SIEMENS

在 VC 中如何实现 OPC 数据访问

How to achieve data access through OPC in VC

Getting-started **Edition (2009 年 06 月)**

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摘　要　本文主要讲述了在 VC 语言环境下，编程实现通过 SimaticNet 提供的 OPC Server，访问 PLC 中数据的步骤，此方法同样适用于 WinCC 作为 OPC Server 时的数据访问。

关键词 SimaticNet、VC、OPC、WinCC

Key Words SimaticNet、VC、OPC、WinCC

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1、概述

1.1 OPC 介绍

OPC 是 Object Linking and Embedding（OLE）for Process Control 的缩写，它是微软公司的对象链接和嵌入技术在过程控制方面的应用。OPC 以 OLE/COM/DCOM 技术为基础，采用客户/服务器模式，为工业自动化软件面向对象的开发提供了统一的标准，这个标准定义了应用 Microsoft 操作系统在基于 PC 的客户机之间交换自动化实时数据的方法，采用这项标准后，硬件开发商将取代软件开发商为自己的硬件产品开发统一的 OPC 接口程序，而软件开发者可免除开发驱动程序的工作，充分发挥自己的特长，把更多的精力投入到其核心产品的开发上。

SimaticNet 是西门子全集成自动化系统中的一个重要组成部分，它为完善的工业自动化控制系统的通讯提供部件和网络，同时提供多个 OPCServer，为数据的外部访问提供接口，本文主要以 OPC.SimaticNET 为例说明。

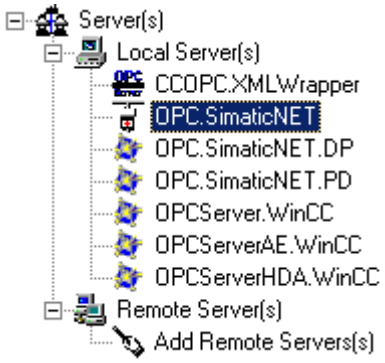


图 1：SimatcicNet 提供的 OPCServer

采用不同的通信方式，通过 OPC.SimaticNET，现场数据可以方便地提供给用户：

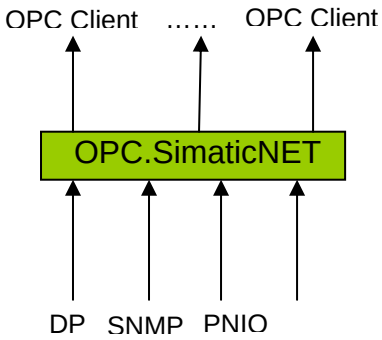


图 2：多种数据提供方式

1.2 OPC 的读写方式

在实际使用中，主要包括对现场数据的读写操作。

OPC 客户端读取数据有三种方式：同步、异步、订阅。

同步通讯时，OPC 客户程序向 OPC 服务器进行请求时，OPC 客户程序必须等到 OPC 服务器对应的响应全部完成以后才能返回，在此期间 OPC 客户程序一直处于等待状态，若进行读操作，那么必须等待 OPC 服务器响应后才返回。因此在同步通讯时，如果有大量数据进行操作或者有很多 OPC 客户程序对 OPC 服务器进行读操作，必然造成 OPC 客户程序的阻塞现象。因此同步通讯适用于 OPC 客户程序较少，数据量较小时的场合。

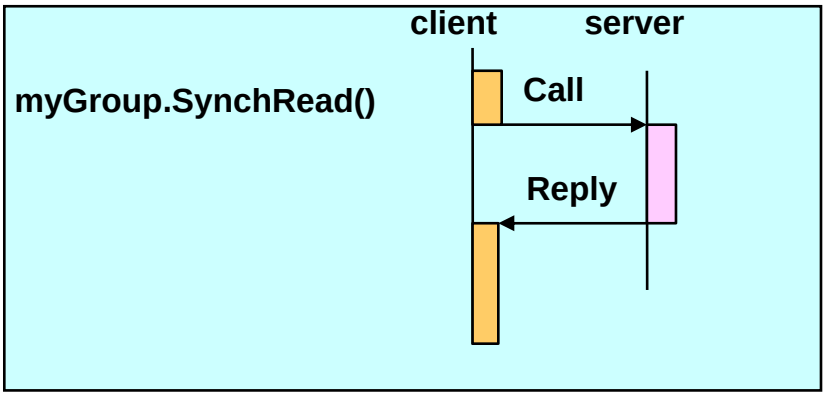


图 3　OPC 同步读写服务器-客户端数据流图

异步通讯时，OPC 客户程序对服务器进行请求时，OPC 客户程序请求后立刻返回，不用等待 OPC 服务器的响应，可以进行其它操作。OPC 服务器完成响应后再通知 OPC 客户程序，如进行读操作，OPC 客户程序通知 OPC 服务器后离开返回，不等待 OPC 服务器的读完成，而 OPC 服务器完成读后，会自动的通知 OPC 客户程序，把读结果传送给 OPC 客户程序。因此相对于同步通讯，异步通讯的效率更高。

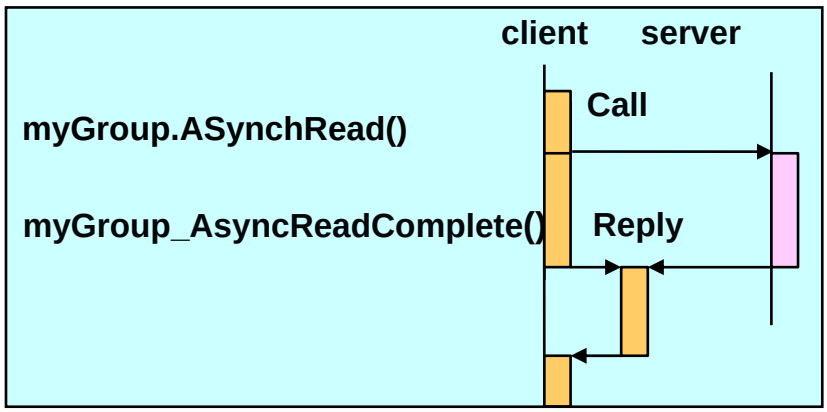


图 4　OPC 异步读服务器-客户端数据流图

订阅方式时，OPC 客户程序对服务器进行请求时，OPC 客户程序操作后立刻返回，不用等待 OPC 服务器的操作，可以进行其它操作， OPC 服务器的 Group 组在组内有数据发生改变时，自动根据更新周期刷新相应的客户端数据，如下图，客户端只向 OPC 服务发送一次请求，之后不再对服务器请求。

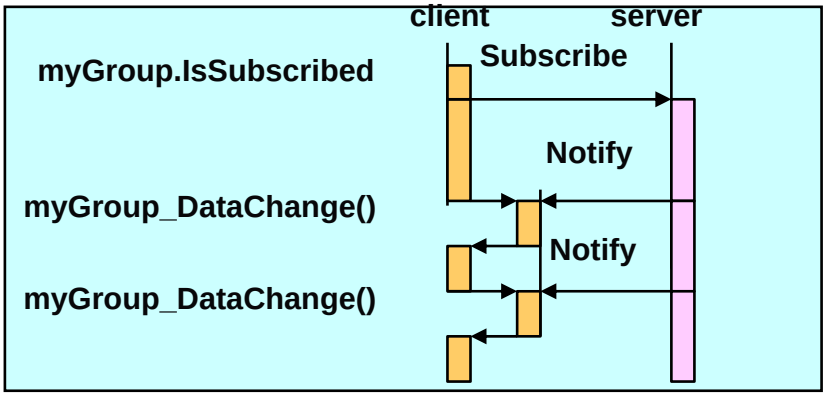


图 5　OPC 同步读服务器-客户端数据流图

OPC 写数有两种方式：同步、异步。区别与上面讲的机制一样，在生产应用中，如果写数据参与控制，一般采用同步方式。

1.3 OPC 访问接口方式

OPC 主要包含两种接口：CUSTOM 标准接口和 OLE 自动化标准接口，自定义接口是服务商必须提供的，而自动化接口则是可选的。

自定义接口是一组 COM 接口，主要用于采用 C++语言的应用程序开发；

自动化接口是一组 OLE 接口，主要用于采用 VB，DELPHI，Excel 等基于脚本编程语言的应用程序开发。

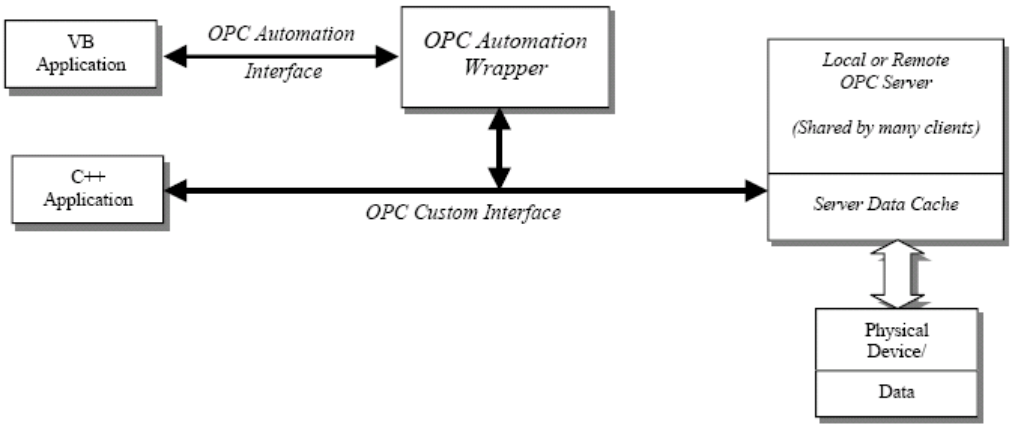


图 6　自定义接口和自动化接口

本文中通过实验，基于自定义接口，逐步讲解了通过 VC 编写客户端程序，访问 OPC.SimaticNet，对 PLC 数据进行读写的实现过程。

2、测试环境

2.1 硬件要求

采用 400 系列 PLC，通过以太网连接到安装有 simaticNet 的计算机上。

computer：windows 2003 server--------192.168.0.102

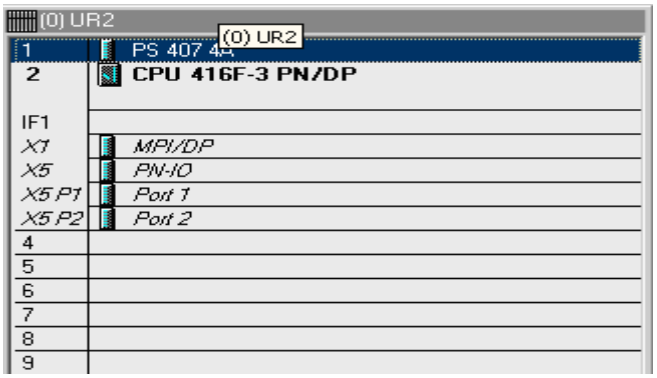
CPU：CPU414-3PN ------416-3FR05-0AB0--------192.168.0.1

