Xpert Software Development Kit

Version 2.3
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Table of Contents

Table of Figures

Table of Tables

1 Introduction

The Xpert Software Development Kit (SDK) enables developers[1] to create Sutron Link Libraries (SLLs)[2] that extend Xpert's functionality according to the developer's unique needs. The SDK is most often used to create libraries containing custom *setup blocks*, *property pages*, and *control panel entries*, but may also be used to create libraries that manipulate ports, files, peripherals, and any other entity accessible through standard Windows CE operating system API calls.

This document assumes the developer reading it is knowledgeable concerning C++ and basic Windows programming.

2 Installing and Configuring the Development Environment

The SDK is intended for use with Microsoft eMbedded Visual Tools 3.0 which, at the time of this writing, is available at no charge from Microsoft. This toolset contains the compiler, linker, and operating system libraries necessary to develop for the Xpert platform. It may be ordered on CD from Microsoft (in which case a modest shipping charge applies), or downloaded from: http://www.microsoft.com/downloads/details.aspx?FamilyId=F663BF48-31EE-4CBE-AAC5-0AFFD5FB27DD&displaylang=en.

The steps to install and configure the development environment follow:

1. Install Microsoft eMbedded Visual Tools 3.0 (EVT):
   a. It is recommended that you install to the default installation directories.
   b. The EVT install program offers to install several components. Only install "eMbedded Visual Tools 3.0".

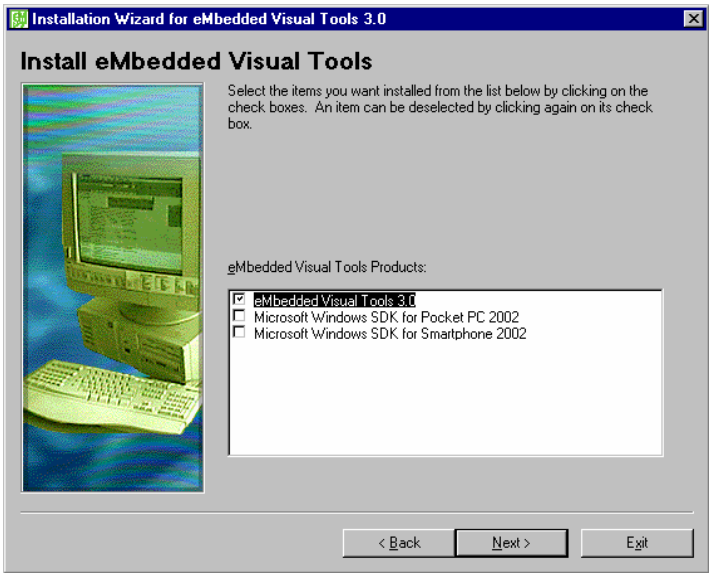


Figure 1: Select Tool Install

[1] Throughout this document, the term *developer* is used to refer to the reader of this document, that is, the person interested in developing an SLL, while the term *user* is reserved for referring to users of the Xpert.
[2] Sutron Link Libraries (SLLs) are standard Windows Dynamic Link Libraries (DLLs) with an extension of "sll".

c. The eMbedded Visual Tools install program offers to install “eMbedded Visual C++ 3.0”, “eMbedded Visual Basic 3.0”, and “Common Components”:
   i. Select only “eMbedded Visual C++ 3.0” and “Common Components” for installation. Xpert SDK support for eMbedded Visual Basic 3.0 has not been evaluated.

