7. **fax rate disable**
8. exit

2.1.1.3   Configuring Cisco IOS outbound VoIP dial peer for fax calls

Perform the following steps on the Cisco gateway to route calls to the UC Server fax answering behavior.

Log onto the Cisco Gateway

1. **destination pattern** *<fax routing prefix>....*

The fax routing prefix configured here must match the parameter defined in the previously configured application service. The fax routing prefix will also be configured in UC Server.

2. **session protocol sipv2**
3. **session target ipv4**:*<IP Address of UC Server>*
4. **dtmf-relay rtp-nte**
5. **fax protocol t38 ls-redundancy 0 hs-redundancy 0 fallback none**
6. exit

2.1.2   Example – minimum configuration settings

The following example shows an incoming 4-digit DID range starting with a digit 7. Voice DID numbers start with 72 whereas dedicated DID fax numbers start with 71.

This example uses the following information

- Incoming DID called number pattern: 7xxx
- UC Server IP Address: 192.168.8.54
- Cisco CallManager IP Address: 192.168.8.129
- Voice routing prefix: 71
- Fax routing prefix: 72

```
dial-peer voice 2850 pots
incoming called-number 7...
 direct-inward-dial
!
dial-peer voice 2851 voip
description Incoming Voice calls to CCM
 destination-pattern 72..
```

```
  session protocol sipv2
  session target ipv4:192.168.8.129
  codec g711ulaw
!
dial-peer voice 2852 voip
description Incoming Fax Calls to UC Server
  destination-pattern 71..
  session protocol sipv2
  session target ipv4:192.168.8.54
  codec g711ulaw
  fax protocol t38 ls-redundancy 0 hs-redundancy 0 fallback none
!
sip-ua
!
```

2.2   Direct SIP Integration using T.38 Relay with CNG Detection

Direct SIP Integration using T.38 relay with CNG detection allows a single incoming telephone number to receive voice and fax calls. All incoming calls will be pre-answered to determine if the incoming caller is a fax machine that generated CNG tones. If CNG tone is not detected, the caller will be transferred to the associated user's extension over a configured SIP trunk between Objectworld UC Server and Cisco CallManager. The pre-answer service requires the database integration feature to be enabled on UC Server and for the UC Server administrator to associate incoming DID called numbers to an internal extension on Cisco CallManager.

In order for a Cisco IOS gateway to detect CNG tones an application (TCL application script) must be loaded onto the Cisco gateway. TCL is a Cisco IVR programming language. The TCL Script that will perform the CNG detection does the following high level functions.

1. Direct an incoming POTS call to the application service.
2. The incoming call is redirected by the CNG-detect TCL script to a voice pre-answering service. If CNG tone is detected the call to the pre-answering service is terminated and another call is made to the fax answering service. The TCL script modifies the original called number (DNIS) by adding some preceding routing digits in front of the original called number and then directs it to UC Server using a SIP VoIP dial peer. This call is then answered by UC Server by an application service that plays a ring back sound (optionally it can be configured to play an audio prompt) for a short period of time. After the audio is played the service will then perform a blind transfer to the associated Cisco telephone extension.
3. If the Cisco Gateway detects CNG tone, it will tear down the original call and directs the call to a SIP VoIP dial peer by inserting some routing digits in front of the original called number. UC Server will then route the call to a user's fax identity that is associated with a UC Server user.
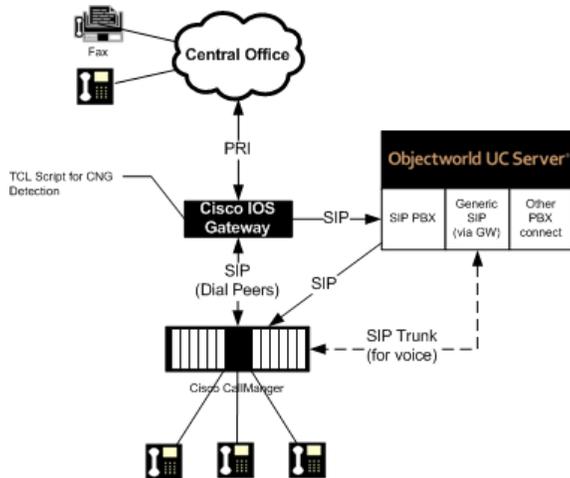
2.2.1 Configuration