2.2 软件要求

computer：

- ✓ Simatic.net 2007
- ✓ Visual studio 2005
- ✓ Step7 V5.4 SP4

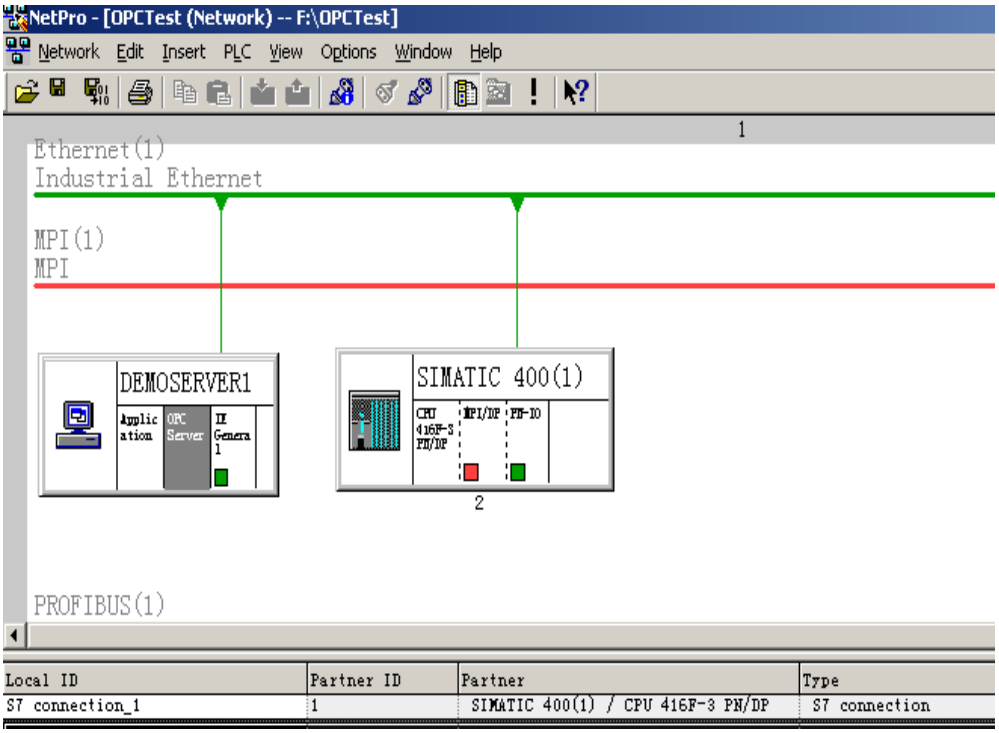
3、OPC Server 端组态配置



在 CPU 中定义 DB 块：DB10

Address	Name	Type	Initial value
0.0		STRUCT	
+0.0	Test_Data3	INT	0
+2.0	Test_Data4	INT	0
+4.0	Test_Data5	REAL	0.000000e+000
+8.0	Test_Data6	REAL	0.000000e+000
+12.0	Test_Data7	BOOL	FALSE
+12.1	Test_Data8	BOOL	FALSE
+14.0	Test_Data9	STRING[10]	''
+26.0	Test_Data10	STRING[10]	''
=38.0		END_STRUCT	

配置 PC Station，参考其它文档。



如上图建立连接 S7_connection_1，然后在 OPC Scout 测试连接的正确性。

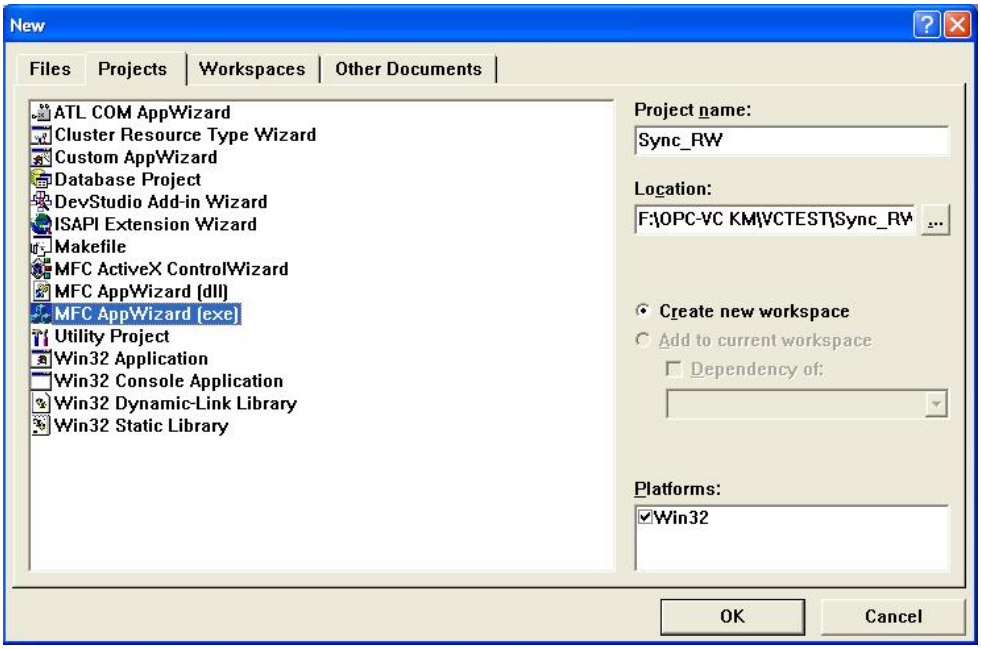
	Item Names	Value	Format	Type	Access	Quality	e Stamp (L
1	S7:[S7 connection_1]DB10,INT0	2	Original	int16	RW	good	03/18/2009
2	S7:[S7 connection_1]DB10,INT2	4	Original	int16	RW	good	03/18/2009
3	S7:[S7 connection_1]DB10,REAL4	3.5	Original	real32	RW	good	03/18/2009
4	S7:[S7 connection_1]DB10,REAL8	5.8	Original	real32	RW	good	03/18/2009
5	S7:[S7 connection_1]DB10,STRING14.10	test	Original	string	RW	good	03/18/2009
6	S7:[S7 connection_1]DB10,STRING26.10	20081213	Original	string	RW	good	03/18/2009
7	S7:[S7 connection_1]DB10,X12.0	True	Original	bool	RW	good	03/18/2009
8	S7:[S7 connection_1]DB10,X12.1	False	Original	bool	RW	good	03/18/2009

从上面可以看到数据访问都是正常的。

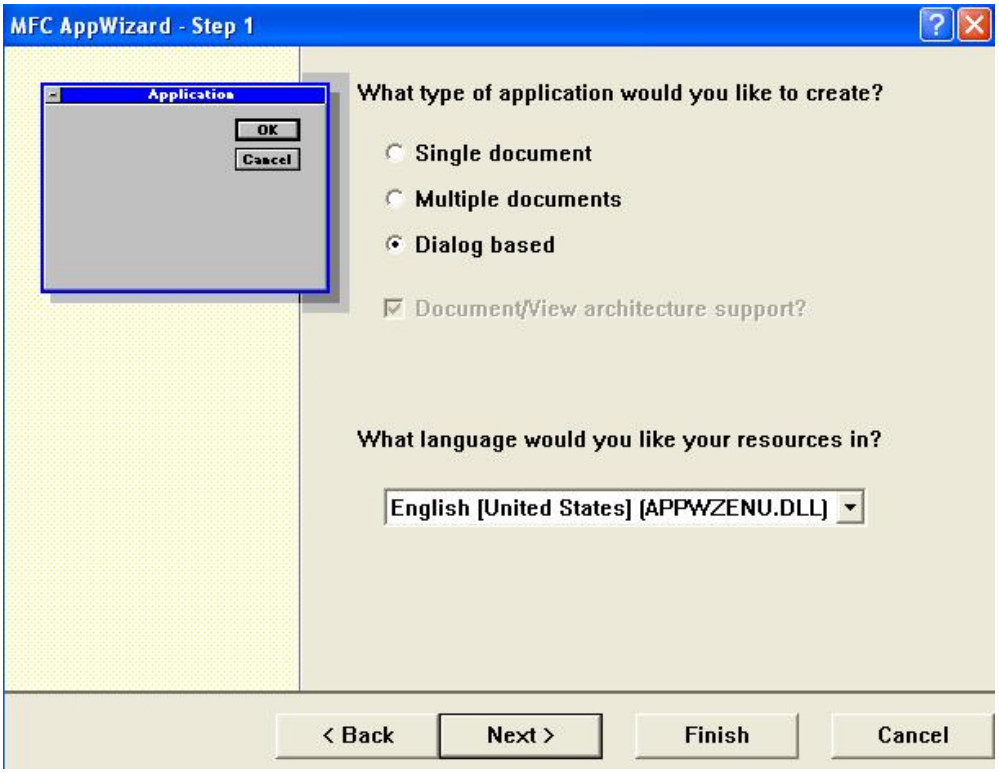
4、用 VC 自定义设计过程

4.1 同步读写

建立项目：命名为 Sync_RW



如下，建立工程项目为 Dialog based 项目类型。



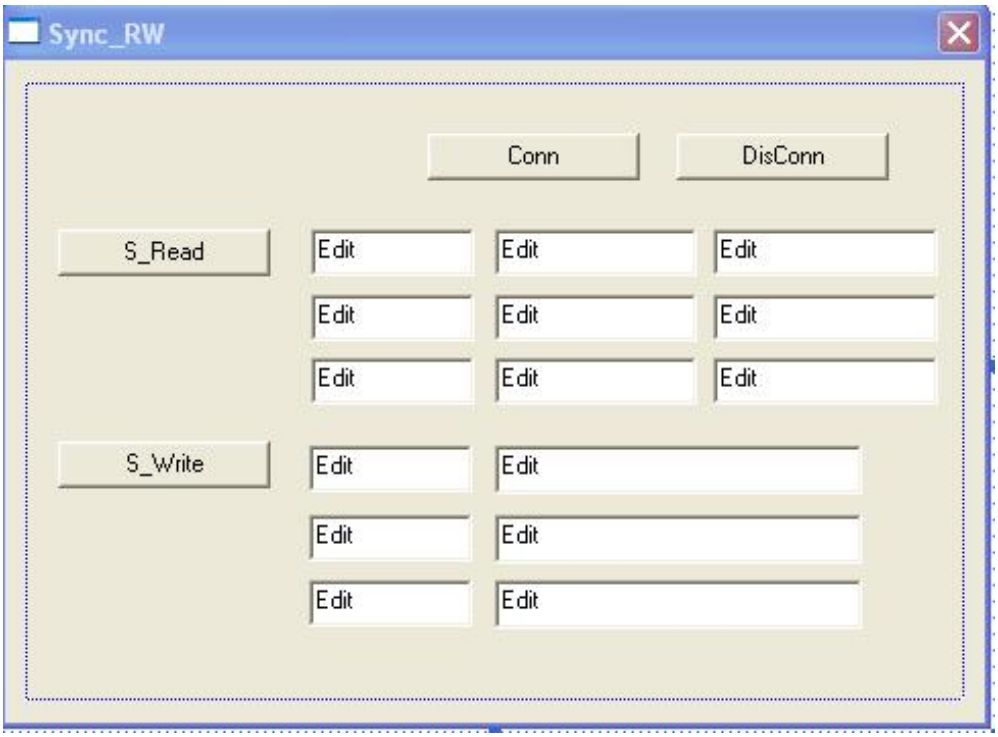
如下：在 IDD_OPCDA_SYNC_DIALOG 对话框中作如下定义：

Control	name	Text
Button:	IDC_BUTTON_Conn	Conn
Button:	IDC_BUTTON_SRead	S_Read
Button:	IDC_BUTTON_SWrite	S_Write
Button:	IDC_BUTTON_DisConn	DisConn
EditBox:	IDC_EDIT_ReadVal1	
EditBox:	IDC_EDIT_ReadVal2	
EditBox:	IDC_EDIT_ReadVal3	
EditBox:	IDC_EDIT_ReadQu1	
EditBox:	IDC_EDIT_ReadQu2	
EditBox:	IDC_EDIT_ReadQu3	
EditBox:	IDC_EDIT_ReadTS1	
EditBox:	IDC_EDIT_ReadTS2	
EditBox:	IDC_EDIT_ReadTS3	
EditBox:	IDC_EDIT_WriteVal1	
EditBox:	IDC_EDIT_WriteVal2	
EditBox:	IDC_EDIT_WriteVal3	