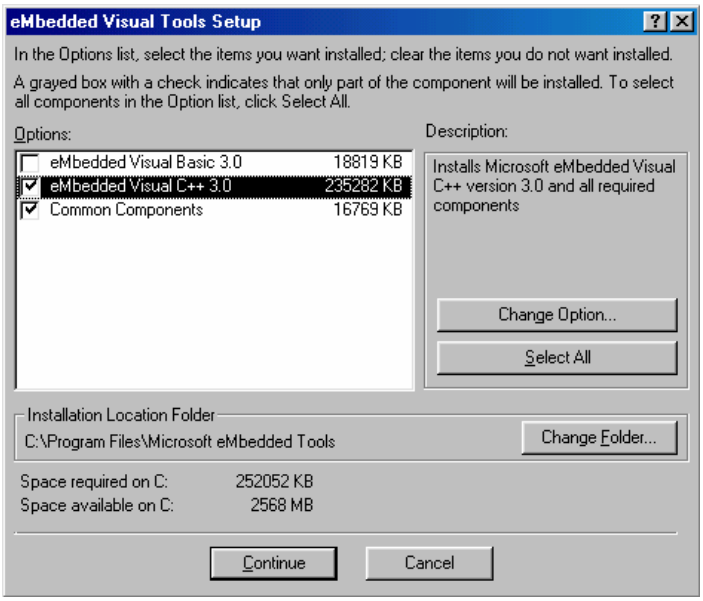


Figure 2: Select EVC and Common Components Install

   ii. With “eMbedded Visual C++ 3.0” highlighted, select the “Change Options” button. The subsequent dialog contains a list of processors supported by Windows CE. Only the X86 processor need be selected.

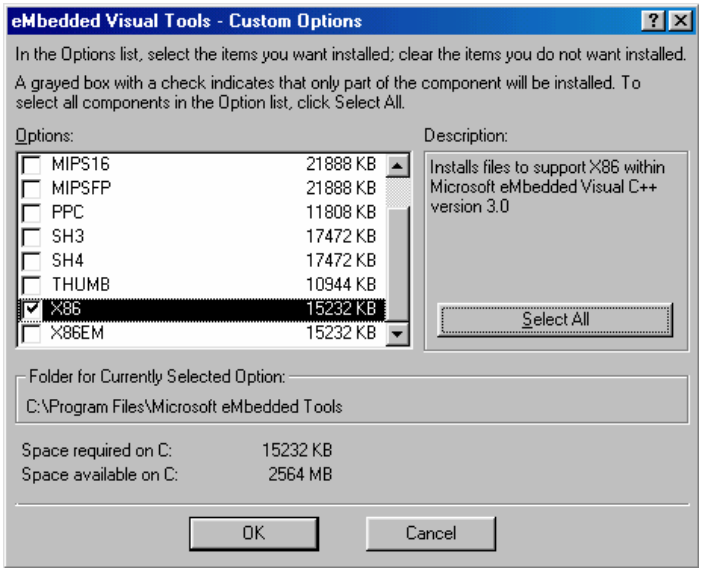


Figure 3: Install Support for x86

2. Install the Xpert SDK by running setup.exe from the Xpert SDK installation disk. Take note of the directory to which you install.
3. Update the eMbedded Visual C++ 3.0 include and library search subdirectories to point to those created by the Xpert SDK:
   a. Run Microsoft eMbedded Visual Tools 3.0.
   b. From the Tools menu, select Options to bring up the options dialog.
   c. In the options dialog, select the Directories tab.
   d. Select “Include Files” in the “Show directories for” drop-down combo-box.
   e. Add the directory <XpertSDK>\Include (where “<XpertSDK>” is replaced the fully qualified path to the Xpert SDK install directory, e.g., “c:\XpertSDK”).

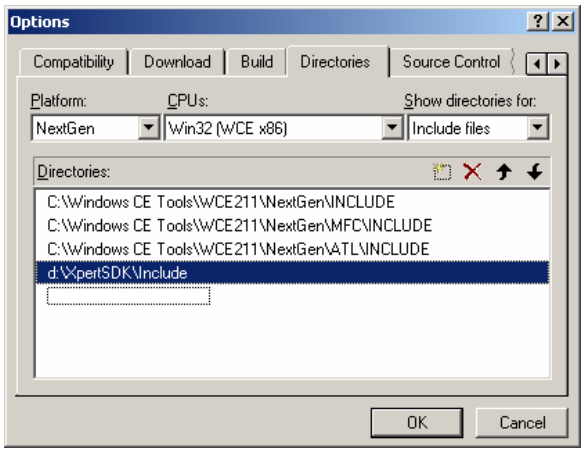


Figure 4: Set Include Search Path

   f. Select “Library Files” in the “Show directories for” drop-down combo-box.
   g. Add the directory <XpertSDK>\Lib (where “<XpertSDK>” is replaced the fully qualified path to the Xpert SDK install directory).