The high level configuration steps are:

1. Loading and configuring the call application on the IOS Gateway
2. Configuring Cisco IOS inbound POTS dial peer
3. Configuring Cisco IOS outbound VoIP dial peer for pre-answer
4. Configuring Cisco IOS outbound VoIP dial peer for fax answer
5. Configuring Cisco IOS default outbound VoIP dial peer for transfer
6. Creating a dial plan entry to route calls between UC Server and Cisco CallManager
7. Creating a database – Mapping pre-answer numbers to target extensions
8. Configuring Objectworld UC Server – Creating a pre-answer service
9. Configuring Objectworld UC Server – Creating a pre-answer identity for users
10. Configuring Objectworld UC Server – Creating a fax identity

2.2.1.1 *Loading and configuring the call application on the IOS Gateway*

Perform the following steps on the UC Server computer platform:

1. Locate the TCL script cng_detect.tcl available on the Objectworld Web site Resource Center or on the UC Server media
2. Copy the *cng_detect.tcl* file to the following directory '*C:\Program Files\Objectworld\UC Server\Data\TFTP*'

Perform the following steps on the Cisco gateway:

1. Log onto the Cisco IOS Gateway
2. **call application voice *application-name location*.** (i.e. call application voice cng-detect tftp://192.168.8.54/cng_detect.tcl)
3. **application service** CNG-detect tftp://*<IP Address of UC Server>*/cng_detect.tcl
4. **application service CNG-detect param prefix_voice** *<voice routing prefix>*

   The voice routing prefix is used to route calls to individual user pre-answer identities on UC Server. In this example, the routing prefix is 46 which will be pre-pended to the original called number.

5. **application service CNG-detect param prefix_fax** *<fax routing prefix>*

   If the Cisco gateway detects fax, the original voice call will be terminated and a new call will be initiated to the fax destination. The fax routing prefix is used to route the call to individual user's faxes.

6. **application service CNG-detect param mode** connect-first

2.2.1.2 *Configuring Cisco IOS inbound POTS dial peer*

Perform the following steps on the Cisco gateway:

1. Log onto the Cisco IOS Gateway
2. **dial-peer voice** tag **pots**
3. **service** *cng-detect*
4. **direct-inward-dial**
5. **incoming called-number** *string*

   Where string is a Cisco routing character that specifically identifies either a single number or multiple numbers that are pre-answered.

6. exit

2.2.1.3 *Configuring Cisco IOS outbound VoIP dial peer for pre-answer*

Perform the following steps on the Cisco gateway.

1. Log onto the Cisco Gateway
2. **destination pattern** *<voice routing prefix>....*

The voice routing prefix configured here must match the parameter defined in the previously configured application service. The voice routing prefix will also be configured in UC Server.

3. **session protocol sipv2**
4. **session target ipv4**:*<IP Address of UC Server>*
5. **dtmf-relay rtp-nte**
6. **codec g711ulaw**
7. **fax rate disable**

2.2.1.4 *Configuring Cisco IOS outbound VoIP dial peer for fax answer*

Perform the following steps on the Cisco gateway.

1. Log onto the Cisco Gateway
2. **destination pattern** *<fax routing prefix>....*

The fax routing prefix configured here must match the parameter defined in the previously configured application service. The fax routing prefix will also be configured in UC Server.

3. **session protocol sipv2**
4. **session target ipv4**:*<IP Address of UC Server>*
5. **dtmf-relay rtp-nte**
6. **fax protocol t38 ls-redundancy 0 hs-redundancy 0 fallback none**
7. exit

2.2.1.5 *Configuring Cisco IOS default outbound VoIP dial peer for transfer*

Perform the following steps on the Cisco gateway.

1. Log onto the Cisco Gateway
2. **destination pattern** *.*

The fax routing prefix configured here must match the parameter defined in the previously configured application service. The fax routing prefix will also be configured in UC Server.