EditBox: IDC_EDIT_WriteRes1

EditBox: IDC_EDIT_WriteRes2

EditBox: IDC_EDIT_WriteRes3



第一步，在 CSync_RWDlg 中增加相应变量定义：

CString m_WriteRes3;

CString m_WriteRes2;

CString m_WriteRes1;

CString m_WriteVal3;

double m_WriteVal2;

int m_WriteVal1;
CString m_ReadTs3;
CString m_ReadTs2;
CString m_ReadTs1;
CString m_ReadQu3;
CString m_ReadQu2;
CString m_ReadQu1;
CString m_ReadVal3;
double m_ReadVal2;
int m_ReadVal1;
HICON m_hIcon;

同时增加 OPC 自定义标准中接口变量

IOPCServer	*m_pIOPCServer; // OPCServer 句柄
IOPCItemMgt	*m_pIOPCItemMgt; //OPCItem 状态句柄
IOPCSyncIO	*m_pIOPCSyncIO;
OPCITEMDEF	m_Items[3];
OPCITEMRESULT	*m_pItemResult;
OPCHANDLE	m_GrpSrvHandle;
HRESULT	*m_pErrors;

第二步，在 CSync_RWDlg 中增加相应函数定义：

afx_msg void OnConn();
afx_msg void OnWrite();
afx_msg void OnRead();
afx_msg void OnDisConn();

第三步，将变量及动作在 DoDataExchange，BEGIN_MESSAGE_MAP 建立联系：

```
void void CSync_RWDlg::DoDataExchange(CDataExchange* pDX)
{
    CDialog::DoDataExchange(pDX);
    DDX_Text(pDX, IDC_EDIT_ReadVal1, m_ReadVal1);
    ......//增加相应代码
}
BEGIN_MESSAGE_MAP(CSync_RWDlg, CDialog)
     ON_BN_CLICKED(IDC_BUTTON_Conn, OnConn)
     ......//增加相应代码
END_MESSAGE_MAP()
```

第四步，增加 OPC 相应的外部引用文件：

增加文件： Pre_OPC.h ， Pre_OPC.cpp

在 Pre_OPC.h 中，增加 OPC 的通用头文件：

```
#include "OPCDA.H"
#include "OPCcomn.H"
#include "OPCError.h"
```

注意在 Sync_RW.cpp 及 Sync_RWDlg.cpp 中引用"Pre_OPC.h"时，按照如下顺序：

```
#include "stdafx.h"
#include "Pre_OPC.h"
#include "Sync_RW.h"
#include "Sync_RWDlg.h"
```

第五步，初始化 Com 控件，注册 OPCGroup 及 OPCItem：

```
void CSync_RWDlg::OnConn()
{
    ......
    HRESULT                 r1;
    r1 = CLSIDFromProgID(L"OPC.SimaticNET", &clsid);
    r1 = CoCreateInstance (clsid, NULL, CLSCTX_LOCAL_SERVER ,
                                IID_IOPCServer, (void**)&m_pIOPCServer);
        //"OPC.SimaticNet", "192.168.0.102"是 OPCServer 名称及所在 computer 地址
        // CoCreateInstance 创建一个 OPCSerer 的实例
```

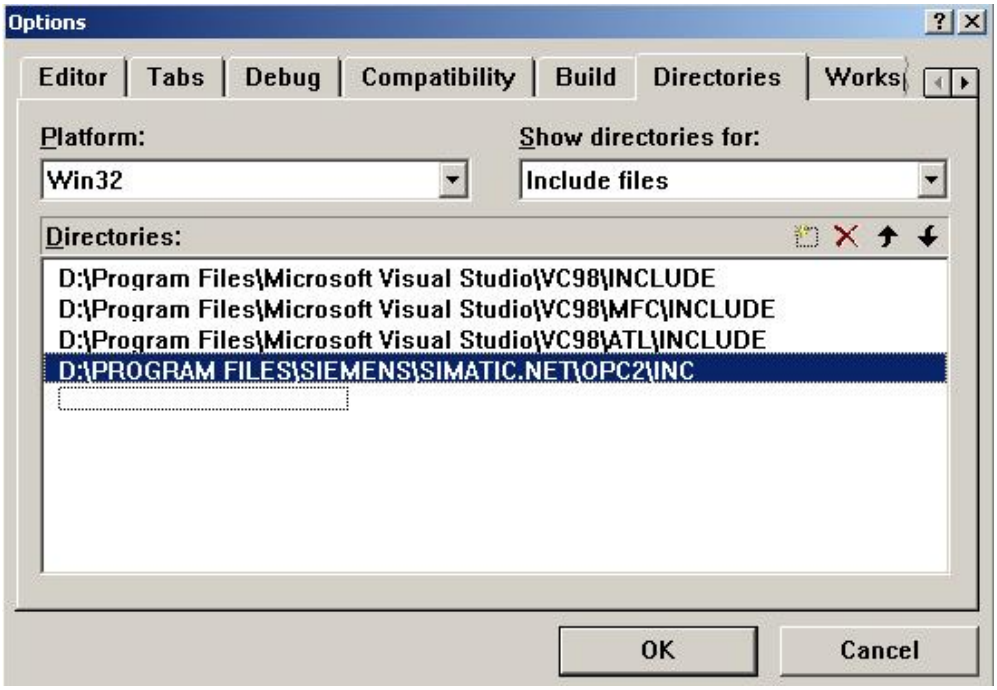
```
        ……
        r1=m_pIOPCServer->AddGroup()//增加相应的组，定义组的特性，并输出组的句柄
        ……
        m_Items[0].szAccessPath      = L"";
        m_Items[0].szItemID    = L"S7:[@LOCALSERVER]DB1,INT0";
                                        //地址，不同数据类型表示方法不同
        m_Items[0].bActive      = TRUE; //是否激活
        m_Items[0].hClient      = 1; //标示 ID，不同的 Item 不一样
        m_Items[0].dwBlobSize = 0;
        m_Items[0].pBlob        = NULL;
        m_Items[0].vtRequestedDataType = 2; //数据类型表示格式，2 表示 int
        ……
        r1 = m_pIOPCItemMgt->AddItems(3,m_Items,&m_pItemResult,
                &m_pErrors);//将定义的 OPCTtem 加入组内，注意数量
        ……
      r1 = m_pIOPCItemMgt->QueryInterface(IID_IOPCSyncIO,
                (void**)&m_pIOPCSyncIO);
                        //为 OPCGroup 的组对象定义接口
        ……
}
```

第六步，同步读：

```
void CSync_RWDlg::OnRead()
{
        ……
        r1 = m_pIOPCSyncIO->Read(OPC_DS_DEVICE, 3, phServer,
                        &pItemValue, &pErrors); //同步读
        m_ReadVal1 = pItemValue[0].vDataValue.lVal; //得出值
        qnr = pItemValue[0].wQuality; //
        m_ReadQu1 = GetQualityText(qnr); //质量码
        m_ReadTs1 = COleDateTime( pItemValue[0].ftTimeStamp ).Format();
                                        //时间
        UpdateData(FALSE); //更新数据到画面
        ……
}
```

注意，编译程序，出现错误：

LINK : fatal error LNK1168: cannot open Debug/Sync_RW.exe for writing，是由于工程的路径不对，需要工具->选择->目录中，如下添加即可：



在测试中，采用了三种数据类型，分别为 int, real , string，在程序设计时要注意。具体参建后面说明。

第七步，同步写：

```
void CSync_RWDlg::OnWrite()
{
        ……
        values[0].vt = VT_I2;
        values[0].iVal = m_WriteVal1; //得出值
        r1 = m_pIOPCSyncIO->Write(3, phServer, values, &pErrors); //同步写
        ……
        UpdateData(FALSE);
        ……
}
```

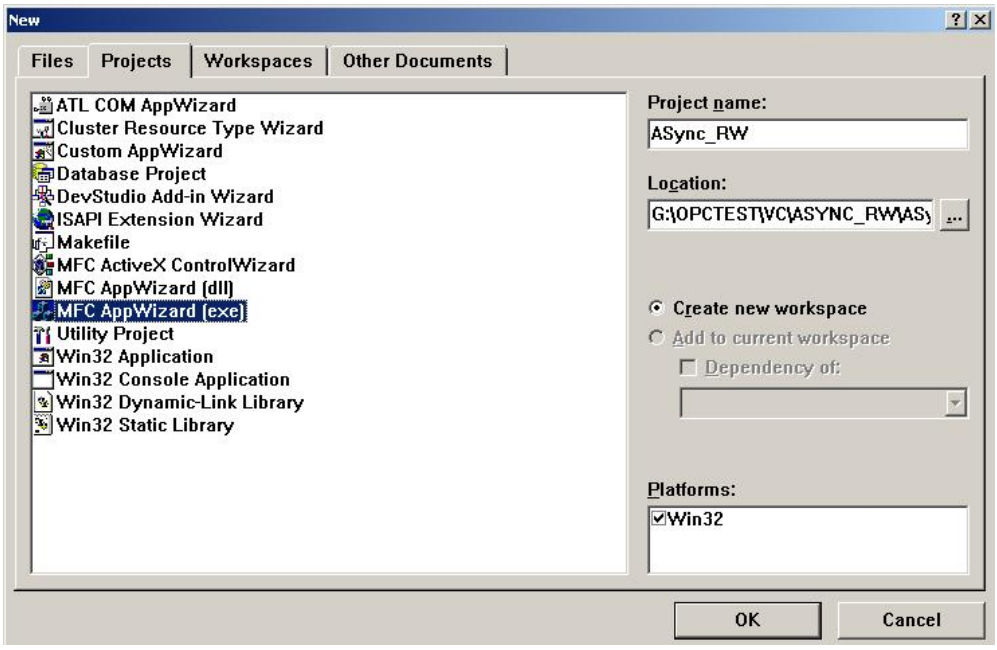
第八步，释放对象：

```
void CSync_RWDlg::OnDisConn()
{
        ……
```

