CaoUPnP

User's guide

Version 1.0

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2006-02-24	1.0	First edition.

Contents

1. Introduction

This is a user's guide of CaoUPnP that is a client application of CAO (Controller Access Object).

CaoUPnP treats the CAO module as one UPnP (Universal Plug and Play) equipment, and offers the functions of UPnP device (Figure 1-1). Since CAO establishes the communication with various FA devices, CaoUPnP, which is the upper layer's application, is able to connect various FA devices as well.

UPnP is a technology that establishes a connection by simply connecting a device to the network seamlessly without complicated settings, advocated by Microsoft.

Since CaoUPnP module works as a UPnP device, CaoUPnP module can be used from a client application by simply connecting to the network. This realizes the seamless connection to CAO provider.

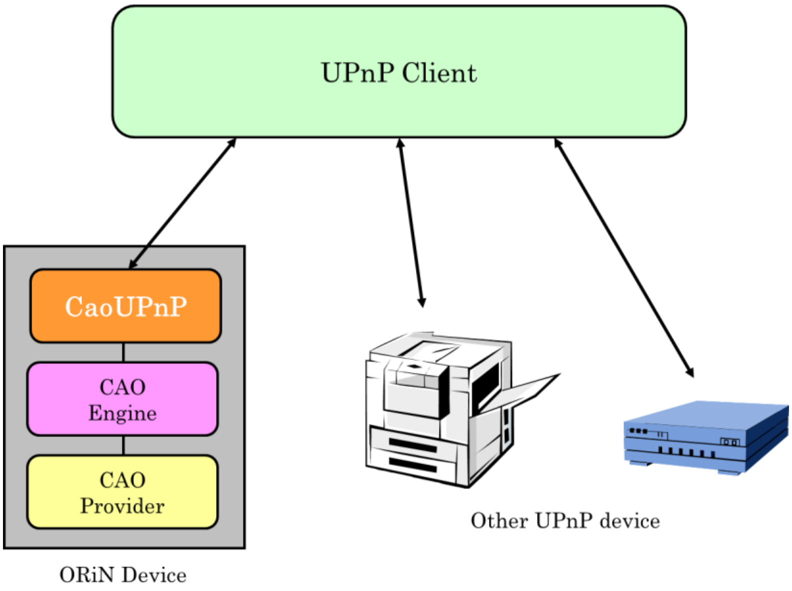


Figure 1-1 Image of CaoUPnP

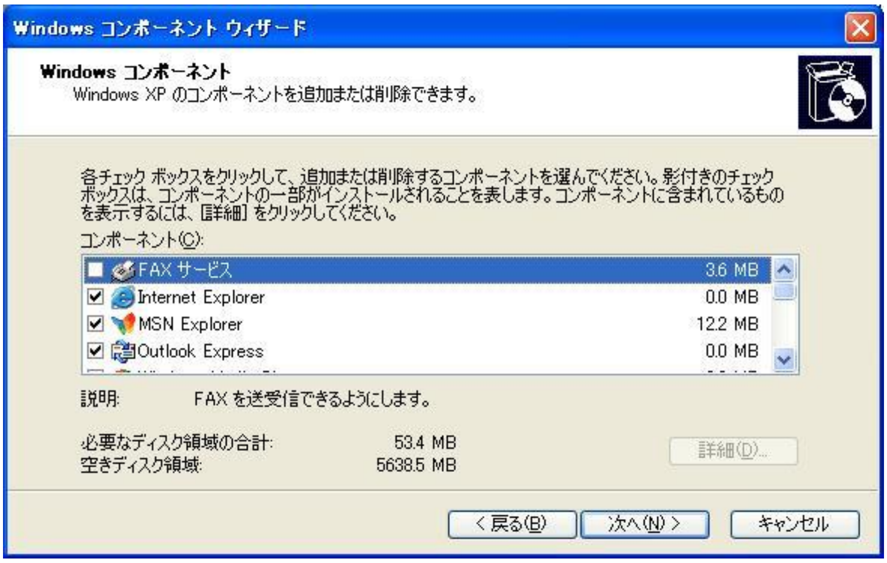
2. UPnP setup

To use CaoUPnP as a UPnP device, you need to install UPnP components. This chapter describes how to configure UPnP components with Windows XP.

2.1. Installation of UPnP component

Install UPnP in your computer because it is not installed in the default setting of Windows XP.

(1) From the [Control panel], click [Add or Remove Programs], and then click [Add/Remove Windows Components].



Windows コンポーネント ウィザード

Windows コンポーネント

Windows XP のコンポーネントを追加または削除できます。

各チェック ボックスをクリックして、追加または削除するコンポーネントを選んでください。影付きのチェック ボックスは、コンポーネントの一部がインストールされることを表します。コンポーネントに含まれているものを表示するには、[詳細] をクリックしてください。

コンポーネント(C):

□ FAX サービス	3.6 MB
☑ Internet Explorer	0.0 MB
☑ MSN Explorer	12.2 MB
☑ Outlook Express	0.0 MB

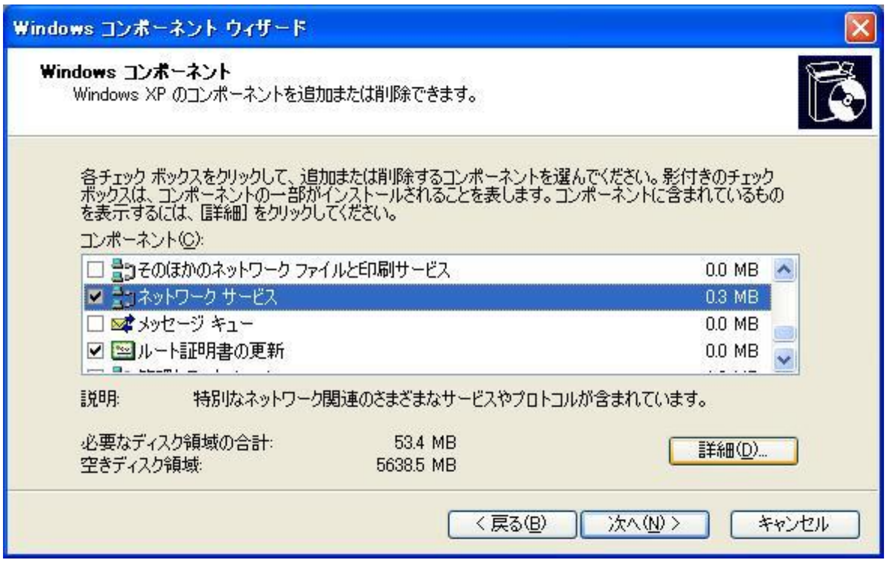
説明: FAX を送受信できるようにします。

必要なディスク領域の合計: 53.4 MB

空きディスク領域: 5638.5 MB

Figure 2-1 Windows component wizard

(2) Select [Networking Services], and then click [Details] button.



Windows コンポーネント ウィザード

Windows コンポーネント
Windows XP のコンポーネントを追加または削除できます。

各チェック ボックスをクリックして、追加または削除するコンポーネントを選んでください。影付きのチェック ボックスは、コンポーネントの一部がインストールされることを表します。コンポーネントに含まれているものを表示するには、[詳細] をクリックしてください。

コンポーネント(C):

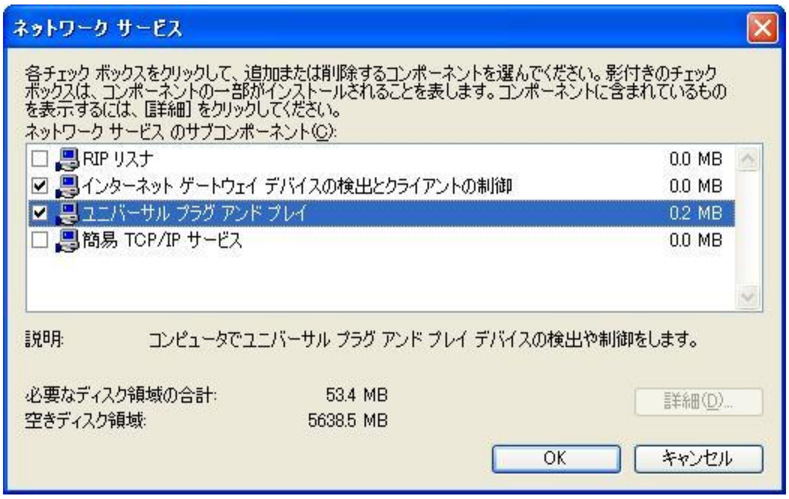
□	そのほかのネットワーク ファイルと印刷サービス	0.0 MB
☑	ネットワーク サービス	0.3 MB
□	メッセージ キュー	0.0 MB
☑	ルート証明書の更新	0.0 MB

説明: 特別なネットワーク関連のさまざまなサービスやプロトコルが含まれています。

必要なディスク領域の合計: 53.4 MB
空きディスク領域: 5638.5 MB

Figure 2-2 Addition of network service

(3) Select [Universal Plug and Play] checkbox, and then click [OK] button.