3. **session protocol sipv2**
4. **session target ipv4**:*<IP Address of UC Server>*
5. **dtmf-relay rtp-nte**
6. **fax protocol t38 ls-redundancy 0 hs-redundancy 0 fallback none**
7. exit

2.2.2   Example

This example uses the following information:

- Incoming DID called number pattern: 28xx (2800 to 2899)
- UC Server IP Address: 192.168.8.54
- Voice routing prefix: 46
- Fax routing prefix: 329

```
dial-peer voice 2800 pots
   description POTS Calls to Datsun
   service cng-detect
   destination-pattern 28..
!
dial-peer voice 2850 voip
   description Default pattern for transfers
      destination-pattern .
      session protocol sipv2
      session target ipv4:192.168.8.54
      dtmf-relay rtp-nte
      codec g711ulaw
!
dial-peer voice 2851 voip
   description SIP to DATSUN
   destination-pattern 46....
   session protocol sipv2
   session target ipv4:192.168.8.54
   dtmf-relay rtp-nte
   codec g711ulaw
   fax rate disable
!
dial-peer voice 2852 voip
   description FAX: SIP to Datsun
   destination-pattern 329....
   session protocol sipv2
   session target ipv4:192.168.8.54
   codec g711ulaw
   fax protocol t38 ls-redundancy 0 hs-redundancy 0 fallback none
!

sip-ua
!
```

2.3   Direct T1/E1 PRI Integration to Central Office

Direct T1/E1 PRI integration to a central office leverages dedicated facilities terminating on an Objectworld interoperable SIP PSTN Gateway. This integration can provide both dedicated fax integration (DID fax) as well as combined voice and fax services. It is also possible to route voice calls through Objectworld UC Server SIP PBX using SIP trunks between Objectworld UC Server and Cisco CallManager. Fax identities are created on Objectworld UC Server to terminate voice and fax calls.
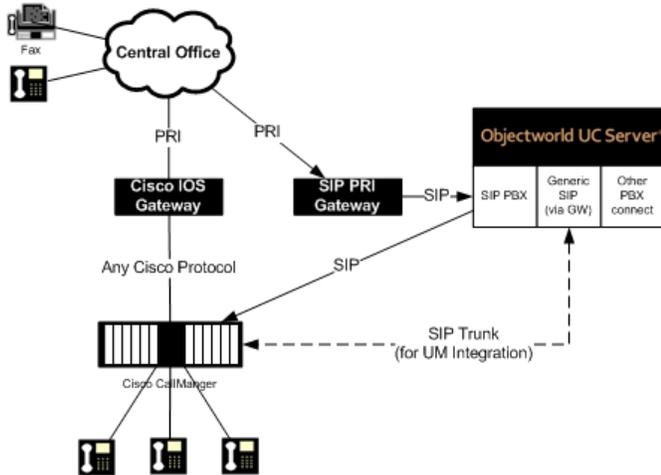
2.3.1   Configuration

This integration technique does not require Cisco IOS Gateway configuration. Two configuration options are available depending on whether or not you are planning to use a single number for voice and fax or are planning to use a dedicated incoming number to associate with a fax behavior.

The high level configuration steps are:

1.   Configure the SIP PRI Gateway in accordance to Objectworld guidelines. Technical notes are available on Objectworld's Web site Resource Center or on the media that is shipped with the product.

If a single number is used for voice and fax:

2.   Creating a Database – Mapping pre-answer numbers to target extensions
3.   Configuring Objectworld UC Server – Creating a pre-answer service
4.   Configuring Objectworld UC Server – Creating a pre-answer identity for users
5.   Configuring Objectworld UC Server – Creating a fax identity

If a dedicated incoming number is used for fax:

2.   Configuring Objectworld UC Server – Creating a fax identity

2.4   Direct T1/E1 Connection via MGCP Gateway

Direct T1/E1 PRI Integration via MGCP Gateway is recommended if the Cisco IOS platform cannot be reconfigured to support SIP. This integration requires additional T1/E1 PRI gateways (Cisco IOS Gateway T1/E1 PRI Span and a corresponding Objectworld Connect Partner SIP PSTN Gateway). This integration can provide both dedicated fax integration (DID fax) as well as combined voice and fax services. SIP Trunks between Objectworld UC Server and Cisco