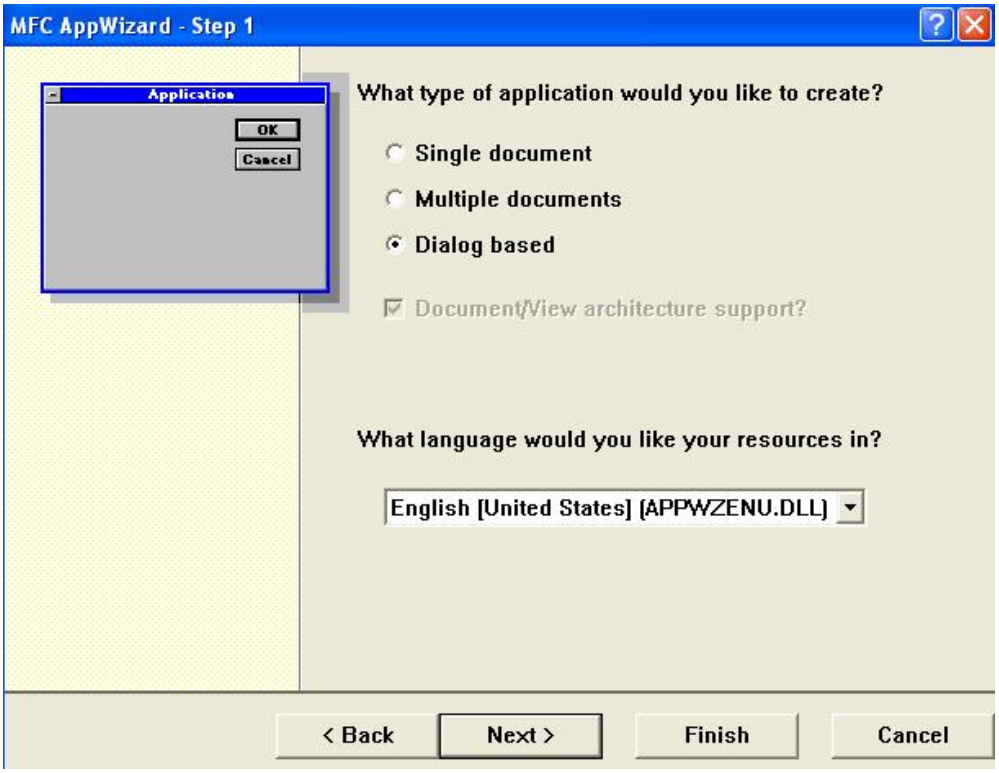
```
        r1 = m_pIOPCItemMgt->RemoveItems(3,phServer,&pErrors);
                                                    //删除 OPCItem
        ……
        r1=m_pIOPCServer->RemoveGroup(m_GrpSrvHandle, TRUE);
        ……                                          //删除 OPCGroup
        m_pIOPCServer->Release();                   //释放 OPCServer
        ……
}
```

4.2 异步读写

建立项目：命名为 ASync_RW



如下，建立工程项目为 Dialog based 项目类型。



如下：在 IDD_OPCDA_SYNC_DIALOG 对话框中作如下定义：

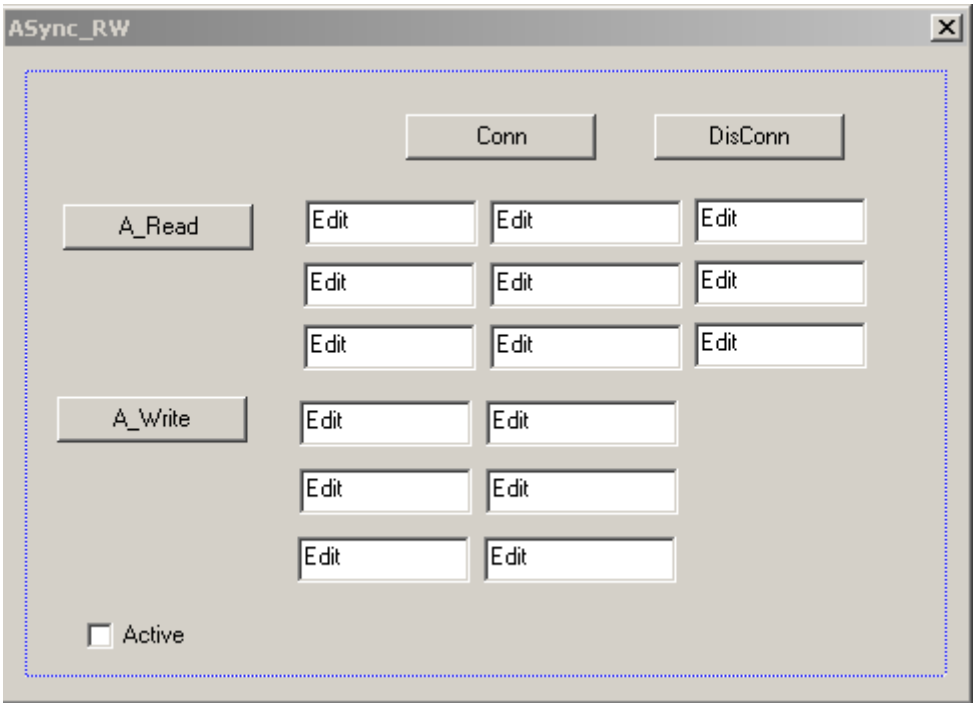
Control	name	Text
Button:	IDC_BUTTON_Conn	Conn
Button:	IDC_BUTTON_ARead	A_Read
Button:	IDC_BUTTON_AWrite	A_Write
Button:	IDC_BUTTON_DisConn	DisConn
EditBox:	IDC_EDIT_ReadVal1	
EditBox:	IDC_EDIT_ReadVal2	
EditBox:	IDC_EDIT_ReadVal3	
EditBox:	IDC_EDIT_ReadQu1	
EditBox:	IDC_EDIT_ReadQu2	
EditBox:	IDC_EDIT_ReadQu3	
EditBox:	IDC_EDIT_ReadTS1	
EditBox:	IDC_EDIT_ReadTS2	
EditBox:	IDC_EDIT_ReadTS3	
EditBox:	IDC_EDIT_WriteVal1	
EditBox:	IDC_EDIT_WriteVal2	
EditBox:	IDC_EDIT_WriteVal3	

EditBox: IDC_EDIT_WriteRes1

EditBox: IDC_EDIT_WriteRes2

EditBox: IDC_EDIT_WriteRes3

CheckBox: IDC_CHK_Active



第一步，在 CASync_RWDlg 中增加相应变量定义：

CString m_WriteRes3;

CString m_WriteRes2;

CString m_WriteRes1;

CString m_WriteVal3;

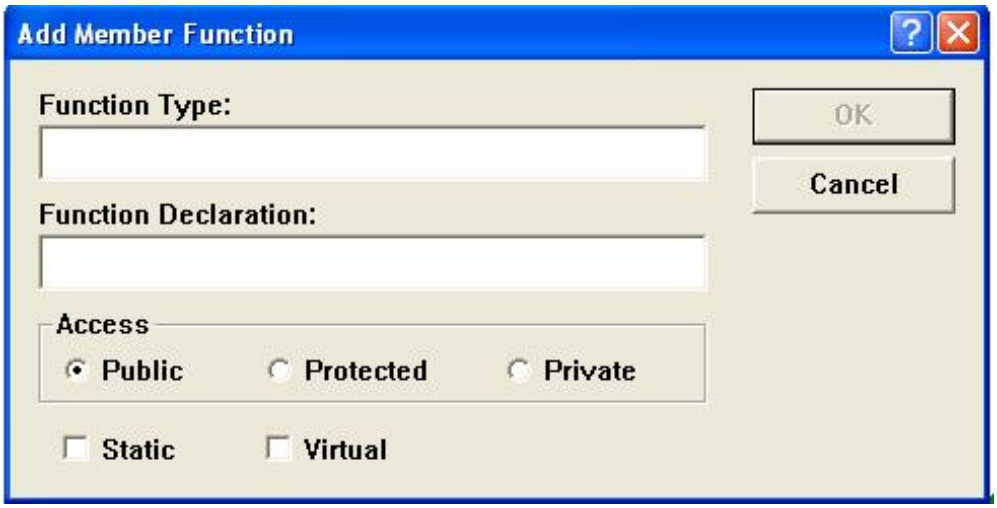
double m_WriteVal2;

int m_WriteVal1;
CString m_ReadTs3;
CString m_ReadTs2;
CString m_ReadTs1;
CString m_ReadQu3;
CString m_ReadQu2;
CString m_ReadQu1;
CString m_ReadVal3;
double m_ReadVal2;
int m_ReadVal1;
BOOL m_ActiveCheck;

同时增加 OPC 自定义标准中接口变量

DWORD	m_dwAdvise;
OPCITEMDEF	m_Items[3];
IOPCServer	*m_pIOPCServer; // OPCServer 句柄
IOPCItemMgt	*m_pIOPCItemMgt; //OPCItem 状态句柄
IOPCGroupStateMgt	*m_pIOPCGroupStateMgt;
IOPCAsyncIO2	*m_pIOPCAsyncIO2;
OPCITEMRESULT	*m_pItemResult;
HRESULT	*m_pErrors;
OPCHANDLE	m_GrpSrvHandle;

第二步，在 CASync_RWDlg 中增加相应函数定义：



afx_msg void OnConn();
afx_msg void OnWrite();

afx_msg void OnRead();

afx_msg void OnCHECKData();

afx_msg void OnDisConn();

第三步，将变量及动作在 DoDataExchange，BEGIN_MESSAGE_MAP 建立联系：

```
void void CASync_RWDlg::DoDataExchange(CDataExchange* pDX)
{
    CDialog::DoDataExchange(pDX);
    DDX_Text(pDX, IDC_EDIT_ReadVal1, m_ReadVal1);
    ....../增加相应代码
}
BEGIN_MESSAGE_MAP(CASync_RWDlg, CDialog)
     ON_BN_CLICKED(IDC_BUTTON_Conn, OnConn)
     ....../增加相应代码
END_MESSAGE_MAP()
```

第四步，增加 OPC 相应的外部引用文件：

增加文件： Pre_OPC.h ， Pre_OPC.cpp

增加文件：Callback.h，Callback.cpp

在 Pre_OPC.h 中，增加 OPC 的通用头文件：

```
#include "OPCDA.H"
#include "OPCcomn.H"
#include "OPCError.h"
```

注意在 ASync_RW.cpp 及 ASync_RWDlg.cpp 中引用"Pre_OPC.h"时，按照如下顺序：

```
#include "stdafx.h"
#include "Pre_OPC.h"
#include "ASync_RW.h"
#include "ASync_RWDlg.h"
```

编译如果报错 fatal error C1010: unexpected end of file while looking for precompiled header directive

则在 callback.cpp 前面加编译文件#include "stdafx.h"。

编译如果 error LNK2001: ATL::CComModule _Module" (?_Module@@3VCComModule@ATL@@A)

则在"ASync_RW.h"前面增加 CComModule _Module;