ネットワーク サービス

各チェック ボックスをクリックして、追加または削除するコンポーネントを選んでください。影付きのチェック ボックスは、コンポーネントの一部がインストールされることを表します。コンポーネントに含まれているものを表示するには、[詳細] をクリックしてください。

ネットワーク サービス のサブコンポーネント(C):

□	RIP リスナ	0.0 MB
☑	インターネット ゲートウェイ デバイスの検出とクライアントの制御	0.0 MB
☑	ユニバーサル プラグ アンド プレイ	0.2 MB
□	簡易 TCP/IP サービス	0.0 MB

説明: コンピュータでユニバーサル プラグ アンド プレイ デバイスの検出や制御をします。

必要なディスク領域の合計: 53.4 MB
空きディスク領域: 5638.5 MB

Figure 2-3 Addition of universal plug and play component

(4) Click Next to start the installation and follow the instruction in the Windows Components Wizard.

(5) At the end of the procedure, the Wizard informs you that the installation was successful. Click [Finish] to quit.

-Since UPnP component in Windows XP where the Service pack is not installed has a security hole, it is highly recommended to perform Windows Update.

3. Outline of CaoUPnP

3.1. Outline

The figure below shows the CaoUPnP structure. CaoUPnP is middleware to connect UPnP client with CAO. It works as an UPnP device to process requests from UPnP client by means of CAO functions. CaoUPnP is an independent process (out-of-process server) and provides services for several UPnP clients.

CaoSQLConfig with UPnP Option (hereafter, CaoUPnPConfig) is a configuration tool used for the followings:

- To set parameters required to create CaoController object of CAO with CaoSQLConfig.
- To set parameters required to create CaoVariable object of CAO with CaoSQLConfig.
- To set CaoUPnP motion option of CAO with CaoSQLConfig.

Contents configured by this tool will be stored in the registry and csq files and will be referred at the startup of CaoUPnP.

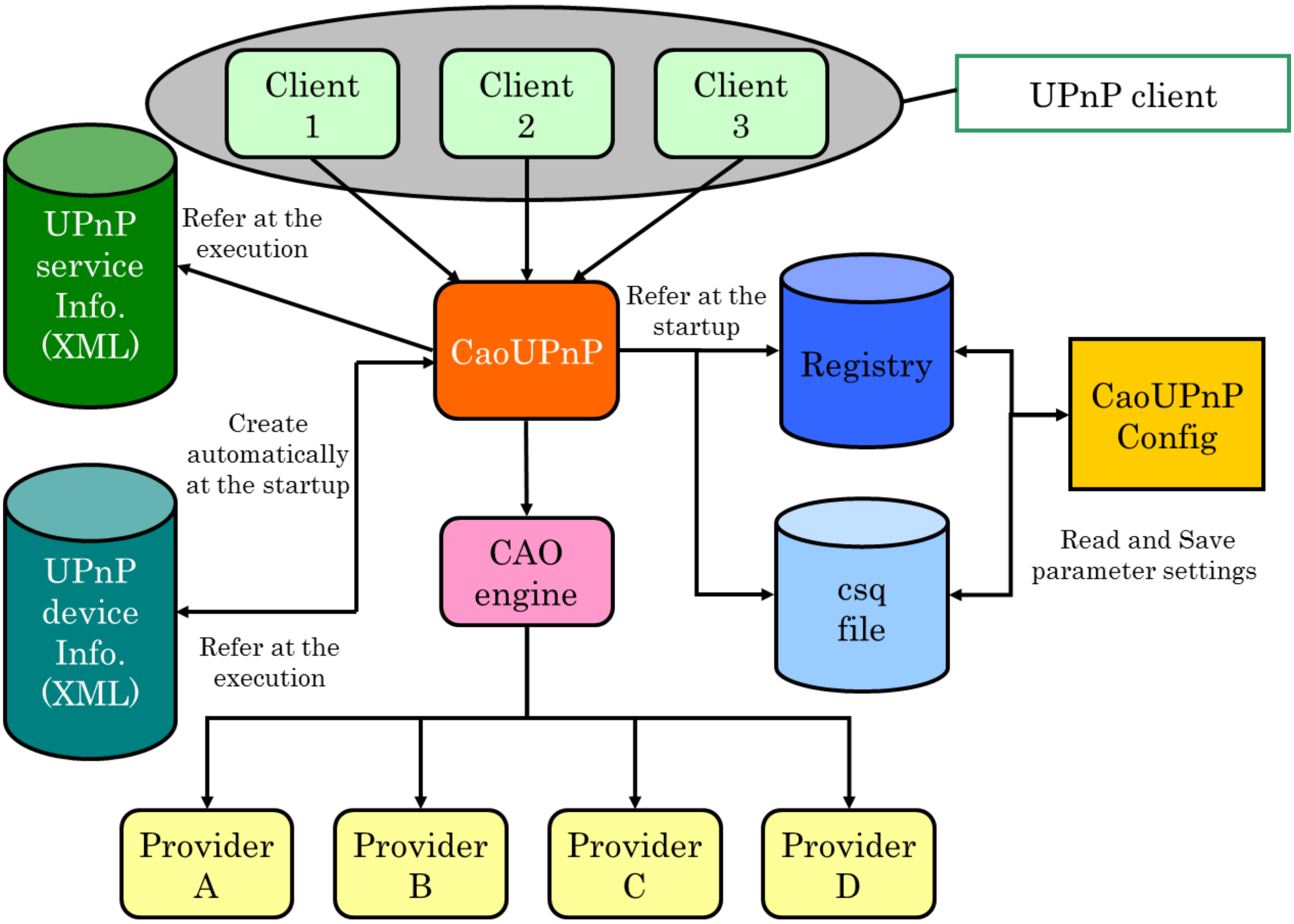


Figure 3-1 Outline of operation of CaoUPnP

The following explains the flow of CaoUPnP-utilized system.

(1) UPnP client application searches an UPnP device by using SSDP (Simple Service Discovery Protocol). In SSDP, the search condition is transmitted from the client application as multicast transmission, and the UPnP device (CaoUPnP is included) that matches to the search condition replies own IP address and port number as unicast transmission.

(2) The client application acquires device information and service information on the UPnP device in the XML format. For CaoUPnP, these information is described in CaoUPnPDevice.xml and CaoUPnPService.xml. (CaoUPnPService.xml exists statically though, CaoUPnPDevice.xml is automatically created at the startup of CaoUPnP.)

(3) Based on acquired information, the client application uses services provided by UPnP device. Control Point API of UPnP APIs is used for the execution of service. In this API, the service of the UPnP device is executed by using SOAP(Simple Object Access Protocol).

(4) In CaoUPnP, CAO provider acquires and sets variables according to the executed service.

3.2. UPnP APIs

To execute UPnP service from the client application, use UPnP APIs.

To utilizes services provided by CaoUPnP, use two APIs (IUPnPService::QueryStateVariable and IUPnPService::InvokeAction) from the client application.

3.2.1. QueryStateVariable API

QueryStateVariable is API to acquire the status variable specified by UPnP device.

The definition of API is as follows.

[Visual Basic]

```
VARIANT QueryStateVariable(
    ByVal bstrVariableName as String
)
```

[Visual C++]

```
HRESULT QueryStateVariable(
    BSTR bstrVariableName,
    VARIANT* pvarValue
);
```

This function obtains the value of status variable by entering the status variable name in “bstrVariableName”. If the program is Visual Basic, the result will be returned as a return value. If the program is Visual C++, the result will be stored in the argument “pvarValue”.

3.2.2. InvokeAction API

InvokeAction is API to execute an operation of the specified UPnP device.

The definition of API is as follows.

[Visual Basic]

```
VARIANT InvokeAction(
    ByVal bstrActionName as String,
    ByVal vInActionArgs as VARIANT,
    ByRef pvOutActionArgs as VARIANT
)
```

[Visual C++]

```
HRESULT InvokeAction(
    BSTR bstrActionName,
    VARIANT varInActionArgs,
    VARIANT* pvarOutActionArgs,
    VARIANT* pvarRetVal
);
```

To execute a method with this function, enter the method name you want to execute in “bstrActionName” and enter the argument of method in “VarInActionArgs”.

3.3. Service XML

UPnP client application inquires of service XML file about the service provided by UPnP device. The service of CaoUPnP is described in CaoUPnPService.xml file.

<serviceStateTable> tag and <actionList> tag are defined in the service XML file. ★7/5 ここまで★

3.3.1. serviceStateTable

The variable that can be acquired with QueryStateVariable API is defined in < serviceStateTable > tag.

Table 3-1 ServiceStateTable list

Variable identifier	Type	Explanation
Name	String	Controller name
Description	String	The controller's explanation
ItemCount	i4(long)	Number of items
ItemNames	String	List of name of item
Command	String	Command statement [azaretsu]
Result	String	Execution result of executing command statement [azaretsu] set to Command with controller's

		Execute
ItemName	String	Present item name
ItemValue	String	Value of present item
ItemAttribute	i4(long)	Attribute of present item
ItemDateTime	Date	Acquisition time of present item
ItemDescription	String	Explanation of present item
ItemAllowedValueMin	r4(float)	Minimum value of present item
ItemAllowedValueMax	r4(float)	The maximum value of present item
ItemAllowedValueStep	r4(float)	Step size of present item
ItemAllowedValueList	String	List of present item
ItemDefaultValue	String	Default value of present item

3.3.2. actionList

The definition of the command that can be executed by using invokeAction API is described in < actionList > tag.

Table 3-2 ActionList list

Command name	Argument	Relating variable identifier	Explanation
put_Command	[in] strCommand	Command	Command statement [azaretsu] to be executed is set.
put_ItemName	[in] strItemName	ItemName	The item to acquire the value is selected. Please specify the item name set with CaoUPnPConfig for the argument.
put_ItemValue	[in] strItemValue	ItemValue	The value is set to a present item.