CallManager are used to avoid hair-pinning (using two channels on the PRI for a single call) calls being redirected through the SIP PRI gateway.
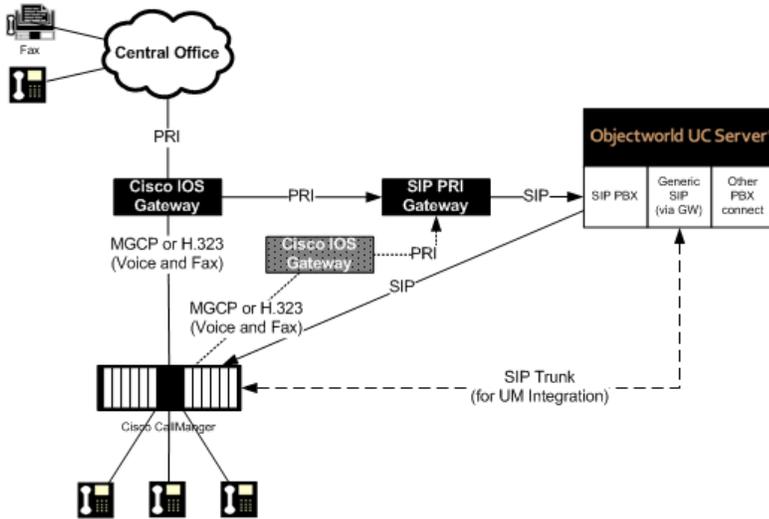
2.4.1 Configuration

The high level configuration steps are:

1. Configure the SIP PRI Gateway in accordance to Objectworld guidelines. Technical notes are available on Objectworld's Web site Resource Center or on the media that is shipped with the product.
2. Configure the Cisco IOS Route according to Cisco recommendations to ensure that faxes can be relayed between trunk facilities that are between Cisco IOS Gateways. It is beyond the scope of this document to provide instructions on how to configure T.38 relay for non-SIP Cisco IOS Gateways.

If a single number is used for voice and fax:

3. Creating a Database – Mapping pre-answer numbers to target extensions
4. Configuring Objectworld UC Server – Creating a pre-answer service
5. Configuring Objectworld UC Server – Creating a pre-answer identity for users
6. Configuring Objectworld UC Server – Creating a fax identity

If a dedicated incoming number is used for fax

3. Configuring Objectworld UC Server – Creating a fax identity:

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3   Configuring Cisco CallManager

This section highlights specific Cisco configuration to provide transparent dialing between CallManager and UC Server.

3.1   Creating a SIP Trunk to Route Calls from Cisco CallManager to Objectworld UC Server

To create a SIP Trunk in Cisco CallManager to route calls to Objectworld UC Server

1.   Log into Cisco Unified CM Administration.
2.   Navigate to **Device > Trunk**.
3.   Click on **Add New**.
4.   Select **SIP Trunk** from the **Trunk Type** drop down list.
5.   Select **SIP** from the **Device Protocol** drop down list.
6.   Click **Next**.
7.   Enter a **Device Name** such as "UCServer_SIP_Trunk".
8.   Select a **Device Pool** from the drop down list.
9.   Select a media resource group list from the **Media Resource Group List** drop down list.
10.   Select a location from the **Location** drop down list.
11.   Ensure **Media Termination Point Required** is checked.
12.   Ensure **Redirecting Diversion Header Delivery – Inbound** is not checked.
13.   Select **Originator** from the **Calling Party Selection** drop down list.
14.   Ensure **Redirecting Diversion Header Delivery – Outbound** is not checked.
15.   Enter UC Server's IP Address or FQDN for the **Destination Address**.
16.   Enter 5060 for the **Destination Port**.
17.   Select **711uLaw** from the **Preferred Originating Codec** drop down list.
18.   Select a SIP trunk security profile from the **SIP Trunk Security Profile** drop down list.
19.   Select a SIP profile from the **SIP Profile** drop down list.
20.   Select **RFC 2833** from the **DTMF Signaling Method** drop down list.
21.   Click **Save**.