第五步，初始化 Com 控件，注册 OPCGroup 及 OPCItem：

```
void CASync_RWDlg::OnConn()
{
        ……
        HRESULT                 r1;
        r1 = CLSIDFromProgID(L"OPC.SimaticNET", &clsid);
        r1 = CoCreateInstance (clsid, NULL, CLSCTX_LOCAL_SERVER ,
                                IID_IOPCServer, (void**)&m_pIOPCServer);
            //"OPC.SimaticNet", "192.168.0.102"是 OPCServer 名称及所在 computer 地址
            // CoCreateInstance 创建一个 OPCSerer 的实例
        ……
        r1=m_pIOPCServer->AddGroup()//增加相应的组，定义组的特性，并输出组的句柄
        ……
        m_Items[0].szAccessPath      = L"";
        m_Items[0].szItemID     = L"S7:[@LOCALSERVER]DB1,INT0";
                                    //地址，不同数据类型表示方法不同
        m_Items[0].bActive      = TRUE; //是否激活
        m_Items[0].hClient      = 1; //标示 ID，不同的 Item 不一样
        m_Items[0].dwBlobSize           = 0;
        m_Items[0].pBlob        = NULL;
        m_Items[0].vtRequestedDataType = 2; //数据类型表示格式，2 表示 int
        ……
        r1 = m_pIOPCItemMgt->AddItems(3,m_Items,&m_pItemResult,
            &m_pErrors);//将定义的 OPCTtem 加入组内，注意数量
        ……
      r1 = m_pIOPCItemMgt->QueryInterface(IID_IOPCSyncIO,
            (void**)&m_pIOPCSyncIO);
                    //为 OPCGroup 的组对象定义接口
        ……
      r1 = m_pIOPCItemMgt->QueryInterface(IID_IOPCAsyncIO2,
            (void**)&m_pIOPCAsyncIO2);
                    //为 OPCGroup 的异步读对象定义接口
      ……
      CComObject<COPCDataCallback>* pCOPCDataCallback;      //Callback 事
      件指针    ……
}
```

第六步，异步读：

```
void CASync_RWDlg::OnRead()
{
        ……
      r1 = m_pIOPCAsyncIO2->Read(3,phServer,10, &dwCancelID,  &pErrors);
                                                    //异步读
        ……
}
```

异步读操作后，通过事件回调函数 OnReadComplete，得到相应数据

```
STDMETHODIMP  COPCDataCallback::OnReadComplete（）
{
        ……
        if (pErrors[0] == S_OK)
        {
                ……
                m_pCDlgClass->m_ReadVal1 =pvValues[0].iVal;        //数值
                m_pCDlgClass->m_ReadQu1 =readQuality;    //质量码
                m_pCDlgClass->m_ReadTs1 =readTS;          //时间
                ……
        }
        m_pCDlgClass->UpdateData(FALSE); //
}
```

第七步，订阅读：

```
void CASync_RWDlg::OnCHECKData()
{
        HRESULT r1=  m_pIOPCGroupStateMgt->SetState(，
                        &dwRevUpdateRate，//更新速度
                        &m_ActiveCheck，//订阅激活
                        ...)
}
```

订阅读操作后，通过事件回调函数 OnReadComplete，得到相应数据

```
STDMETHODIMP COPCDataCallback:: OnDataChange()
{
   for (i = 0;  i<dwCount; i++)
```

```
    {
      switch (phClientItems[i])
      {
        case 1:
        m_pCDlgClass->m_ReadVal1 =pvValues[i].iVal; //数值
        m_pCDlgClass->m_ReadQ=GetQualityText(pwQualities[0]); //质量码
         m_pCDlgClass->m_ReadTs1=COleDateTime( pftTimeStamps[0] ).Format();
          break;
          ……
       }
     }
```

在这里要注意，对于 phClientItems[i]是 Item 的 ID 号。一定要对应上。

第八步，异步写：

```
void CASync_RWDlg::OnWrite()
{
   ……
    r1 = m_pIOPCAsyncIO2->Write(2,phServer,values,2,&dwCancelID,&pErrors)
                                                    //异步写
    ……
}
```

写操作后，通过事件回调函数 OnWriteComplete，得到处理结果

```
STDMETHODIMP  COPCDataCallback::OnWriteComplete（）
```

第九步，释放对象：

```
void CASync_RWDlg::OnDisConn()
{
        ……
        r1 = m_pIOPCItemMgt->RemoveItems(3,phServer,&pErrors);
                                          //删除 OPCItem
        ……
        r1=m_pIOPCServer->RemoveGroup(m_GrpSrvHandle, TRUE);
        ……                                //删除 OPCGroup
        m_pIOPCServer->Release();         //释放 OPCServer
        ……
}
```

5、OPCItem 的数据类型

```
m_Items[0].szAccessPath      = L"";
m_Items[0].szItemID     = L"S7:[@LOCALSERVER]DB1,INT0";
                                    //地址，不同数据类型表示方法不同
m_Items[0].bActive      = TRUE; //是否激活
m_Items[0].hClient      = 1; //标示 ID，不同的 Item 不一样
m_Items[0].dwBlobSize = 0;
m_Items[0].pBlob        = NULL;
m_Items[0].vtRequestedDataType = 2; //数据类型表示格式，2 表示 int
```

在上面可以看到，vtRequestedDataType 代表了不同数据类型，在使用中需要注意的。

在取数据时对于 vDataValue 结构分析，各种数据类型对应关系如下：

VbBoolean	VbByte	VbDecimal	VbDouble	Vbinteger	VbLong	VbSingle	VbString
11	17	14	5	2	3	4	8
boolVal	bVal		dblVal	iVal	lVal	fltVal	bstrVal

6、小结

在实际应用中，根据实际要求，合理选择读写方式是很重要的。同时实例中是以 SimaticNet 的 OPCServer 为例，对于 WinCC 作为 OPCServer 同样适用，只需要将"OPC.SimaticNet"改为"OPCServer.WinCC"。

7、代码

下面是异步读写（包括订阅）的代码，不包含自动生成文件，同步方式读写可参考。在西门子 Simatic 安装盘中也有类似例程可参考。

7.1 异步读写（包括订阅）

```
//Pre_OPC.h
#define VC_EXTRALEAN                    // Exclude rarely-used stuff from Windows headers
#include <afxwin.h>         // MFC core and standard components
#include <afxext.h>         // MFC extensions
#include <afxdisp.h>        // MFC OLE automation classes
#ifndef _AFX_NO_AFXCMN_SUPPORT
#include <afxcmn.h>                     // MFC support for Windows Common Controls
#endif // _AFX_NO_AFXCMN_SUPPORT
#include <atlbase.h>
extern CComModule _Module;
#include <atlcom.h>
#include "OPCDA.H"
#include "OPCcomn.H"
```

```
#include "OPCError.h"

//Pre_OPC.cpp
#include "pre_opc.h"
#include "atlimpl.cpp"
#define IID_DEFINED
#include "Opccomn_i.c"
#include "OPCDA_I.C"

//ASync_RWDlg.h
//

#if !defined(AFX_ASYNC_RWDLG_H__DE84F897_EBB8_483B_98F4_CFE8C7F228C5__INC
LUDED_)
#define
AFX_ASYNC_RWDLG_H__DE84F897_EBB8_483B_98F4_CFE8C7F228C5__INCLUDED_
#if _MSC_VER > 1000
#pragma once
#endif // _MSC_VER > 1000

/////////////////////////////////////////////////////////////////////////////
// CASync_RWDlg dialog
class CASync_RWDlg : public CDialog
{
// Construction
public:
        CString m_WriteRes3;
        CString m_WriteRes2;
        CString m_WriteRes1;
        CString m_WriteVal3;
        double m_WriteVal2;
        int m_WriteVal1;
        CString m_ReadTs3;
        CString m_ReadTs2;
        CString m_ReadTs1;
        CString m_ReadQu3;
        CString m_ReadQu2;
        CString m_ReadQu1;
        CString m_ReadVal3;
        double m_ReadVal2;
        int m_ReadVal1;
        IOPCServer                      *m_pIOPCServer;
        BOOL m_ActiveCheck;
        CASync_RWDlg(CWnd* pParent = NULL);         // standard constructor
// Dialog Data
        //{{AFX_DATA(CASync_RWDlg)
        enum { IDD = IDD_ASYNC_RW_DIALOG };
                // NOTE: the ClassWizard will add data members here
        //}}AFX_DATA

        // ClassWizard generated virtual function overrides
        //{{AFX_VIRTUAL(CASync_RWDlg)
        protected:
        virtual void DoDataExchange(CDataExchange* pDX);     // DDX/DDV support
        //}}AFX_VIRTUAL
```

```
// Implementation
protected:
	HICON m_hIcon;
	DWORD                   m_dwAdvise;
	OPCITEMDEF              m_Items[3];
	IOPCItemMgt             *m_pIOPCItemMgt;
	IOPCGroupStateMgt       *m_pIOPCGroupStateMgt;
	IOPCAsyncIO2            *m_pIOPCAsyncIO2;
	OPCITEMRESULT           *m_pItemResult;
	HRESULT                 *m_pErrors;
	OPCHANDLE               m_GrpSrvHandle;
	// Generated message map functions
	//{{AFX_MSG(CASync_RWDlg)
	virtual BOOL OnInitDialog();
	afx_msg void OnSysCommand(UINT nID, LPARAM lParam);
	afx_msg void OnPaint();
	afx_msg HCURSOR OnQueryDragIcon();
	afx_msg void OnConn();
	afx_msg void OnWrite();
	afx_msg void OnRead();
	afx_msg void OnCHECKData();
	afx_msg void OnDisConn();
	//}}AFX_MSG
	DECLARE_MESSAGE_MAP()
};

//{{AFX_INSERT_LOCATION}}
// Microsoft Visual C++ will insert additional declarations immediately before the previous line.
#endif
// !defined(AFX_ASYNC_RWDLG_H__DE84F897_EBB8_483B_98F4_CFE8C7F228C5__INCL
UDED_)
```