- The argument set with put_ItemValue is described by the following formats.

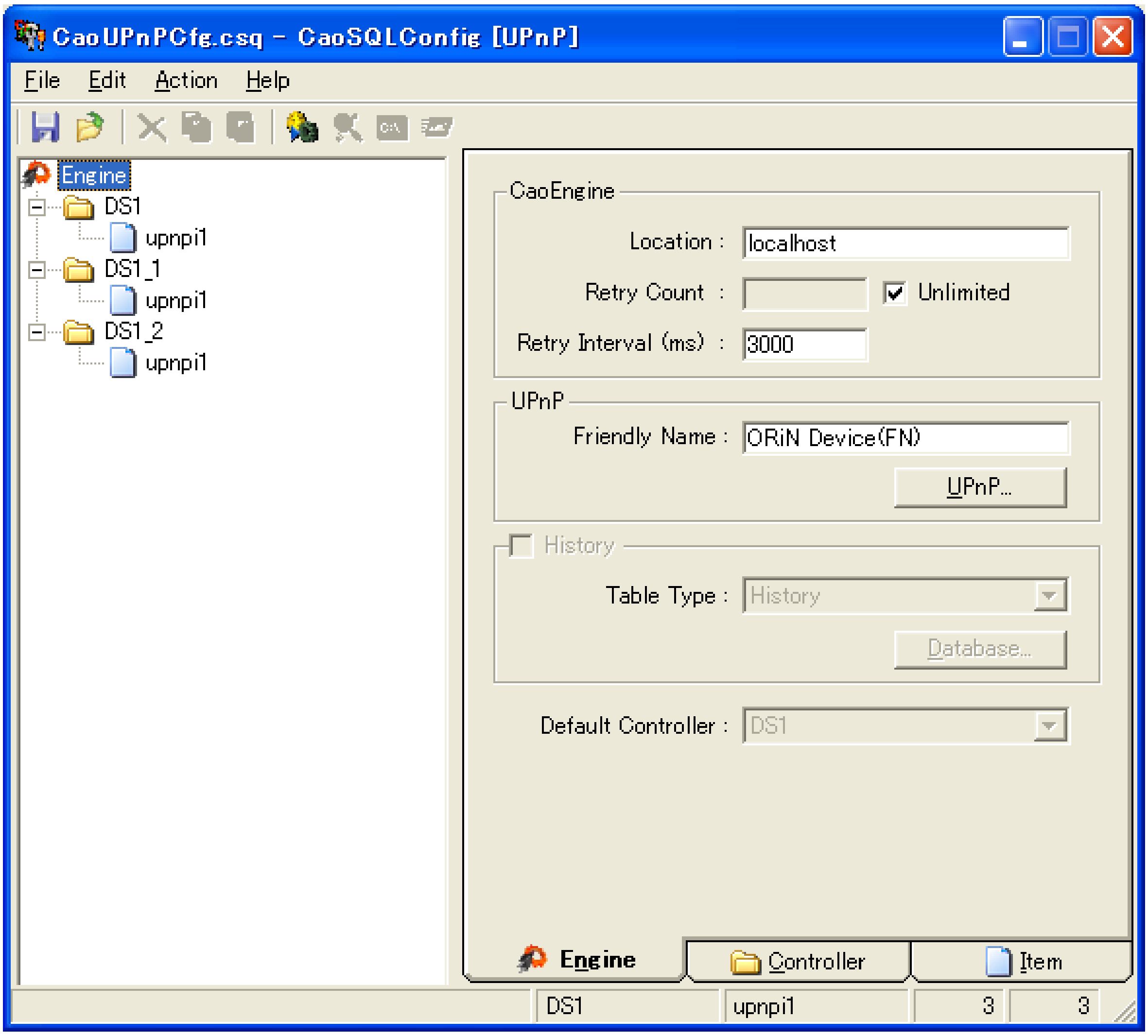
< **data string** >,< **data type** >

Please refer to "2.2.5. the description method of data" of 'ORiN2 programming guide' for details of this format.

4. CaoUPnPConfig

4.1. Outline

CaoSQLConfig (henceforth CaoUPnPConfig) for CaoUPnP is started by executing it putting “UPnP" on the argument of CaoSQLConfig (“CaoSQLComfig.exe UPnP"). CaoUPnPConfig is a tool that sets a necessary parameter when the controller object and the variable object of CAO used by drinking CaoUPnP are made. Information set here is recorded in the registry and the csq file, and when CaoUPnP is started, read.



Location : localhost

Retry Count : ☑ Unlimited

Retry Interval (ms) : 3000

Friendly Name : ORiN Device(FN)

□ History

Table Type : History

Default Controller : DS1

Figure 4-1 CaoUPnPConfig screen

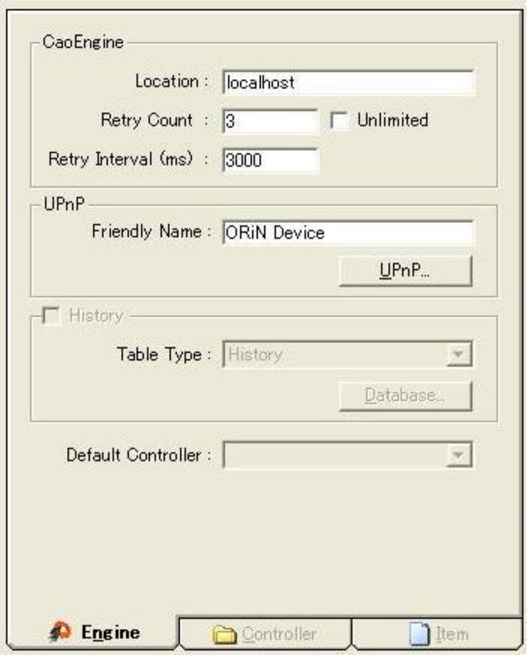
4.2. Manner of operation

4.2.1. Tab input

The tab in the right of the screen displays the information by making the node of the tree view a selective state. When the node of the engine is selected, the tab displays information on the CAO engine. When controller's node is selected, the tab displays the controller's information. When the node of the item is selected, the tab displays information on the item.

4.2.1.1. Engine tab

Information is set and displayed in the engine tab by the form shown in Figure 4-2. Information on the CAO engine can be freely set.



CaoEngine

Location : localhost

Retry Count : 3 □ Unlimited

Retry Interval (ms) : 3000

UPnP

Friendly Name : ORiN Device

□ History

Table Type : History

Default Controller :

Figure 4-2 Start of CaoUPnPConfig

The item that can be set here is as follows.

[Location]

The start computer name of Cao.exe started from CaoOPC.exe is input. When nothing is input, it starts in the local.

[Retry Count / Unlimited]

It is possible to retry when failing because of the opening of CaoController. ..retrying.. frequency checks unrestricted or inputs the frequency.

[Retry Interval(ms)]

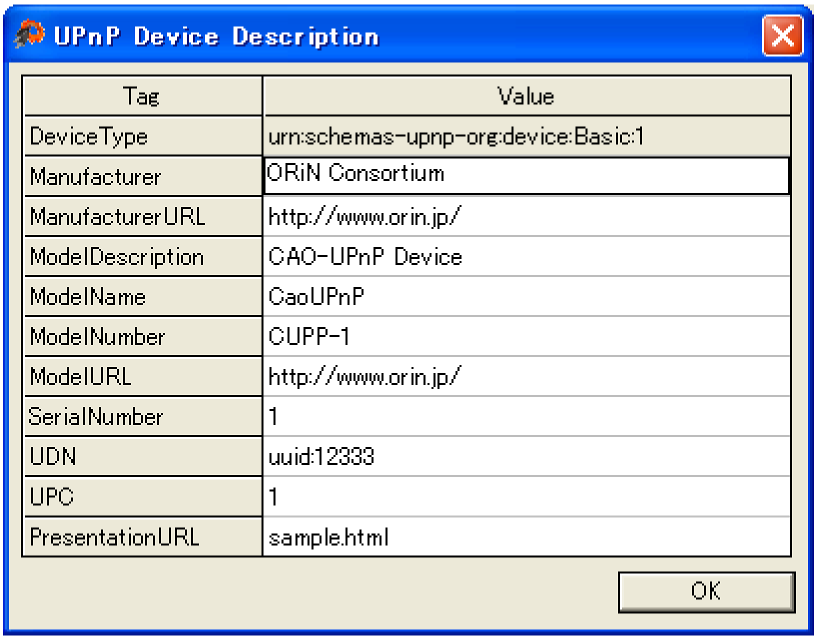
The interval to retrying after it fails by one degree ..retrying.. interval is input in each millisecond.

[Friendly Name]

The UPnP device name of CaoUPnP is set. CaoUPnP is judged from the name set from the UPnP client application here. (**input indispensability item**)

[UPnP]

Device information as the UPnP device of CaoUPnP can be confirmed. This information is described in “CaoUPnPDevice.xml".



Tag	Value
DeviceType	urn:schemas-upnp-org:device:Basic:1
Manufacturer	ORiN Consortium
ManufacturerURL	http://www.orin.jp/
ModelDescription	CAO-UPnP Device
ModelName	CaoUPnP
ModelNumber	CUPP-1
ModelURL	http://www.orin.jp/
SerialNumber	1
UDN	uuid:12333
UPC	1
PresentationURL	sample.html

Figure 4-3 Display of device information

It explains each item as follows.