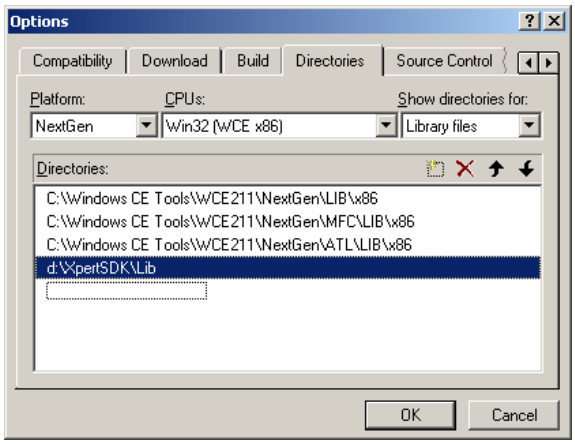


Figure 5: Set Lib Search Path

2.1 Uninstalling the Development Environment

The development environment can be uninstalled from the Add/Remove Programs control panel applet:

1. Uninstall “Xpert SDK”.
2. Uninstall “Windows CE Platform SDK (NextGen)”.
3. Uninstall “Microsoft eMbedded Visual Tools 3.0”.

The directory “Windows CE Tools” and its subdirectories are not always completely removed following the uninstall. These directories can safely be removed as long as they do not contain files from any source other than the uninstalled applications.

3 Creating SLLs

“Sutron Link Libraries”, or SLLs, are simply standard Windows dynamic link libraries with the extension “sll” instead of “dll”. This section describes the process of creating SLLs using the EVT and Xpert SDK.

3.1 Overview

As stated previously, SLLs are most often created to contain *setup blocks*, *property pages*, and/or *control panel entries* designed by the developer for some specific purpose. But what exactly are setup blocks, property pages, and control panel entries? A few words describing each of these things is in order. After that, the steps necessary to create an SLL are defined.

3.1.1 Setup Blocks Defined

A Setup Block is represented visually by an icon on the Xpert graphical setup page. Each block typically has inputs and outputs. The block performs some action on the data it receives (or it may produce data) which it then outputs to blocks connected to its outputs. Hence, the connections between these blocks represent data flowing from block to block.

The Xpert “Engine” is an Xpert software component that controls when data actually flows through the connections between setup blocks. The flows typically occur either due to a schedule submitted to the Engine, or due to some asynchronous event like an alarm generated by a connected device.

The figure below shows an example Xpert graphical setup with a variety of setup blocks. The first line of the example setup has the effect of taking an air temperature measurement at a scheduled time and storing it in a log. To make this actually happen, the Measure setup block was coded to submit an activation schedule to the Engine at recording start and, when activated, “pull” the data from its input which it then “pushes” to its outputs. The AirTemp setup block was coded to take a measurement and output the resulting data when a block connected to its outputs “pulls”. The Log setup block was coded to receive data “pushed” into it and store it in the log identified by the block.

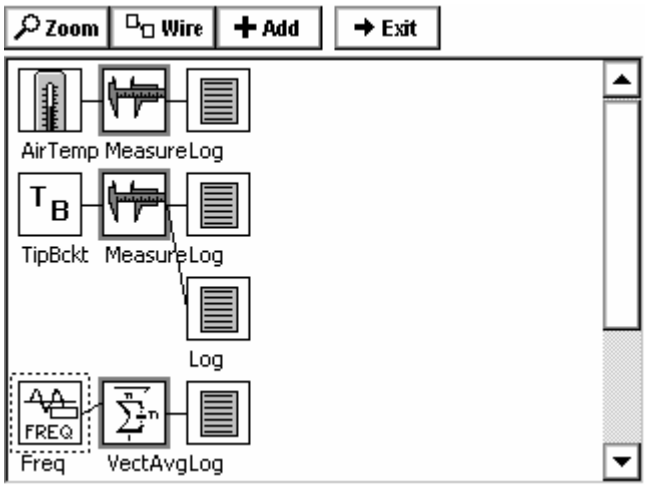


Figure 6: Setup Blocks

In the scenario described above, the Measure block is said to be the "active" block, e.g., the block that initiates data flow through a chain of blocks. In this case, the active block is a "scheduled" block (because it schedules itself with the Engine). The other type of active block is an "event-driven" block, where an event such as an I/O module alarm can signal a block to initiate data flow.