//ASync_RWDlg.cpp

```
// ASync_RWDlg.cpp : implementation file
//
#include "stdafx.h"
#include "Pre_OPC.h"
#include "ASync_RW.h"
#include "ASync_RWDlg.h"
#include "Callback.h"
#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif
// CAboutDlg dialog used for App About
#define LOCALE_ID    0x409      // Code 0x409 = ENGLISH
const LPWSTR szItemID0 = L"S7:[S7 connection_1]DB10,INT2";    // this item must be readable
and writeablein this sample
const LPWSTR szItemID1 = L"S7:[S7 connection_1]DB10,REAL4";    // this item must be
readable in this sample
const LPWSTR szItemID2 = L"S7:[S7 connection_1]DB10,STRING14.10";
class CAboutDlg : public CDialog
{
public:
```

```
        CAboutDlg();
// Dialog Data
        //{{AFX_DATA(CAboutDlg)
        enum { IDD = IDD_ABOUTBOX };
        //}}AFX_DATA
        // ClassWizard generated virtual function overrides
        //{{AFX_VIRTUAL(CAboutDlg)
        protected:
        virtual void DoDataExchange(CDataExchange* pDX);    // DDX/DDV support
        //}}AFX_VIRTUAL
// Implementation
protected:
        //{{AFX_MSG(CAboutDlg)
        //}}AFX_MSG
        DECLARE_MESSAGE_MAP()
};
CAboutDlg::CAboutDlg() : CDialog(CAboutDlg::IDD)
{
        //{{AFX_DATA_INIT(CAboutDlg)
        //}}AFX_DATA_INIT
}
void CAboutDlg::DoDataExchange(CDataExchange* pDX)
{
        CDialog::DoDataExchange(pDX);
        //{{AFX_DATA_MAP(CAboutDlg)
        //}}AFX_DATA_MAP
}
BEGIN_MESSAGE_MAP(CAboutDlg, CDialog)
        //{{AFX_MSG_MAP(CAboutDlg)
                // No message handlers
        //}}AFX_MSG_MAP
END_MESSAGE_MAP()
/////////////////////////////////////////////////////////////////////////////
// CASync_RWDlg dialog

CASync_RWDlg::CASync_RWDlg(CWnd* pParent /*=NULL*/)
        : CDialog(CASync_RWDlg::IDD, pParent)
{
        //{{AFX_DATA_INIT(CASync_RWDlg)
                // NOTE: the ClassWizard will add member initialization here
        //}}AFX_DATA_INIT
        // Note that LoadIcon does not require a subsequent DestroyIcon in Win32
         m_WriteRes3= _T("");
         m_WriteRes2= _T("");
         m_WriteRes1= _T("");
         m_WriteVal3= _T("");
         m_WriteVal2=0.0;
         m_WriteVal1=0;
         m_ReadTs3= _T("");
         m_ReadTs2= _T("");
         m_ReadTs1= _T("");
         m_ReadQu3= _T("");
         m_ReadQu2= _T("");
         m_ReadQu1= _T("");
         m_ReadVal3=_T("");
         m_ReadVal2=0.0;
```

```
	m_ReadVal1=0;
	m_ActiveCheck=false;
	m_hIcon = AfxGetApp()->LoadIcon(IDR_MAINFRAME);
}
void CASync_RWDlg::DoDataExchange(CDataExchange* pDX)
{
	CDialog::DoDataExchange(pDX);
	DDX_Text(pDX, IDC_EDIT_ReadVal1, m_ReadVal1);
	DDX_Text(pDX, IDC_EDIT_ReadVal2, m_ReadVal2);
	DDX_Text(pDX, IDC_EDIT_ReadVal3, m_ReadVal3);
	DDX_Text(pDX, IDC_EDIT_ReadQu1, m_ReadQu1);
	DDX_Text(pDX, IDC_EDIT_ReadQu2, m_ReadQu2);
	DDX_Text(pDX, IDC_EDIT_ReadQu3, m_ReadQu3);
	DDX_Text(pDX, IDC_EDIT_ReadTS1, m_ReadTs1);
	DDX_Text(pDX, IDC_EDIT_ReadTS2, m_ReadTs2);
	DDX_Text(pDX, IDC_EDIT_ReadTS3, m_ReadTs3);
	DDX_Text(pDX, IDC_EDIT_WriteVal1, m_WriteVal1);
	DDX_Text(pDX, IDC_EDIT_WriteVal2, m_WriteVal2);
	DDX_Text(pDX, IDC_EDIT_WriteVal3, m_WriteVal3);
	DDX_Text(pDX, IDC_EDIT_WriteRes1, m_WriteRes1);
	DDX_Text(pDX, IDC_EDIT_WriteRes2, m_WriteRes2);
	DDX_Text(pDX, IDC_EDIT_WriteRes3, m_WriteRes3);
	DDX_Check(pDX, IDC_CHK_Active, m_ActiveCheck);
	//{{AFX_DATA_MAP(CASync_RWDlg)
		// NOTE: the ClassWizard will add DDX and DDV calls here
	//}}AFX_DATA_MAP
}
BEGIN_MESSAGE_MAP(CASync_RWDlg, CDialog)
	//{{AFX_MSG_MAP(CASync_RWDlg)
	ON_WM_SYSCOMMAND()
	ON_WM_PAINT()
	ON_WM_QUERYDRAGICON()
	ON_BN_CLICKED(IDC_BUTTON_Conn, OnConn)
	ON_BN_CLICKED(IDC_BUTTON_DisConn, OnDisConn)
	ON_BN_CLICKED(IDC_BUTTON_ARead, OnRead)
	ON_BN_CLICKED(IDC_BUTTON_AWrite, OnWrite)
	ON_BN_CLICKED(IDC_CHK_Active, OnCHECKData)
	//}}AFX_MSG_MAP
END_MESSAGE_MAP()
/////////////////////////////////////////////////////////////////////////////
// CASync_RWDlg message handlers
BOOL CASync_RWDlg::OnInitDialog()
{
	CDialog::OnInitDialog();
	// Add "About..." menu item to system menu.
	// IDM_ABOUTBOX must be in the system command range.
	ASSERT((IDM_ABOUTBOX & 0xFFF0) == IDM_ABOUTBOX);
	ASSERT(IDM_ABOUTBOX < 0xF000);
	CMenu* pSysMenu = GetSystemMenu(FALSE);
	if (pSysMenu != NULL)
	{
		CString strAboutMenu;
		strAboutMenu.LoadString(IDS_ABOUTBOX);
		if (!strAboutMenu.IsEmpty())
		{
			pSysMenu->AppendMenu(MF_SEPARATOR);
```

```
                pSysMenu->AppendMenu(MF_STRING, IDM_ABOUTBOX, strAboutMenu);
            }
        }
        // Set the icon for this dialog.  The framework does this automatically
        //  when the application's main window is not a dialog
        SetIcon(m_hIcon, TRUE);                         // Set big icon
        SetIcon(m_hIcon, FALSE);                // Set small icon
        // TODO: Add extra initialization here
        return TRUE;  // return TRUE  unless you set the focus to a control
}
void CASync_RWDlg::OnSysCommand(UINT nID, LPARAM lParam)
{
        if ((nID & 0xFFF0) == IDM_ABOUTBOX)
        {
            CAboutDlg dlgAbout;
            dlgAbout.DoModal();
        }
        else
        {
            CDialog::OnSysCommand(nID, lParam);
        }
}
// If you add a minimize button to your dialog, you will need the code below
//  to draw the icon.  For MFC applications using the document/view model,
//  this is automatically done for you by the framework.
void CASync_RWDlg::OnPaint()
{
        if (IsIconic())
        {
            CPaintDC dc(this); // device context for painting
            SendMessage(WM_ICONERASEBKGND, (WPARAM) dc.GetSafeHdc(), 0);
            // Center icon in client rectangle
            int cxIcon = GetSystemMetrics(SM_CXICON);
            int cyIcon = GetSystemMetrics(SM_CYICON);
            CRect rect;
            GetClientRect(&rect);
            int x = (rect.Width() - cxIcon + 1) / 2;
            int y = (rect.Height() - cyIcon + 1) / 2;
            // Draw the icon
            dc.DrawIcon(x, y, m_hIcon);
        }
        else
        {
            CDialog::OnPaint();
        }
}
// The system calls this to obtain the cursor to display while the user drags
//  the minimized window.
HCURSOR CASync_RWDlg::OnQueryDragIcon()
{
        return (HCURSOR) m_hIcon;
}
void CASync_RWDlg::OnConn()
{
        HRESULT                 r1;
        CLSID           clsid;
```

```
        LONG            TimeBias = 0;
        FLOAT           PercentDeadband = 0.0;
        DWORD                   RevisedUpdateRate;
        LPWSTR                  ErrorStr1,ErrorStr2,ErrorStr3;
        CString         szErrorText;
        m_pItemResult = NULL;
        // Initialize the COM library
        r1 = CoInitialize(NULL);
        if (r1 != S_OK)
        {       if (r1 == S_FALSE)
                {       MessageBox("COM Library already initialized",
                        "Error CoInitialize()", MB_OK+MB_ICONEXCLAMATION);
                }
                else
                {szErrorText.Format("Initialisation of COM Library failed. ErrorCode= %4x", r1);
                MessageBox(szErrorText,"Error CoInitialize()", MB_OK+MB_ICONERROR);
                SendMessage(WM_CLOSE);
                return;
                }
        }
        // Given a ProgID, this looks up the associated CLSID in the registry
        r1 = CLSIDFromProgID(L"OPC.SimaticNET", &clsid);
        if (r1 != S_OK)
        {       MessageBox("Retrival of CLSID failed",
                                "Error CLSIDFromProgID()", MB_OK+MB_ICONERROR);
                CoUninitialize();
                SendMessage(WM_CLOSE);
                return;
        }
        // Create the OPC server object and querry for the IOPCServer interface of the object
        r1 = CoCreateInstance (clsid, NULL, CLSCTX_LOCAL_SERVER ,IID_IOPCServer,
(void**)&m_pIOPCServer);
        if (r1 != S_OK)
        {       MessageBox("Creation of IOPCServer-Object failed",
                        "Error CoCreateInstance()", MB_OK+MB_ICONERROR);
                m_pIOPCServer = NULL;
                CoUninitialize();
                SendMessage(WM_CLOSE);
                return;
        }
        // Add a group object "grp1" and querry for interface IOPCItemMgt
      r1=m_pIOPCServer->AddGroup(L"grp1",FALSE,500,1,
      &TimeBias,&PercentDeadband,LOCALE_ID,&m_GrpSrvHandle,&RevisedUpdateRate,
                IID_IOPCItemMgt,(LPUNKNOWN*)&m_pIOPCItemMgt);
        if (r1 == OPC_S_UNSUPPORTEDRATE)
        {
                szErrorText.Format ("Revised Update Rate %d is different from Requested
Update Rate 500",RevisedUpdateRate );
                AfxMessageBox (szErrorText);
        }
        else
                if (FAILED(r1))
                {       MessageBox("Can't add Group to Server!",
                                        "Error AddGroup()", MB_OK+MB_ICONERROR);
                        m_pIOPCServer->Release();
                        m_pIOPCServer = NULL;
```

```
                    CoUninitialize();
                    SendMessage(WM_CLOSE);
                    return;
                }
        // define item tables with 2 items as in parameters for AddItem
        m_Items[0].szAccessPath                 = L"";
        m_Items[0].szItemID                     = L"S7:[S7 connection_1]DB10,INT2";
        m_Items[0].bActive                      = TRUE;
        m_Items[0].hClient                      = 1;
        m_Items[0].dwBlobSize           = 0;
        m_Items[0].pBlob                        = NULL;
        m_Items[0].vtRequestedDataType = 2;
        m_Items[1].szAccessPath                 = L"";
        m_Items[1].szItemID                     = L"S7:[S7 connection_1]DB10,Real4";
        m_Items[1].bActive                      = TRUE;
        m_Items[1].hClient                      = 2;
        m_Items[1].dwBlobSize           = 0;
        m_Items[1].pBlob                        = NULL;
        m_Items[1].vtRequestedDataType = 5;
        m_Items[2].szAccessPath                 = L"";
        m_Items[2].szItemID     = L"S7:[S7 connection_1]DB10,STRING14.10";
        m_Items[2].bActive                      = TRUE;
        m_Items[2].hClient                      = 3;
        m_Items[2].dwBlobSize           = 0;
        m_Items[2].pBlob                        = NULL;