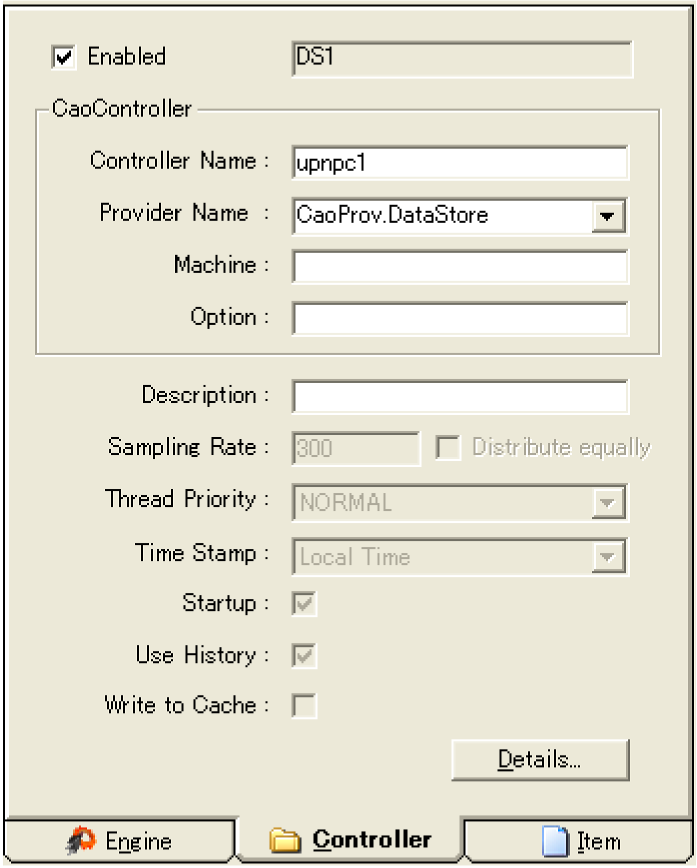
Table 4-1 Device information on UPnP

Set item	Explanation
Device Type	The device type of UPnP is specified. This item is decided depending on the UPnP forum or the maker, and a peculiar value to each device is given. (**item that cannot be changed**)
Manufacturer	The name of the maker in which the device is produced is specified. (**input indispensability item**)
Manufacturer URL	URL to maker's Web site is specified.
Model Description	The explanation of the device is described.
Model Name	The model name of the device is specified. (**input indispensability item**)

Model Number	The model number of the device is specified.
Model URL	URL to the Web site to explain the device is specified.
Serial Number	The serial number of the device is specified.
UDN	Unique ID that the maker of the device decided is specified. (**input indispensability item**)
UPC	Universal product code (Universal Product Code) is specified.
Presentation URL	URL for the presentation of the device is specified. It is loaded into a browser with the control point, and the presentation page can see, and control information on the device.

4.2.1.2. Controller tab

Information is set and displayed in the controller tab by the form shown in Figure 4-4. Because it is demanded that only "CaoUPnP controller name" have unique information in registered information, it is revokable only in the change of the name of the menu though controller's information can be freely set. Moreover, the case sensitivity is not done for the controller name, and the name only of the numerical value is not permitted. Moreover, ¥$#: cannot be used among signs.



☑ Enabled DS1

CaoController

Controller Name : upnpc1

Provider Name : CaoProv.DataStore

Machine :

Option :

Description :

Sampling Rate : 300 □ Distribute equally

Thread Priority : NORMAL

Time Stamp : Local Time

Startup : ☑

Use History : ☑

Write to Cache : □

Figure 4-4 Setting of controller tab

The item that can be set here is as follows.

[Enable]

It is an invalid effective/setting of this controller. When CAO-OPC is executed, it is not started when invalidly set.

[Name]

It is a controller name in CaoUPnP. “Name" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

[Controller Name，Provider Name，Machine，Option]

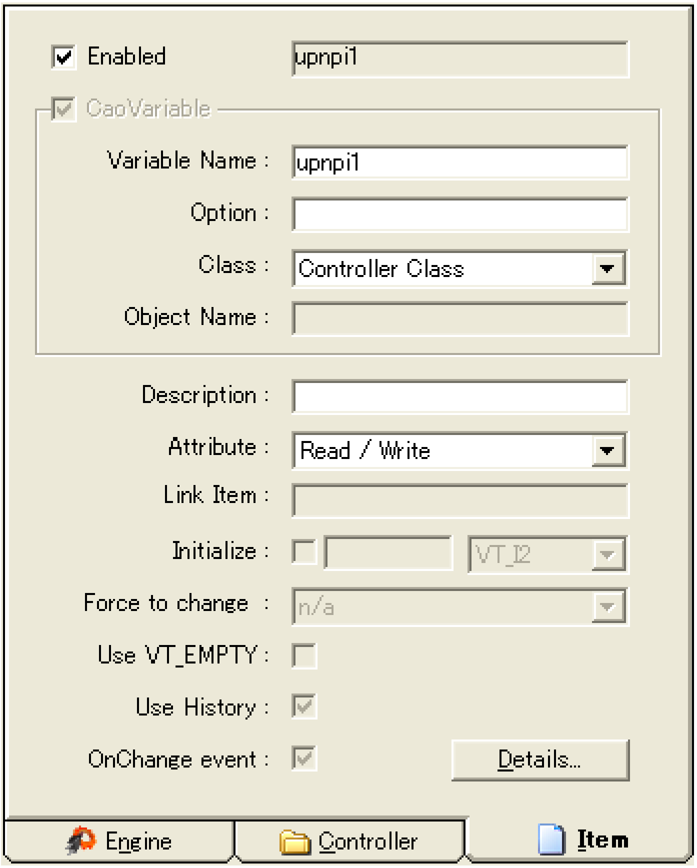
It is a parameter passed when CaoController is done in Add. The input value is used as it is.

[Description]

If the explanation of the controller etc. are described, it might be comprehensible because here can store an arbitrary character string. “Description" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

4.2.1.3. Item tab

Information shown in Figure 4-5 is set and displayed in the item tab. If an item name alone is not a name of the menu change as well as the controller tab, it is not possible to change. Moreover, the case sensitivity is not done for the item name, and the name only of the numerical value is not permitted. Moreover, ¥$#: cannot be used among signs.



☑ Enabled: upnpi1

☑ CaoVariable

Variable Name : upnpi1

Option :

Class : Controller Class

Object Name :

Description :

Attribute : Read / Write

Link Item :

Initialize : ☐ VT_I2

Force to change : n/a

Use VT_EMPTY : ☐

Use History : ☑

OnChange event : ☑

Figure 4-5 Setting of item tab

The item that can be set here is as follows.

[Enabled]

It is a setting whether to not make this item effective. Information on this item is not used when invalidly set.

[Name]

The item name is set. The value can be acquired by setting “ItemName" from the UPnP client to the argument of QueryStateVariable.

[Variable Name]

It is an argument passed at acquisition (ICaoController::AddVariable) of the CaoVariable object. The input value is used as it is. Neither the capital letter nor the small letter are distinguished.

[Option]

The option that adds to the variable is specified. It is used for the argument of CaoVariable object acquisition (ICaoController::AddVariable).

[Class]

The kind of the variable class is chosen.

[Object Name]

The parents object name of the variable is input. However, because only the parents controller is possible, controller's variable object cannot be input.

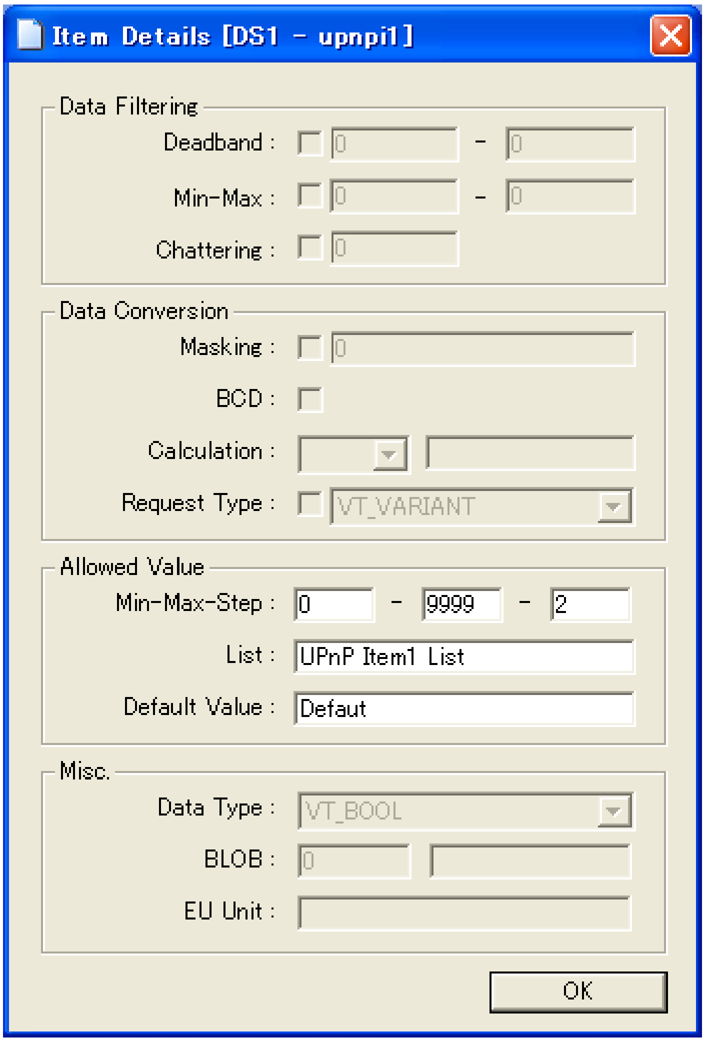
[Description]

Detailed information on the item can be set. It turns to set not volatile information because it is registered from the XML file. “ItemDescription" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

[Attribute]

The attribute of the item can be set. “ItemAttribute" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

[Details]



Item Details [DS1 - upnpi1]

Data Filtering

Deadband : □ 0 - 0

Min-Max : □ 0 - 0

Chattering : □ 0

Data Conversion

Masking : □ 0

BCD : □

Calculation :

Request Type : □ VT_VARIANT

Allowed Value

Min-Max-Step : 0 - 9999 - 2

List : UPnP Item1 List

Default Value : Defaut

Misc.