Active blocks are special in the sense that there is typically only one in an entire block chain. When active blocks are connected together and one pulls (or pushes) from (or to) another, the pull (or push) is typically ignored. Active blocks are drawn with thick borders to make them easier to identify.

When using the Xpert AppWizard to create a setup block, all of the code necessary to create the shell of a setup block is generated automatically. The developer's job is to fill-in the details, which usually means making calls into the various APIs to accomplish the desired task. So, the developer must know 1) what API call to make, and 2) where to put it. This document's "APIs" section helps identify what API calls are necessary. The section "Creating Setup Blocks" helps identify where those calls should go.

3.1.2 Property Pages Defined

A Property Page is a single tab of Xpert's property sheet interface. For example, the figure below shows the "Main", "Setup", "Sensors", "Data", "Log", and "Status" property pages. A page is selected by first selecting the associated tab at the top of the screen.

Simply put, property pages exist to organize related information in a single place (or display pane, more specifically). As part of an extension to Xpert, if a developer wanted to display some set of status data in a single, easily accessible location, a property page would be ideal. Fundamentally, a property sheet is nothing more than a standard Windows dialog.

When using the Xpert AppWizard to create a property page, just as with setup blocks, all of the code necessary to create the shell of a property page is generated automatically. The developer's job is to fill-in the details, which usually means displaying and processing standard Windows dialog controls.

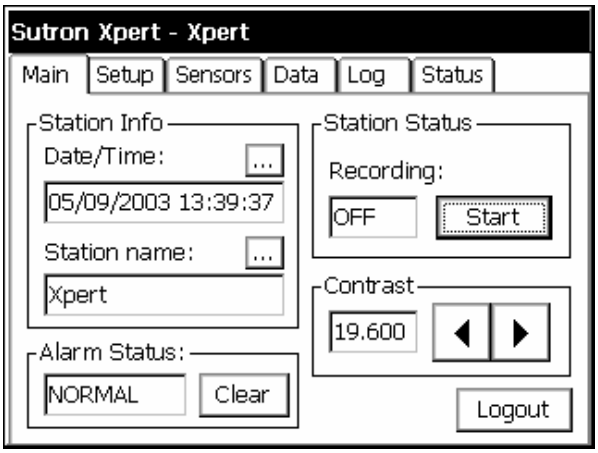


Figure 7: Property Pages

3.1.3 Control Panel Entries Defined

A Control Panel Entry is a node of the Xpert's TreeView control panel interface found on the Setup property page. The figure below shows several standard control panel entries: *Graphical Setup*, *I/O Modules*, *Log files*, *Self-test*, and *Setup File*. These entries are "standard" because they are provided by the Xpert application, as opposed to an optional SLL. The entries *Coms*, *EZSetup Measurements*, and *Satlink* are provided by SLLs of similar names.

Control panel entries are typically used to present configuration data to the user for reading and editing. For example, the configuration for an attached device could be accessed here.

When using the Xpert AppWizard to create a control panel entry, just as with setup blocks and property pages, all of the code necessary to create the shell of a control panel entry is generated automatically. The developer's job is to fill-in the details, which usually means displaying and processing standard Windows dialog controls that belong to the dialog created by the user's press of "Edit…".

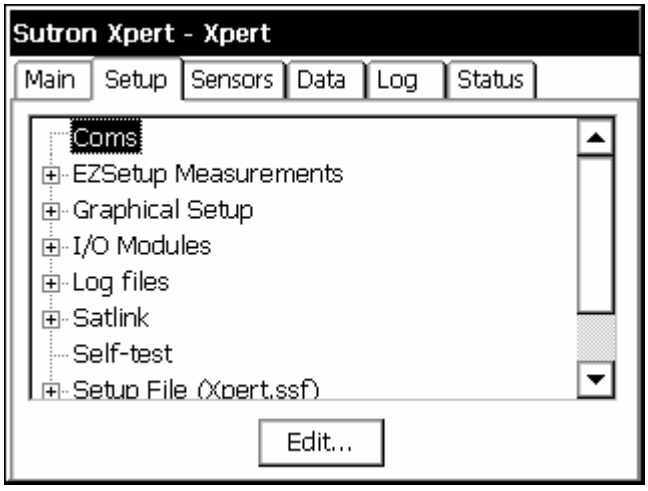


Figure 8: Control Panel Entries

3.1.4 The Basic Steps to Creating an SLL

The basic steps to creating an SLL are:

1. Create a project within the EVT.
2. Add code to perform the functions desired.
3. Compile, link, and download the SLL.