4 Configuring Objectworld UC Server

This section highlights the configuration steps that can be performed on UC Server. Some of the detailed steps may be optional.

4.1 Creating SIP Routing Rule to Cisco CallManager

4.1.1 Adding a gateway

To add a gateway

1. From the Administration Navigation pane, select **Gateways**.
2. Right-click in the Content pane and select **New Gateway**.
3. Follow the wizard instructions and include the following information:
   a. Select SIP Peer
   b. Hostname or IP Address of Cisco CallManager
   c. Unique Name of the gateway
   d. Select UC Server as the associated gateway
   e. Enter an appropriate description
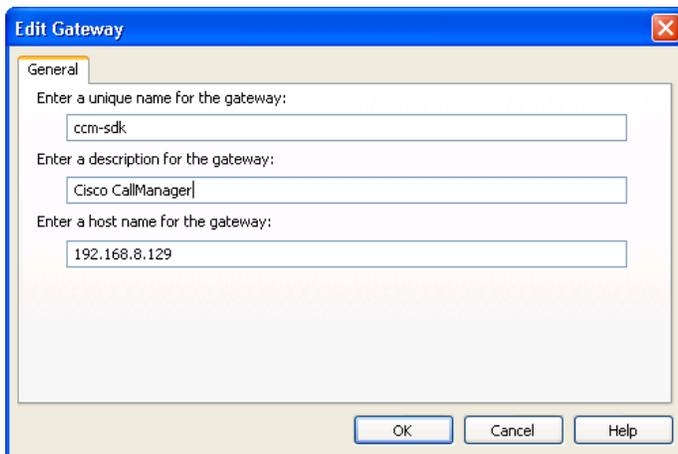
4.1.2 Modifying the Dial Plan

The UC Server dial plan will be modified to allow calls that are transferred from UC Server to terminate on Cisco CallManager configured telephones.

4.1.2.1 Creating a dial plan entry to route calls between UC Server and Cisco CallManager

The following dial plan entry routes incoming call where the destination is a 4 digit numbers that start with the digit 1 to Cisco CallManager. This example assumes that Cisco CallManager telephone extensions are in the 1xxx range.

To create a dial plan entry

1. From the Administration Navigation pane, select **Communications Systems > UC Server > Routing**.
2. Right-click in the Contents Pane and select **Add…**

4.2 Creating a Database – Mapping Pre-answer Numbers to Target Extensions

Follow the instructions below to create a new data source that allows an incoming DID number to be mapped to extension numbers. This table will define a mapping between the incoming called number and the associated extension. If the call is not a fax – no CNG tone is detected – then the call will be transferred to the associated extension using the SIP trunk.

4.2.1 Creating a data source on UC Server platform

A database is used to match incoming pre-answer called numbers and match to a target extension number. The database can be simply a Microsoft Excel spreadsheet that will be defined as a data source.

To create the database

1. Create an Excel spreadsheet that includes 2 columns (Called Number and Transfer Extension)

|	A	B
1	Called Number	Transfer Extension
2	462890	2890
3	462891	1001

   Microsoft Excel was chosen for simplicity. It is also possible to use any ODBC Database type that is support by Windows.

2. Save the Excel spreadsheet into a folder on the UC Server platform (i.e., Preanswer.xls)
3. Navigate to Control Panel > Administrative Tools > Data Sources (ODBC)
4. Select the System DSN tab and click Add
5. Select Microsoft Excel Driver (.xls) and click Finish
6. Configure a Data Source Name
7. Click Select workbook... and navigate to the Excel spreadsheet that was created in step 2.

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Note: The ODBC Data source cannot be used while the Microsoft Excel spreadsheet is open.