        m_Items[2].vtRequestedDataType = 8;
        r1 = m_pIOPCItemMgt->AddItems(      3,m_Items,&m_pItemResult,&m_pErrors);
        if ( (r1 != S_OK) && (r1 != S_FALSE) )
        {       MessageBox("AddItems failed!",
                        "Error AddItems()", MB_OK+MB_ICONERROR);
                m_pIOPCItemMgt->Release();
                m_pIOPCItemMgt = NULL;
                m_GrpSrvHandle = 0;
                m_pIOPCServer->Release();
                m_pIOPCServer = NULL;
                CoUninitialize();
                SendMessage(WM_CLOSE);
                return;
        }
        else
        {
                m_pIOPCServer->GetErrorString(m_pErrors[0], LOCALE_ID, &ErrorStr1);
                m_pIOPCServer->GetErrorString(m_pErrors[1], LOCALE_ID, &ErrorStr2);
                m_pIOPCServer->GetErrorString(m_pErrors[2], LOCALE_ID, &ErrorStr3);
                CString szOut;
    szOut.Format("Item %ls :\n %ls\n\nItem %ls :\n %ls\n", szItemID0, ErrorStr1, szItemID1,
ErrorStr2,szItemID2, ErrorStr3);
                MessageBox(szOut, "Result AddItems()", MB_OK+MB_ICONEXCLAMATION);
    CoTaskMemFree(ErrorStr1);
    CoTaskMemFree(ErrorStr2);
                CoTaskMemFree(ErrorStr3);
                // go on
        }
        // check if Item0 is readable and writeable
        if (m_pItemResult[0].dwAccessRights != (OPC_READABLE + OPC_WRITEABLE))
        {
```

```
                MessageBox("Item 0 ist not readable and writeable.\nThis is essential for
correct operation of this sample.", "Result AddItems()", MB_OK+MB_ICONEXCLAMATION);
        }
        // Get interface for GroupStateMgt
        r1=m_pIOPCItemMgt->QueryInterface(IID_IOPCGroupStateMgt, (void**)
&m_pIOPCGroupStateMgt);
        if (r1 != S_OK)
        {       MessageBox("No IOPCGroupStateMgt found",
                                "Error QueryInterface()", MB_OK+MB_ICONERROR);
                CoTaskMemFree(m_pItemResult);
                m_pIOPCItemMgt->Release();
                m_pIOPCItemMgt = 0;
                m_GrpSrvHandle = 0;
                m_pIOPCServer->Release();
                m_pIOPCServer = NULL;
                CoUninitialize();
                SendMessage(WM_CLOSE);
                return;
        }
        // query interface for async calls on group object
        r1 = m_pIOPCItemMgt->QueryInterface(IID_IOPCAsyncIO2,
(void**)&m_pIOPCAsyncIO2);
        if (r1 < 0)
        {       MessageBox("No IOPCAsyncIO found!",
               "Error QueryInterface()", MB_OK+MB_ICONERROR);
                CoTaskMemFree(m_pItemResult);
                m_pIOPCItemMgt->Release();
                m_pIOPCItemMgt = 0;
                m_GrpSrvHandle = 0;
                m_pIOPCServer->Release();
                m_pIOPCServer = NULL;
                CoUninitialize();
                SendMessage(WM_CLOSE);
    return;
        }
        // Activate Group according to Checkbox
        OnCHECKData();
        // Establish Callback for all async operations
        CComObject<COPCDataCallback>* pCOPCDataCallback;// Pointer to Callback Object
        // Create Instance of Callback Object using an ATL template
  CComObject<COPCDataCallback>::CreateInstance(&pCOPCDataCallback);

        // pass pointer of this dialog class to callback object
        pCOPCDataCallback->InformAboutDialog(this);
  // query IUnknown interface of callback object, needed for the ATL Advise
        LPUNKNOWN pCbUnk;
  pCbUnk = pCOPCDataCallback->GetUnknown();
  // Creates a connection between the OPC servers's connection point and
        // this client's sink (the callback object).
        HRESULT hRes = AtlAdvise(     m_pIOPCGroupStateMgt,
                                      pCbUnk,IID_IOPCDataCallback,&m_dwAdvise   );
        if (hRes != S_OK)
        {       AfxMessageBox("Advise failed!");
                CoTaskMemFree(m_pItemResult);
                m_pIOPCItemMgt->Release();
                m_pIOPCItemMgt = 0;
```

```
                m_GrpSrvHandle = 0;
                m_pIOPCServer->Release();
                m_pIOPCServer = NULL;
                CoUninitialize();
                SendMessage(WM_CLOSE);
    return;
        }
}
void CASync_RWDlg::OnRead()
{
        OPCHANDLE           *phServer;
        DWORD                       dwCancelID;
        HRESULT                     *pErrors;
        HRESULT                     r1;
        CString             szOut;
        LPWSTR                      ErrorStr1;
        LPWSTR                      ErrorStr2;
        LPWSTR                      ErrorStr3;

  if (m_pErrors[0] != S_OK ||m_pErrors[1]!= S_OK) // Item not available

        {       MessageBox("OPC Item0 not available!",
                        "Error Read async", MB_OK+MB_ICONERROR);
                return;
        }
  // Memory allocation really needed, if more than 1 item to be read
        phServer = new OPCHANDLE[3];
        // Select item by server handle, received at AddItem
        phServer[0] = m_pItemResult[0].hServer;
        phServer[1] = m_pItemResult[1].hServer;
        phServer[2] = m_pItemResult[2].hServer;
        r1 = m_pIOPCAsyncIO2->Read(3,phServer,10,&dwCancelID,     &pErrors);
        delete[] phServer;
        if (r1 == S_FALSE)
        {       m_pIOPCServer->GetErrorString(pErrors[0], LOCALE_ID, &ErrorStr1);
                m_pIOPCServer->GetErrorString(m_pErrors[1], LOCALE_ID, &ErrorStr2);
                m_pIOPCServer->GetErrorString(m_pErrors[2], LOCALE_ID, &ErrorStr3);
                CString szOut;
    szOut.Format("Item %ls :\n %ls\n\nItem %ls :\n %ls\n", szItemID0, ErrorStr1, szItemID1,
                 ErrorStr2,szItemID2, ErrorStr3);
                MessageBox(szOut, "Error Reading ", MB_OK+MB_ICONERROR);
                // release ErrorStr
    CoTaskMemFree(ErrorStr1);
                CoTaskMemFree(ErrorStr2);
    CoTaskMemFree(ErrorStr3);
  }
        if (FAILED(r1))
        {szOut.Format ("Method call IOPCAsyncIO2::Read failed with error code %x", r1);
        MessageBox(szOut, "Error Reading Item0", MB_OK+MB_ICONERROR);
        }
        else
        {       // release [out] parameter in case of not failed
                CoTaskMemFree(pErrors);
        }
}
void CASync_RWDlg::OnWrite()
```

```
{
        OPCHANDLE               *phServer;
        DWORD                           dwCancelID;
        VARIANT                         values[2];
        HRESULT                         *pErrors;
        HRESULT                         r1;
        LPWSTR                          ErrorStr;
        LPWSTR                          ErrorStr1;
        LPWSTR                          ErrorStr2;
        CString                 szOut;
        if (m_pErrors[0] != S_OK || m_pErrors[1] != S_OK || m_pErrors[2] != S_OK)       {
        MessageBox("OPC Item not available!",
                                "Error Write async", MB_OK+MB_ICONERROR);
                return;
        }
        // Select item by server handle, received at AddItem
        phServer = new OPCHANDLE[3];
        phServer[0] = m_pItemResult[0].hServer;
        phServer[1] = m_pItemResult[1].hServer;
        phServer[2] = m_pItemResult[2].hServer;
        // Retrieve data from dialog
        UpdateData(TRUE);
        // Set Variant with datatype and received value
        values[0].vt = VT_I2;
        values[0].iVal = m_WriteVal1;
        values[1].vt = VT_R8;
        values[1].dblVal = m_WriteVal2;
        values[2].vt = VT_BSTR;
        //values[2].bstrVal =m_WriteVal3;
        r1 = m_pIOPCAsyncIO2->Write(2,values,2,
                                        &dwCancelID
                &pErrors                                                        );
        delete[] phServer;

        if (r1 == S_FALSE)
        {       m_pIOPCServer->GetErrorString(pErrors[0], LOCALE_ID, &ErrorStr);
                m_pIOPCServer->GetErrorString(pErrors[1], LOCALE_ID, &ErrorStr1);
                m_pIOPCServer->GetErrorString(pErrors[2], LOCALE_ID, &ErrorStr2);
                m_WriteRes1 = ErrorStr;
                m_WriteRes1.Remove('\r');
                m_WriteRes1.Remove('\n');
                m_WriteRes2 = ErrorStr1;
                m_WriteRes2.Remove('\r');
                m_WriteRes2.Remove('\n');
                m_WriteRes3 = ErrorStr2;
                m_WriteRes3.Remove('\r');
                m_WriteRes3.Remove('\n');
                UpdateData(FALSE);
                // release parameter in case of S_FALSE
                CoTaskMemFree(ErrorStr);
                CoTaskMemFree(ErrorStr1);
                CoTaskMemFree(ErrorStr2);
  }
        if (FAILED(r1))
        {szOut.Format ("Method call IOPCAsyncIO2::Write failed with error code %x", r1);
                MessageBox(szOut, "Error Writing Item0", MB_OK+MB_ICONERROR);
```

```
	}
	else
	{	// release [out] parameter in case of not failed
		CoTaskMemFree(pErrors);
	}
}
void CASync_RWDlg::OnDisConn()
{
	HRESULT			r1;
	OPCHANDLE	*phServer;
	HRESULT			*pErrors;
	LPWSTR			ErrorStr;
	char		str[100];
	phServer = new OPCHANDLE[3];
	phServer[0] = m_pItemResult[0].hServer;
	phServer[1] = m_pItemResult[1].hServer;
	phServer[2] = m_pItemResult[2].hServer;
	r1 = m_pIOPCItemMgt->RemoveItems(3, phServer,	&pErrors);

	if ( (r1 != S_OK) && (r1 != S_FALSE) )
		{	MessageBox("RemoveItems failed!",
				"Error RemoveItems()", MB_OK+MB_ICONERROR);
		}
	else
		{	m_pIOPCServer->GetErrorString(pErrors[0], LOCALE_ID, &ErrorStr);
			sprintf(str, "%ls\n", ErrorStr);
		MessageBox(str, "Result RemoveItems()", MB_OK+MB_ICONEXCLAMATION);
		CoTaskMemFree(ErrorStr);
		}
	delete[] phServer;
	CoTaskMemFree(pErrors);
	CoTaskMemFree(m_pItemResult);
	m_pItemResult=NULL;
	CoTaskMemFree(m_pErrors);
	m_pErrors = NULL;
	//	Release interface for sync calls
	m_pIOPCAsyncIO2->Release();
	m_pIOPCAsyncIO2 = NULL;
	//	Release ItemManagement interface
	m_pIOPCItemMgt->Release();
	m_pIOPCItemMgt = NULL;
	//	Remove Group
	r1=m_pIOPCServer->RemoveGroup(m_GrpSrvHandle, TRUE);
	if (r1 != S_OK)
	{	MessageBox("RemoveGroup failed!",
				"Error RemoveGroup()", MB_OK+MB_ICONERROR);
	}
	m_GrpSrvHandle = NULL;
	//	Release OPC-Server
	m_pIOPCServer->Release();
	m_pIOPCServer = NULL;
	//	Uninit COM
	CoUninitialize();
}
void CASync_RWDlg::OnCHECKData()
{
```

```
        // TODO: Add your control notification handler code here