Data Type : VT_BOOL

BLOB : 0

EU Unit :

Figure 4-6 Detailed setting of item

[Allowed Value]

[Min-Max-Step]

Minimum value, the maximum value, and the width of carving of the permissible value are set.

Each “ItemAllowedValueMin", “ItemAllowedValueMax", and “ItemAllowedValueStep" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

[List]

The permissible value list is set. “ItemAllowedValueList" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

[Default Value]

An initial value of the permissible value is set. “ItemDefaultValue" can be set from the UPnP client to the argument of QueryStateVariable and the value be acquired by executing it.

4.2.2. Menu

A basic operation in CaoUPnPConfig is selected from the menubar. It is quite equal to the function that can be selected from the menubar though there is a menu that can be selected by right-clicking part in the tree view, too.

4.2.2.1. File menu

It is processed to save of data of making and to load it.

The extension used in **Open**,**Save**,**Save As..** is "**csq**".

The extension used in **Import**,**Export** is "**csx**".

[New]

The csq file is newly made.

[Open…]

The set up information is read from the specified csq file.[1]

When reading is canceled, the reading result is not reflected.

[Save]

A present set content is preserved in the csq file in the superscription.

[Save As…]

A present set content is preserved in the csq file.

[Import...]

It adds it to the node that has selected the node from the csx file.

[Export...]

The node that has been selected is output to the csx file.

[Import from CSV file...]

It adds it to the node that has selected the node from the csv file.

[Export to CSV file...]

The node that has been selected is output to the csv file.

[1] Please note that the loss might be caused in data from the limitation of OS for reading the file of the size of 64K or more in Win9x/Me.

[Exit]

The program of CaoUPnPConfig is ended.

4.2.2.2. Edit menu

The edit processing of an additional deletion etc. of the item is done.

[Add Controller]

The controller who reads with CaoUPnP is newly added. An existing controller and the controller of the same name cannot add it (Neither the capital letter nor the small letter are distinguished). It is added to the tree that an effective name is input, and inputs the detailed information from the tab in the right of the screen.

[Add Item]

The item is added to the node selected by the tree view. The item already been registered by the selected controller and the item of the same name cannot be added (Neither the capital letter nor the small letter are distinguished). It is added to the tree that an effective name is input, and inputs detailed information from the tab in the right of the screen.

[Rename]

The name of controller/item selected by the tree view is changed. It is not possible to change to the name of controller/item that has already been registered (Neither the capital letter nor the small letter are distinguished).

[Delete]

The node selected by the tree view is deleted. All items registered by the controller are recurrently deleted for the controller. Equal processing can be done by pressing the Del key from the keyboard with the item selected by the tree.

[Copy]

The node selected by the tree is copied. The registered item is copied for the controller. However, trigger information is not copied. The clone of information copied by the following "Put" operation can be added to the node.

[Paste]

Copied information is put, and a new name is input and the node is put.

[Sort]

The node at the level that has been selected is sorted in ascending order.

4.2.2.3. Action menu

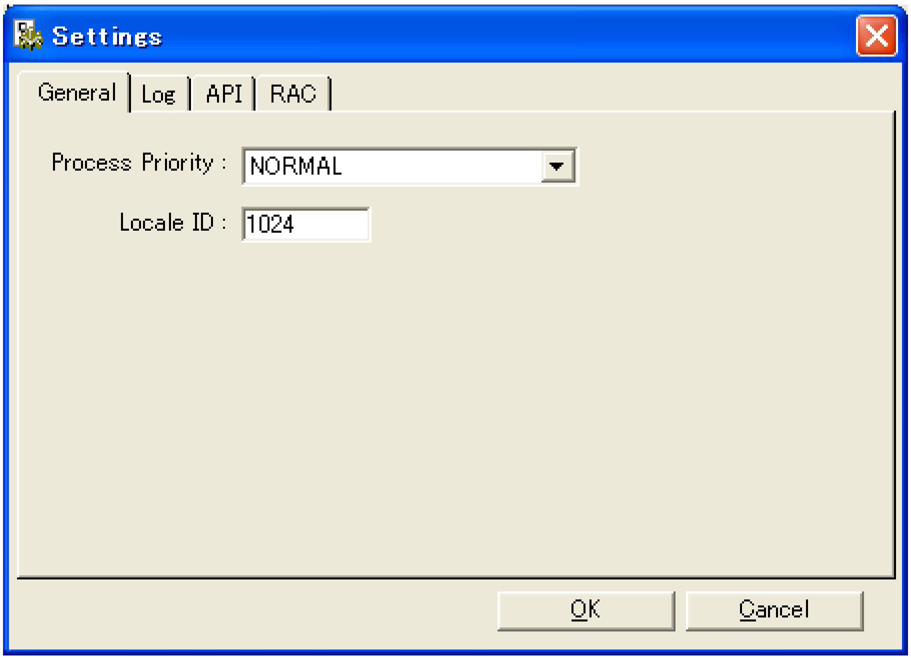
The execution of CaoUPnP.exe and the setting concerning the setting when executing it are done. The setting is preserved in the registry.

[Settings]

An environmental, set dialog of CaoUPnP is displayed.

[General]

It is possible to set it concerning the CaoUPnP whole like priorities of processes and the language used, etc.



Process Priority : NORMAL

Locale ID : 1024

Figure 4-7 CaoUPnP environmental setting (General)

[Process Priority]

The process priority of CaoUPnP is set. The adjustment of priority is as follows.

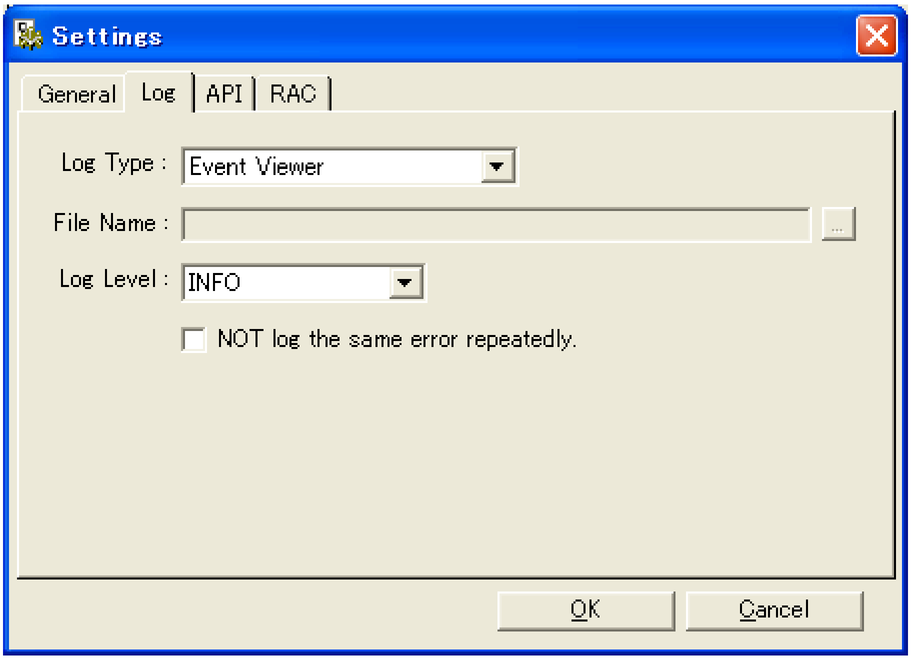
REAL TIME > HIGH > **NORMAL** > IDEL

[LocaleID]

Language ID used is set.

[Log]

It is possible to set it concerning the log output of CaoUPnP.



Log Type : Event Viewer

File Name :

Log Level : INFO

□ NOT log the same error repeatedly.

Figure 4-8 CaoUPnP environmental setting (Log)

[Log Type]

The output type of the log of CaoUPnP.exe is selected.

The output type of the log can select the following.

Table4-1Log type

At the output destination	Remarks
Console	It outputs it to the console.
Message Box	It outputs to the message box (Service starts).
Event Viewer	It outputs to the event viewer (Service starts).
Debug Viewer	The debugging output is done.
Text File	It outputs it to the specified text file.

[File Name]

The file passing that outputs the log when Log Type is made Text File is set.

[Log Level]

The output level of the log is set. The setting of the log level can be selected according to the following five levels. "It is the highest the seriousness degree, and the more approaches “DEBUG" by FATAL "the more the seriousness degree lowers. It is set to “INFO" in the standard.