To create an ODBC Data source in UC Server

1. From the Administration Navigation pane, select **Data Sources**.
2. Right-click in the Content pane and select **New > ODBC Source**...
3. Create a name.
4. ODBC DSN: Select the data source that was created in a previous step.
5. Click Connect
6. Include the Called Number and Transfer Extension
7. Click OK
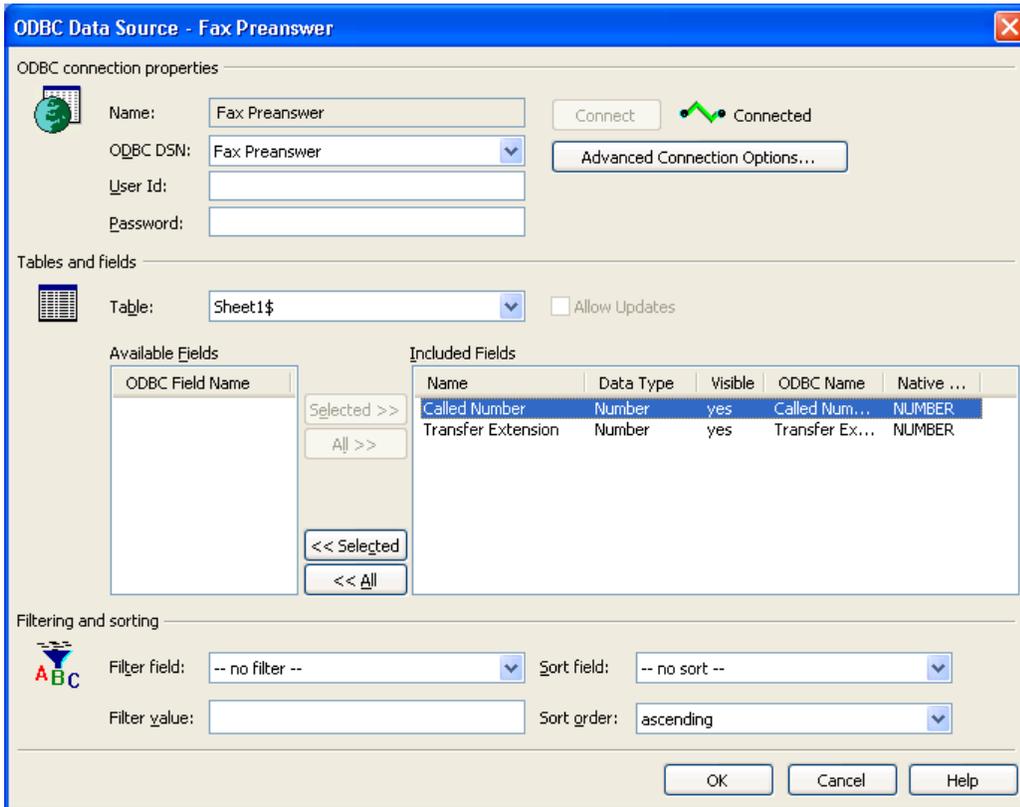
8. Change the access settings for this database to **Everyone**
   a. Right-click on the data source and select Access > Everyone
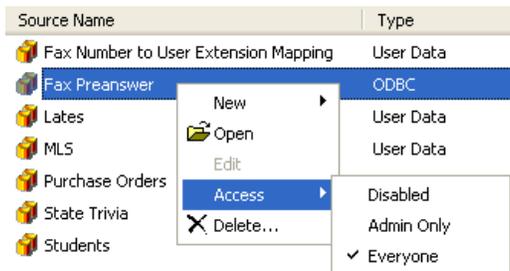
4.3   Creating a Fax Pre-answer Service

The fax pre-answer service is only required if you want to provide voice and fax on the same incoming called number. You can skip this step if you have separate incoming numbers for voice and fax.