        UpdateData(TRUE);
        DWORD dwRevUpdateRate;
        int aa=1;
        HRESULT      r1=      m_pIOPCGroupStateMgt->SetState(NULL,
        &dwRevUpdateRate,    &m_ActiveCheck, NULL,，NULL,NULL, NULL);
        if (FAILED(r1))
        {          MessageBox("Set State failed",
                 "Error", MB_OK+MB_ICONERROR);
                  return;
        }
}

//callback.h
class COPCDataCallback :
public CComObjectRoot,
        public IOPCDataCallback
{
public:
COPCDataCallback() {};
BEGIN_COM_MAP(COPCDataCallback)
        COM_INTERFACE_ENTRY(IOPCDataCallback)
END_COM_MAP()
// IOPCDataCallback
        STDMETHODIMP  OnDataChange(
        /* [in] */ DWORD dwTransid,
        /* [in] */ OPCHANDLE hGroup,
        /* [in] */ HRESULT hrMasterquality,
        /* [in] */ HRESULT hrMastererror,
        /* [in] */ DWORD dwCount,
        /* [size_is][in] */ OPCHANDLE __RPC_FAR *phClientItems,
        /* [size_is][in] */ VARIANT __RPC_FAR *pvValues,
        /* [size_is][in] */ WORD __RPC_FAR *pwQualities,
        /* [size_is][in] */ FILETIME __RPC_FAR *pftTimeStamps,
        /* [size_is][in] */ HRESULT __RPC_FAR *pErrors);


   STDMETHODIMP  OnReadComplete(
        /* [in] */ DWORD dwTransid,
        /* [in] */ OPCHANDLE hGroup,
        /* [in] */ HRESULT hrMasterquality,
        /* [in] */ HRESULT hrMastererror,
        /* [in] */ DWORD dwCount,
        /* [size_is][in] */ OPCHANDLE __RPC_FAR *phClientItems,
        /* [size_is][in] */ VARIANT __RPC_FAR *pvValues,
        /* [size_is][in] */ WORD __RPC_FAR *pwQualities,
        /* [size_is][in] */ FILETIME __RPC_FAR *pftTimeStamps,
        /* [size_is][in] */ HRESULT __RPC_FAR *pErrors);
      STDMETHODIMP  OnWriteComplete(
        /* [in] */ DWORD dwTransid,
        /* [in] */ OPCHANDLE hGroup,
        /* [in] */ HRESULT hrMastererr,
        /* [in] */ DWORD dwCount,
        /* [size_is][in] */ OPCHANDLE __RPC_FAR *pClienthandles,
        /* [size_is][in] */ HRESULT __RPC_FAR *pErrors);
```

```
        STDMETHODIMP  OnCancelComplete(
            /* [in] */ DWORD dwTransid,
            /* [in] */ OPCHANDLE hGroup)
                    {
                            return S_OK;
                    };
             void InformAboutDialog (CASync_RWDlg *pCDlgClass)
                    {m_pCDlgClass = pCDlgClass;}
protected:
             CASync_RWDlg *m_pCDlgClass;
};
//callback.cpp
#include "stdafx.h"
#include "pre_opc.h"                    #include "ASync_RW.h" // include class declaration for
application class
#include "ASync_RWDlg.h" // include class declaration of dialog class
#include "Callback.h"                   // for OPC: include class declaration fpr this callback class
CString GetQualityText(UINT qnr);
#define LOCALE_ID    0x409      // Code 0x409 = ENGLISH
                                //         text description from quality code
////////////////////////////////////////////////////////////////////////////
//
// IOPCDataCallback - implementation

// OnDataChange called by OPC server when the OPC server has detected modified data
// (being called only when group and item is set to active)
STDMETHODIMP COPCDataCallback:: OnDataChange(
            /* [in] */ DWORD dwTransid,
            /* [in] */ OPCHANDLE hGroup,
            /* [in] */ HRESULT hrMasterquality,
            /* [in] */ HRESULT hrMastererror,
            /* [in] */ DWORD dwCount,
            /* [size_is][in] */ OPCHANDLE __RPC_FAR *phClientItems,
            /* [size_is][in] */ VARIANT __RPC_FAR *pvValues,
            /* [size_is][in] */ WORD __RPC_FAR *pwQualities,
            /* [size_is][in] */ FILETIME __RPC_FAR *pftTimeStamps,
            /* [size_is][in] */ HRESULT __RPC_FAR *pErrors)
{
             DWORD i;
             for (i = 0;  i<dwCount; i++)
             {
                        switch (phClientItems[i])
                        {
                                    case 1:
                                                m_pCDlgClass->m_ReadVal1 =pvValues[i].iVal;
                                                m_pCDlgClass->m_ReadQu1 =GetQualityText(pwQualities[0]);
                                                                        m_pCDlgClass->m_ReadTs1
                                                =COleDateTime( pftTimeStamps[0] ).Format();
                                    break;
                                    case 2:
                                                m_pCDlgClass->m_ReadVal2 =pvValues[i].dblVal;
                                                m_pCDlgClass->m_ReadQu2 =GetQualityText(pwQualities[1]);
                                                m_pCDlgClass->m_ReadTs2
=COleDateTime( pftTimeStamps[1] ).Format();
```

```
                        break;
                        case 3:
                                m_pCDlgClass->m_ReadVal3 =pvValues[i].bstrVal;
                                m_pCDlgClass->m_ReadQu3 =GetQualityText(pwQualities[2]);
                                m_pCDlgClass->m_ReadTs3
=COleDateTime( pftTimeStamps[2] ).Format();
                        break;
                }
                m_pCDlgClass->UpdateData(FALSE);
        }
        return S_OK;
};
STDMETHODIMP  COPCDataCallback::OnReadComplete(
                /* [in] */ DWORD dwTransid,
                /* [in] */ OPCHANDLE hGroup,
                /* [in] */ HRESULT hrMasterquality,
                /* [in] */ HRESULT hrMastererror,
                /* [in] */ DWORD dwCount,
                /* [size_is][in] */ OPCHANDLE __RPC_FAR *phClientItems,
                /* [size_is][in] */ VARIANT __RPC_FAR *pvValues,
                /* [size_is][in] */ WORD __RPC_FAR *pwQualities,
                /* [size_is][in] */ FILETIME __RPC_FAR *pftTimeStamps,
                /* [size_is][in] */ HRESULT __RPC_FAR *pErrors)
{
                if (pErrors[0] == S_OK)
                {
                        m_pCDlgClass->m_ReadVal1 =pvValues[0].iVal;
                        m_pCDlgClass->m_ReadQu1 =GetQualityText(pwQualities[0]);
                        m_pCDlgClass->m_ReadTs1
=COleDateTime( pftTimeStamps[0] ).Format();

                        //delete pvarOut;
                }
                else {
                        /* error case: display error text */
                        CString readQuality = GetQualityText(pErrors[0]);
                        m_pCDlgClass->m_ReadQu1 =readQuality;
                }
                if (pErrors[1] == S_OK)
                {

                        m_pCDlgClass->m_ReadVal2 =pvValues[1].dblVal;
                        m_pCDlgClass->m_ReadQu2 =GetQualityText(pwQualities[1]);
                        m_pCDlgClass->m_ReadTs2
=COleDateTime(pftTimeStamps[1]).Format();

                        //delete pvarOut;
                }
                else
                {
                        /* error case: display error text */
                        CString readQuality1 = GetQualityText(pErrors[1]);
                        m_pCDlgClass->m_ReadQu2 =readQuality1;
                }
                if (pErrors[2] == S_OK)
                {
```

```
                        m_pCDlgClass->m_ReadVal3 =pvValues[2].bstrVal;
                        m_pCDlgClass->m_ReadQu3 =GetQualityText(pwQualities[2]);
                        m_pCDlgClass-
>m_ReadTs2=COleDateTime( pftTimeStamps[2] ).Format();

                        //delete pvarOut;
                }
                else
                {
                        /* error case: display error text */
                        CString readQuality2 = GetQualityText(pErrors[2]);
                        m_pCDlgClass->m_ReadQu3 =readQuality2;
                }
                m_pCDlgClass->UpdateData(FALSE);
                        return S_OK;
};
STDMETHODIMP  COPCDataCallback::OnWriteComplete(
      /* [in] */ DWORD dwTransid,
      /* [in] */ OPCHANDLE hGroup,
      /* [in] */ HRESULT hrMastererr,
      /* [in] */ DWORD dwCount,
      /* [size_is][in] */ OPCHANDLE __RPC_FAR *pClienthandles,
      /* [size_is][in] */ HRESULT __RPC_FAR *pErrors)
{
                LPWSTR                          ErrorStr1;
        m_pCDlgClass->m_pIOPCServer->GetErrorString(pErrors[0], LOCALE_ID, &ErrorStr1);
                m_pCDlgClass->m_WriteRes1=ErrorStr1;
                m_pCDlgClass->m_WriteRes1.Remove('\r');
                m_pCDlgClass->m_WriteRes1.Remove('\n');
                CoTaskMemFree(ErrorStr1);
                m_pCDlgClass->UpdateData(FALSE);
                return S_OK;
};
CString GetQualityText(UINT qnr)
{       CString qstr;
        switch(qnr)
   {    case OPC_QUALITY_BAD:                       qstr = "BAD";
                                        break;
      case OPC_QUALITY_UNCERTAIN:                   qstr = "UNCERTAIN";
                                        break;
      case OPC_QUALITY_GOOD:                        qstr = "GOOD";
                                        break;
     case OPC_QUALITY_NOT_CONNECTED: qstr = "NOT_CONNECTED";
                                        break;
      case OPC_QUALITY_DEVICE_FAILURE:qstr = "DEVICE_FAILURE";
                                        break;
      case OPC_QUALITY_SENSOR_FAILURE:qstr = "SENSOR_FAILURE";
                                        break;
      case OPC_QUALITY_LAST_KNOWN:    qstr = "LAST_KNOWN";
                                        break;
      case OPC_QUALITY_COMM_FAILURE:  qstr = "COMM_FAILURE";
                                        break;
      case OPC_QUALITY_OUT_OF_SERVICE:qstr = "OUT_OF_SERVICE";
                                        break;
      case OPC_QUALITY_LAST_USABLE:       qstr = "LAST_USABLE";
```

```
                                        break;
    case OPC_QUALITY_SENSOR_CAL:        qstr = "SENSOR_CAL";
                                        break;
    case OPC_QUALITY_EGU_EXCEEDED:  qstr = "EGU_EXCEEDED";
                                        break;
    case OPC_QUALITY_SUB_NORMAL:        qstr = "SUB_NORMAL";
                                        break;
    case OPC_QUALITY_LOCAL_OVERRIDE:qstr = "LOCAL_OVERRIDE";
                                        break;
    default:                                        qstr = "UNKNOWN ERROR";
        }
        return qstr;
}
```