FATAL > ERROR > WARN > **INFO** > DEBUG

[NOT log the same error repeatedly.]

The output control setting of the same error is done. No matter how the same error occurs, the error message is output only once if the check is put.

[API]

There is no item that can be set.

[RAC]

There is no item that can be set.

[Service Start]

The CaoUPnP service is started. It is necessary to reactivate the CaoUPnP service for the csq file information to be read when CaoUPnP is started, and to update the csq file information.

When CaoUPnP.exe is not registered as service, and service has already been executed, it is not possible to use it.

[Service Stop]

The CaoUPnP service can be stopped. When CaoUPnP.exe is not registered as service, and service has already been stopped, it is not possible to use it.

[Service Restart]

The CaoUPnP service can be reactivated. When CaoUPnP.exe is not registered as service, it is not possible to use it.

4.2.2.4. Help menu

It is a menu of help and the registration of license.

[Version]

Version information is displayed.

4.3. Registry composition information

The registry used is the same as CaoSQLConfig, and refer to "4.3 registry composition information" of 'CaoSQL user's guide' for details, please.

5. CaoUPnP tutorial

This chapter explains the method for construction of the system that uses CaoUPnP.

Here, an easy UPnP client application to access CaoUPnP is made, and it accesses the DataStore provider that sets it with CaoUPnPConfig.

5.1. Making of client application

The client application is made by using Visual Basic 6.0 here.

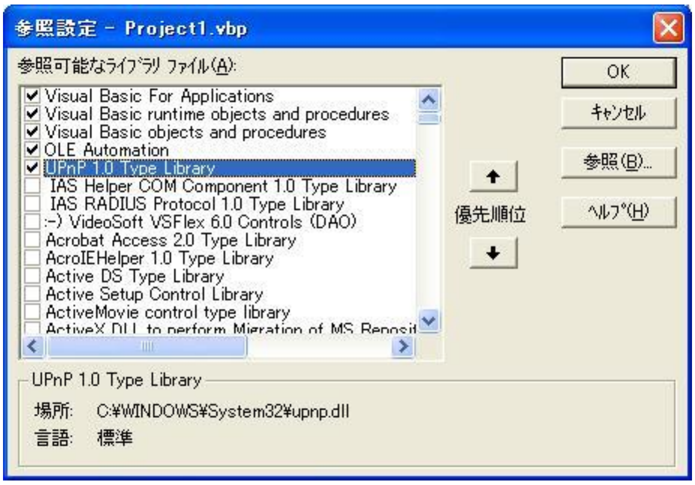
Please refer to 7 chapter when you want to use other environments such as Visual C++6.0.

(1) Making of project

First of all, please start Visual Basic6.0, and make the project of "Standard EXE" newly.

(2) Reference configuration

It is necessary to add the reference to UPnP Type Library to use UPnP APIs from the client application. Please add “UPnP 1.0 Type Library" from "Reference configuration" of "Project".



参照可能なライブラリ ファイル(A):

- ☑ Visual Basic For Applications
- ☑ Visual Basic runtime objects and procedures
- ☑ Visual Basic objects and procedures
- ☑ OLE Automation
- ☑ UPnP 1.0 Type Library
- □ IAS Helper COM Component 1.0 Type Library
- □ IAS RADIUS Protocol 1.0 Type Library
- □ :-) VideoSoft VSFlex 6.0 Controls (DAO)
- □ Acrobat Access 2.0 Type Library
- □ AcroIEHelper 1.0 Type Library
- □ Active DS Type Library
- □ Active Setup Control Library
- □ ActiveMovie control type library
- □ ActiveX DLL to perform Migration of MS Reposit

UPnP 1.0 Type Library

場所: C:¥WINDOWS¥System32¥upnp.dll

言語: 標準

Figure 5-1 Reference configuration

(3) Preparation of forms

Next, the form of the client application is made. Please make the form with the text box, the button, and the combo box in which it is the following.

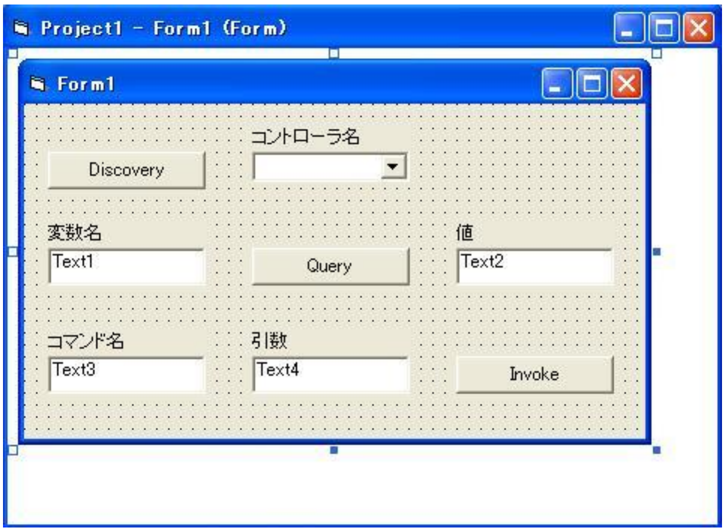


Figure 5-2 Form of UPnP client

(4) Making of code

Please describe the following source codes.

List 5-1 Form1.frm

```
Private devices As UPnPDevices
Private services As UPnPServices

Private device As UPnPDevice
Private service As UPnPService

Private serviceTable() As UPnPService

Private devicefinder

Private Sub Form_Load()
    'Device Finder is generated.                                               ①
    Set devicefinder = CreateObject(″UPnP.UPnPDeviceFinder.1″)
End Sub

'The UPnP device on the network is retrieved.
Private Sub cmdDiscovery_Click()
    cmdDiscovery.Enabled = False
    Combo1.Clear

    'All UPnP devices are acquired.                                            ②
    Set devices = devicefinder.FindByType(″upnp:rootdevice″, FD_ANY)

    If devices.count = 0 Then
```

```
        MsgBox ("The UPnP device was not found. ")
        GoTo Finish
    End If

    'All the services of ORiN Device are acquired.                                  ③
    For Each device In devices
        If StrComp(device.FriendlyName, "ORiN Device") = 0 Then
            MsgBox ("ORiN Device was discovered. ")
            Set services = device.services
            Exit For
        End If
    Next

    If services Is Nothing Then
        MsgBox "ORiN Device was not found. "
        GoTo Finish
    End If

    'The service of the ORiN device is acquired.                                    ④
    ReDim serviceTable(services.count)
    Dim cnt As Integer
    cnt = 0
    For Each service In services
        Combo1.AddItem (service.QueryStateVariable("Name"))
        Set serviceTable(cnt) = service
        cnt = cnt + 1
    Next

Finish:
    cmdDiscovery.Enabled = True
End Sub

'Service is selected from the combo box.
Private Sub Combo1_Click()
    Set service = serviceTable(Combo1.ListIndex)
    cmdQuery.Enabled = True
    cmdInvoke.Enabled = True
End Sub

'The value of a variable is acquired.                                               ⑤
Private Sub cmdQuery_Click()
    Text2.Text = service.QueryStateVariable(Text1.Text)
End Sub

'The command is executed.                                                           ⑥
Private Sub cmdInvoke_Click()
    Dim actionArgs(1)
    Dim actionOutArgs As Variant
    Dim retVal
    ' The argument of the command is set.
    actionArgs(0) = Text4.Text
    ' The command is executed.
    retVal = service.InvokeAction(Text3.Text, actionArgs, actionOutArgs)
End Sub
```

The explanation of the source code is shown as follows.

1. UPnPDeviceFinder is generated by the late binding.
2. The UPnP device is retrieved by using UPnPDeviceFinder. Here, it retrieves it specifying the type by using the FindByType method. Because the type specified this time is “upnp:rootdevice", all UPnP devices that exist on the network are found.
3. Friendly Name looks for the one of “ORiN Device" from among discovered UPnPDevice.
4. The service that “ORiN Device" has is acquired, and it registers in the table.
5. The variable is acquired by using QueryStateVariable API.
6. The command is executed by using InvokeAction API.

5.2. Setting of CaoUPnPConfig

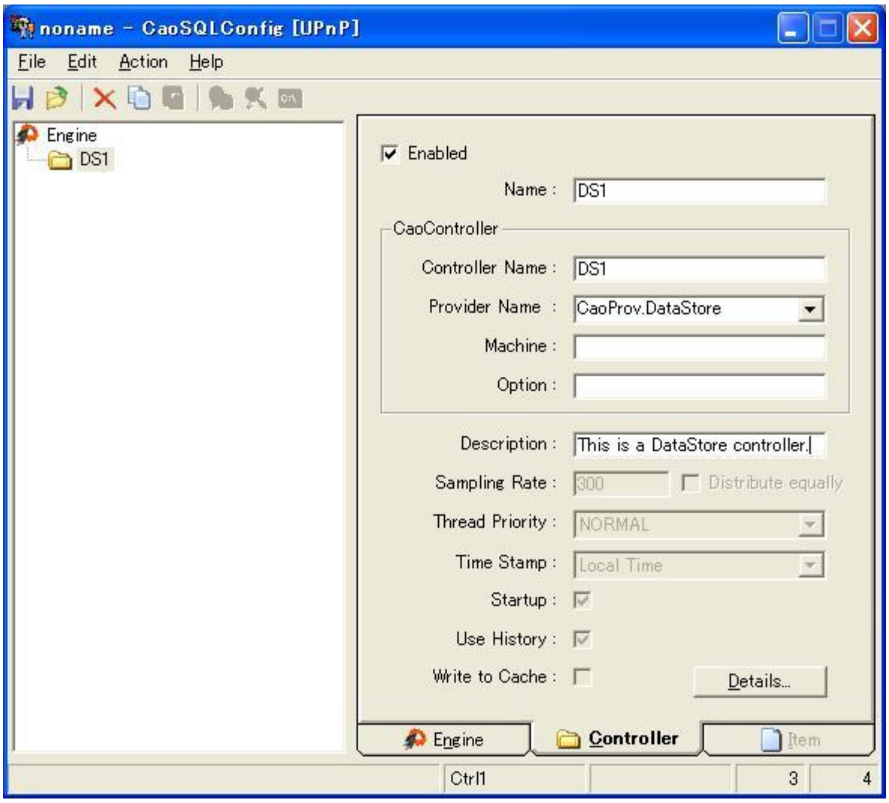
Next, the CAO provider that can access it by CaoUPnP is set by using CaoUPnPConfig.