The fax pre-answer service performs a database 'fetch data' that matches the original called number (represented as Caller-ID Number) to an associated extension. If there is nothing matching the called number in the database or the service is not able to access the ODBC Database, the service will transfer the call to the operator. The "Ringing (2 rings).wav" audio file is available as part of this integration note.
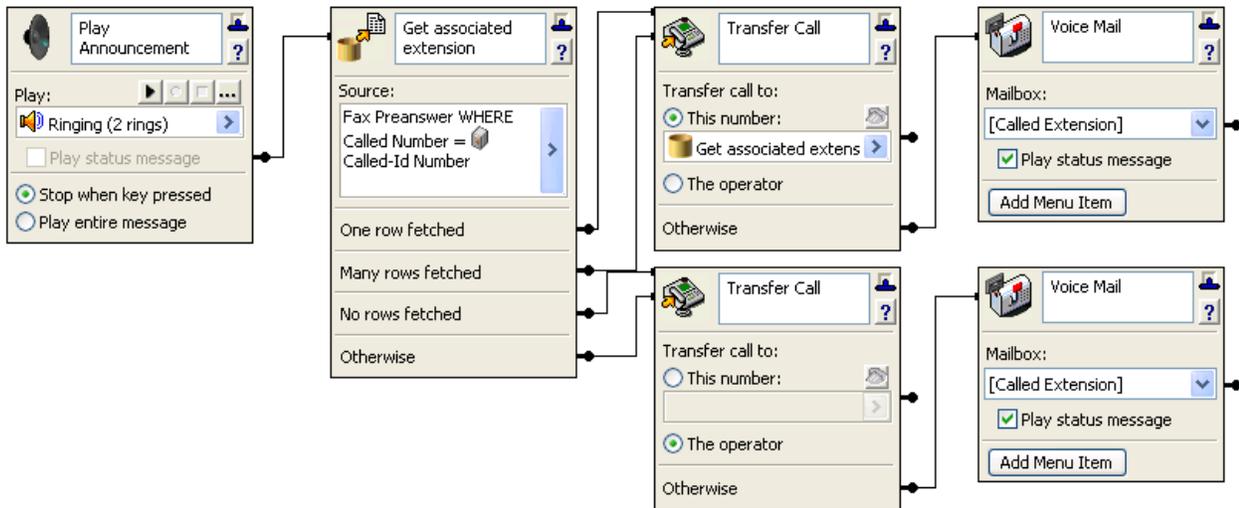
To create the Pre-answer service

1. Copy the "Ringing (2 rings).wav" to the
   "*C:\Program Files\Objectworld\UC Server\Data\Users\oooooooo\Announcements\Shared*" directory on the UC Server platform.
2. From the Administration Services Navigation pane, navigate to the **Shared** services folder.
3. Right-click and select **New > Service**
4. Name the service *Pre-answer*
5. Double-click on the newly created service to open the Service Editor
6. Create the service as defined in the picture above.

4.4   Creating an Identity for the Pre-answer Service for Users

The pre-answer service will be configured for each user. Each user that requires a single number for both voice and fax will require 'Personal Business Assistant' as the call answering mode.

To verify that the user is configured for 'Personal Business Assistant' call answering mode

1. From the Administration Navigation pane, select **Users**.
2. Double-click the user that you want to associate the pre-answer service in the content pane.
3. Select the General tab, and verify that the Call Answering mode for the user is configured as Personal Business Assistant.

To create an identity for pre-answer service

1. From the Administration Navigation pane, select **Users**.

2. Right-click the user in the Content pane that you want to create the pre-answer service and select **Create Identity…**
3. Select the UC Server communications system.
4. Select **Attendant Service** and click Next.
5. Configure a Name and Address. The address that you enter is the *<Voice Routing Prefix><User's Called Number>.*
6. Check the **Run Service** radio button, and navigate to the shared service that was created in the previous step.
7. Click Finish.

4.5 Creating an Identity for the Fax Service

Creating an identity for the fax answering behavior is only required for the Cisco IOS gateway with CNG tone detection or if the faxes are directly redirected to UC Server.

To create an identity for the pre-answer service

1. From the Administration Navigation pane, select **Users**.
2. Right-click the user in the Content pane that you want to create Receive fax behavior and select **Create Identity…**
3. Select the UC Server communications system.
4. Select **Attendant Service** and click Next.
5. Configure a Name and Address. The address that you enter is the *<Fax Routing Prefix><User's Called Number>.*
6. Check the **Receive Fax** radio button.
7. Click Finish.