(1) Start of CaoUPnPConfig

Please start CaoUPnPConfig after confirming CaoUPnP.exe doesn't start by the task manager.

(2) Addition of Controller

The controller is added from "Add Controller" of "Edit". Here, the controller name was assumed to be “DS1", and “CaoProv.DataStore" was selected in the provider.



☑ Enabled

Name : DS1

CaoController

Controller Name : DS1

Provider Name : CaoProv.DataStore

Machine :

Option :

Description : This is a DataStore controller.

Sampling Rate : 300 □ Distribute equally

Thread Priority : NORMAL

Time Stamp : Local Time

Startup : ☑

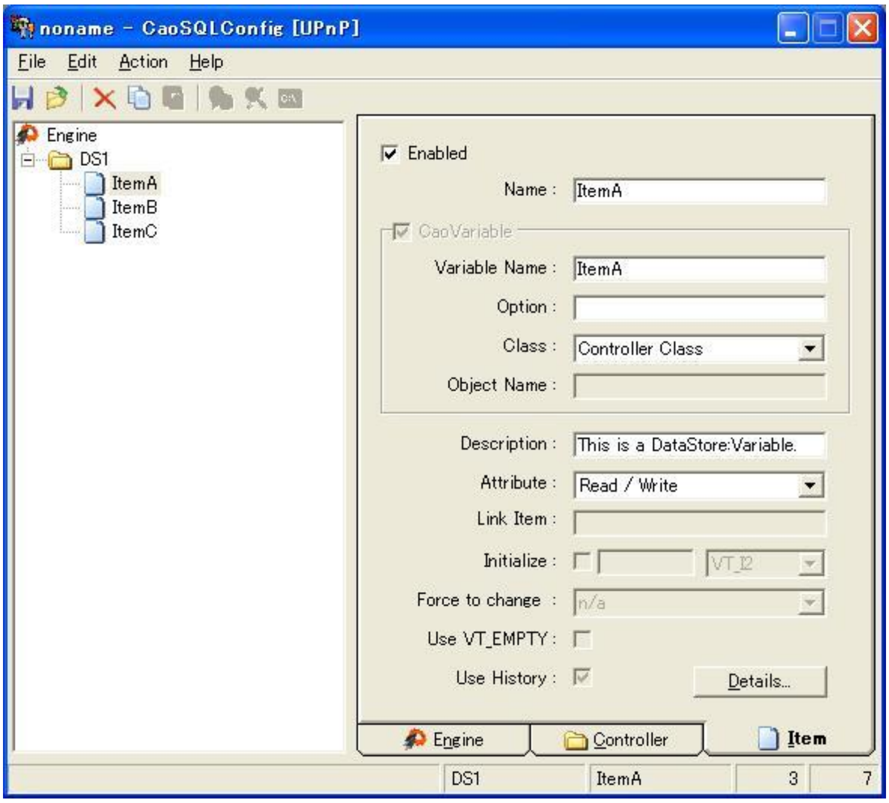
Use History : ☑

Write to Cache : □

Figure 5-3 The controller's addition

(3) Addition of Item

"Add Item" is selected from "Edit" of the menu, and the item is added. Here, “ItemA", “ItemB", and “ItemC" were added. Please set the item of "Description" and "Details" freely.



☑ Enabled

Name : ItemA

☑ CaoVariable

Variable Name : ItemA

Option :

Class : Controller Class

Object Name :

Description : This is a DataStore:Variable.

Attribute : Read / Write

Link Item :

Initialize : □ VT_I2

Force to change : n/a

Use VT_EMPTY : □

Use History : ☑

DS1 ItemA 3 7

Figure 5-4 Addition of item

(4) Preservation of setting

"Save as..." is selected from "File" of the menu, and the setting is preserved.

5.3. Execution of sample

The client application made at the end is executed.

(1) Start of CaoUPnP.exe

CaoUPnP.exe is started. Please select “CaoUPnP" from "Control panel" →"Management tool" → "Management of the computer" and begin serving to start CaoUPnP.exe. Or, please select “Service Start" from the "Action" menu of CaoUPnPConfig and start service.

(2) Execution of client application

Please start the client application made in 5.1. The following screens are displayed when succeeding in the start.

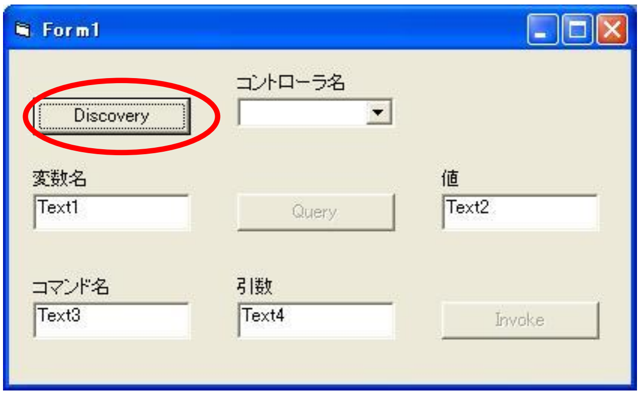
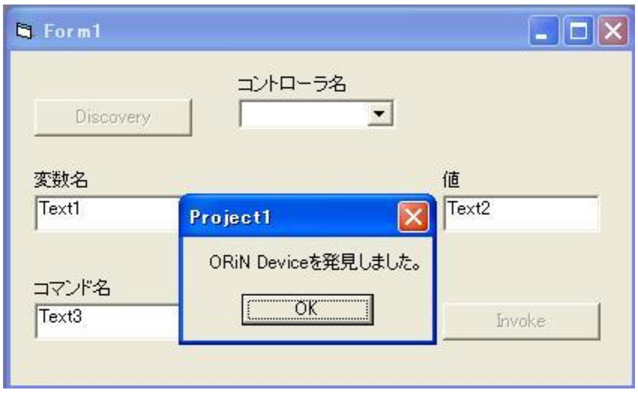


Figure 5-5 Client application screen

Next, please press the “Discovery" button. The UPnP device that exists on the network is retrieved. Here, when CaoUPnP is found, the following dialogs are displayed.



ORiN Deviceを発見しました。

Figure 5-6 Discovery of UPnP device

Here, when the controller name combo box is clicked, the controller's name list set with CaoUPnPConfig as follows is displayed.

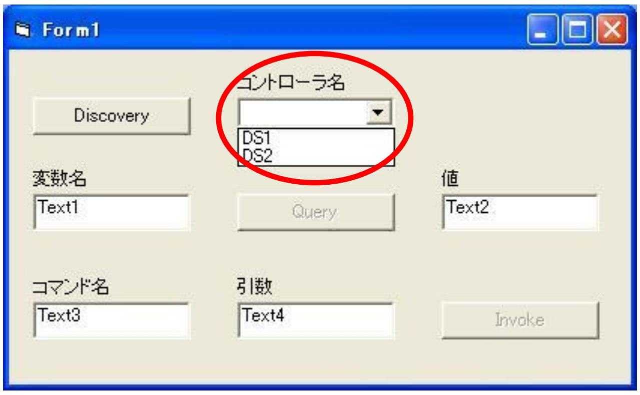
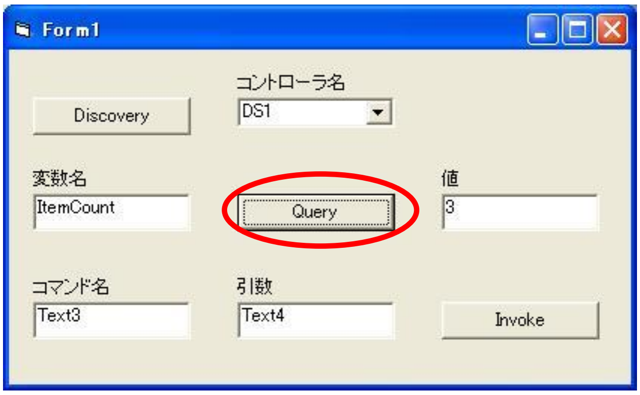


Figure 5-7 The controller's selection

When “ItemCount" is input to the variable identifier after the controller is selected from the combo box and the “Query" button is pressed, the number of items registered in the value with CaoUPnPConfig is displayed. This time, because three (“ItemA", “ItemB", and “ItemC") were registered, “3" is displayed.



Form1

コントローラ名 DS1

変数名 ItemCount

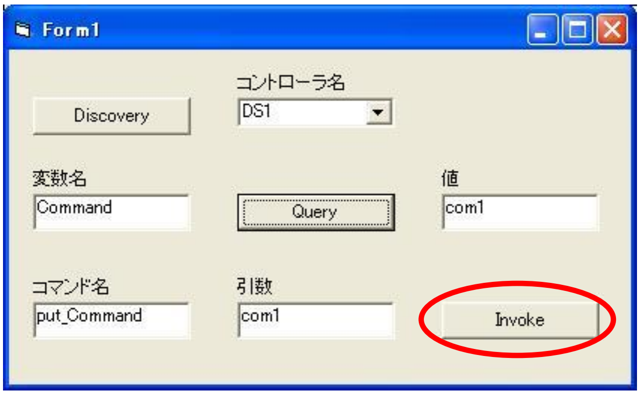
値 3

コマンド名 Text3

引数 Text4

Figure 5-8 Acquisition of ItemCount

“put_Command" is input to the command name, a suitable character string is input to the argument, and the “Invoke" button is pressed. The character string input to input “Command" to the variable identifier for the confirmation, and to press the “Query" button ahead is displayed.



Form1

コントローラ名 DS1

変数名 Command

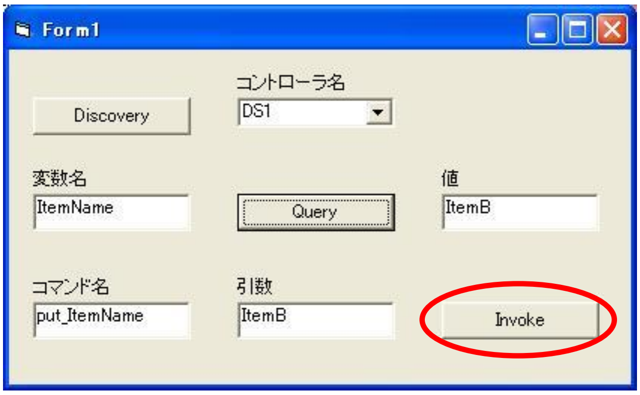
値 com1

コマンド名 put_Command

引数 com1

Figure 5-9 Execution of put_Command command

“put_ItemName" is input to the command name, and similarly, the item name registered with CaoUPnPConfig is input and the “Invoke" button is pressed to the argument. When “ItemName" is input to the variable identifier for the confirmation, and the “Query" button is pressed, a present item name is displayed.



コントローラ名: DS1

変数名: ItemName

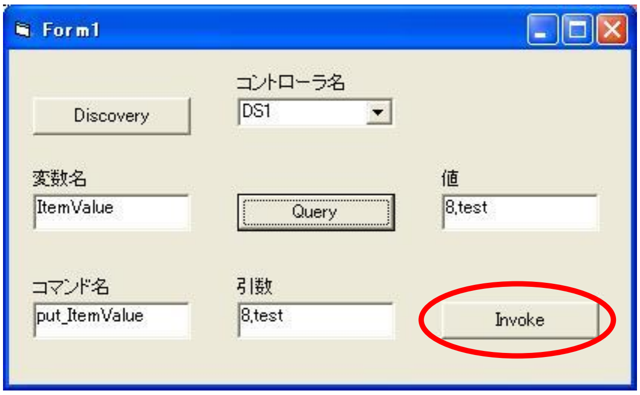
値: ItemB

コマンド名: put_ItemName

引数: ItemB

Figure 5-10 Execution of put_ItemName command

“put_ItemValue" is input to the command name, and in addition, the value of a variable is input and the “Invoke" button is pressed to the argument. When “ItemValue" is input to the variable identifier for the confirmation, and the “Query" button is pressed, a present item value is displayed.



コントローラ名: DS1

変数名: ItemValue

値: 8,test

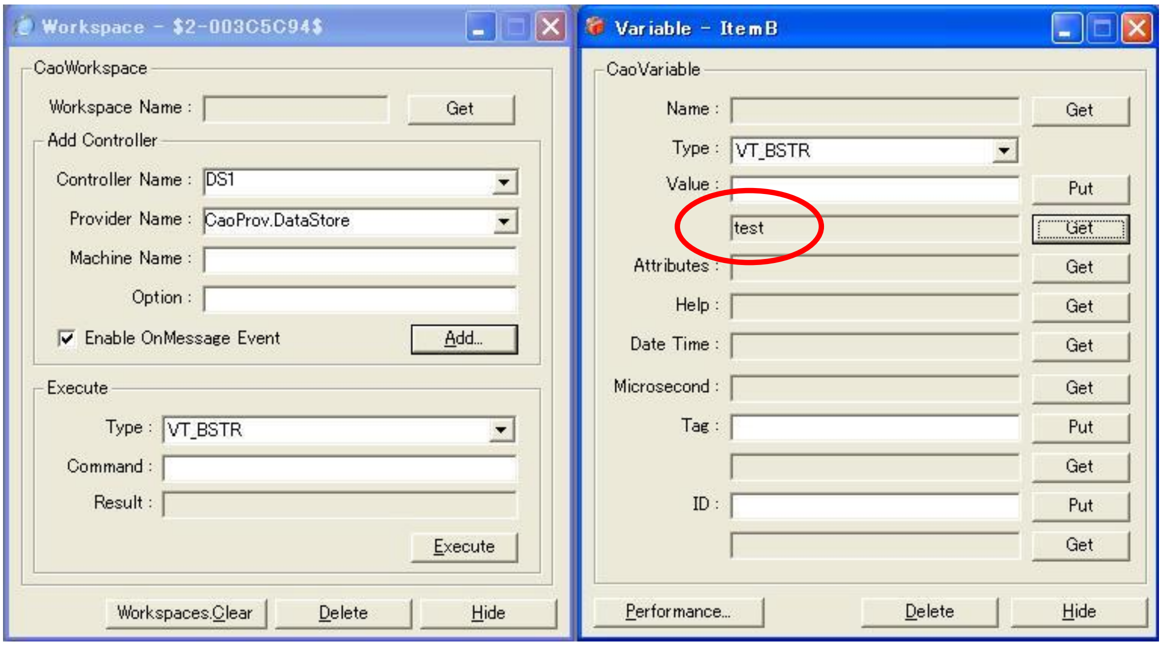
コマンド名: put_ItemValue

引数: 8,test

Figure 5-11 Execution of put_ItemValue command

(3) Confirming the operation by CaoTester

It is confirmed that the value is written in the variable object of DataStore by using the CaoTester tool. First of all, please do AddContorller by controller name “DS1" and provider name “CaoProv.DataStore". Next, AddVariable is done by variable identifier “ItemA", and the Get button is pressed. Please confirm the value is written in the variable.



Workspace - $2-003C5C94$

CaoWorkspace

Workspace Name :

Add Controller

Controller Name : DS1

Provider Name : CaoProv.DataStore

Machine Name :

Option :

☑ Enable OnMessage Event

Execute

Type : VT_BSTR

Command :

Result :

Variable - ItemB

CaoVariable

Name :

Type : VT_BSTR

Value :

test

Attributes :

Help :

Date Time :

Microsecond :

Tag :

ID :

Figure 5-12 Confirmation by CaoTester

6. Notes

(1) Please start CaoUPnP after generation/preserving the csq file with CaoUPnPConfig.

(2) Please put CaoUPnP.exe, CaoUPnPDevice.dll, and CaoUPnPService.xml on the same folder. Please put the file of presentationURL below these same to file folders.

(3) Please describe presentationURL by the relative path.

(4) Please open port (**2869**) used with UPnP when the firewall software is installed.

(5) Please reactivate the Universal Plug and Play Device Host service from → of the management of the computer service and application → service when CaoUPnP remains on the network because of an illegal end etc.

7. Reference information

7.1. Client sample

(1) Sample that exists in "Platform SDK for Windows XP SP2" (VB,CPP)

"Platform SDK for Windows XP SP2" can be obtained from following URL.

http://www.microsoft.com/msdownload/platformsdk/sdkupdate/XPSP2FULLInstall.htm

The sample of the UPnP client exists in the following folders.

%Platform SDK for Windows XP SP2 installation folder %¥Samples¥NetDS¥upnp¥GenericUCP

- Please referring set TLBTypes.olb and VBoostTypes6.olb in the FunctionDelegator folder for VB, and generate the exe file.

- Please put devtype.txt and the udn.txt file on the same folder as sample exe file generated.

(2) Sample of MSDN (VBScript)

Please refer to following URL.

http://msdn.microsoft.com/library/default.asp?url=/library/en-us/upnp/upnp/creating_a_presentation_web_page.asp

(3) If DeviceSpy.exe that exists in "Intel Tools for UPnP Technologies" that Intel is distributing is used, it is possible to test easily.

It is possible to obtain it from following URL.

http://www.intel.com/cd/ids/developer/asmo-na/eng/downloads/upnp/tools/index.htm#anchor_3

Microsoft .NET Framework version 1.1 or more is necessary to use here.

7.2. UPnP related link

UPnP Forum :

http://www.upnp.org/

MSDN(UPnP):

http://www.microsoft.com/japan/whdc/device/netAttach/UPnP/default.mspx

MSDN(UPnP APIs):

http://msdn.microsoft.com/library/en-us/upnp/upnp/universal_plug_and_play_start_page.asp

MSDN(UPnP client support):

http://www.microsoft.com/japan/technet/itsolutions/network/plan/insidenet/sohonet/upnpsup.mspx