3.1.4.1 Create an EVT Project

To create a project in the EVT, select File – New. In the list of available project types, select "Sutron Link Library (Xpert)". Follow the AppWizard prompts, providing the data requested using the following guidelines:

Create Setup Block - Select this option to create a block to be placed on Xpert's setup page.

Block Name - Enter the name of the setup block here. This is the name that will appear by default below the icon on the setup page. This name should be kept fairly short (e.g., 6 to 8 characters) so it can be discerned on the Xpert screen.

Block Type - Select the block type from this list. The block type determines which category the block icon is placed into in the setup page's "Add Block" dialog box. Another restriction based on block type is that only INPUT and OUTPUT blocks are queried for display data by the Sensors property page.

Input Count - Enter the number of inputs belonging to the setup block. If the block is of type INPUT, then this must be 0.

Output Count - Enter the number of outputs belonging to the setup block.

Input Names - Enter the names of the inputs, if any. The number of names entered must match the number of inputs previously specified. To make an entry, simply double-click off of an entry, within the confines of the list block control.

Output Names - Enter the names of the outputs, if any. The number of names entered must match the number of outputs previously specified. To make an entry, simply double-click off of an entry, within the confines of the list block control.

Uses I2C analog I/O - Select this option if the setup block will interface to an Analog I/O Module (either the onboard module of an Xlite, or an external module connected to an Xpert). The resulting code will contain device handles and function overrides used in accessing and supporting the Analog I/O Module API.

Uses I2C digital I/O - Select this option if the setup block will interface to a Digital I/O Module (either the onboard module of an Xlite, or an external module connected to an Xpert). The resulting code will contain device handles and function overrides used in accessing and supporting the Digital I/O Module API.

Uses SDI - Select this option if the setup block will interface to a device via SDI. The resulting code will contain device handles and function overrides used in accessing and supporting the SDI API.

Create Property Page - Select this option to create a property page. Note: a property page manifests as one of the "tabbed" pages of the Xpert's property sheet interface. Selecting this option causes a new page to be added to the tabbed list of pages available.

Page Name - Enter the name of the property page here. This is the name that will appear on the page's tab.

Create Control Panel Entry - Select this option to create an entry in the control panel on the Setup page. Note: an entry in the control panel manifests as a root entry of the Xpert's control panel interface. Selecting this option causes a new root entry to be added.

Entry Name - Enter the name of the control panel entry here. This is the name that will appear on tree's node.

3.1.4.2 Add Code

After pressing Finish in the AppWizard, the project is populated with source code according to the options selected. The file Readme.txt contains a description of the purpose of each file generated. The developer then adds the source code necessary to perform the library's unique functions.

The AppWizard marks areas where source code typically needs to be added or changed with a comment beginning with "TODO". The developer may want to search on this phrase to ensure all areas that typically require definition have been considered.

The developer's source typically make calls into the various Xpert APIs as well as into the Windows CE operating system API. The Xpert APIs are documented later in this document. The Windows CE operating system API is documented in the online help of the EVT.

3.1.4.3 Compile, Link, and Download

To compile and link a release version of the SLL (i.e., one that does not contain debug information), the Active Configuration must be set to "Win32 (WCE x86) Release". Pressing F7 within the EVT will compile and link the code to build the SLL.

Following link, the SLL can be downloaded to the Xpert using Xterm.

The SLL should be downloaded to the Xpert's "flash disk" subdirectory. Following link, the EVT places the SLL in the "X86Rel" subdirectory when building a release version. Once the SLL resides in the flash disk subdirectory, Xpert will load the library at boot.

3.2 Creating Setup Blocks

Setup blocks are represented in code as classes derived from TModule (see module.h). When creating a setup block using the Xpert SDK, the SDK's AppWizard provides the class specification and overrides of basic methods consistent with the options selected during project creation in the files <block name>.h and <block name>.cpp. These files form the foundation for the developer's addition of code to perform the processing required for his or her specific application.

To complete the setup block, the developer should review and update (as necessary) the functions provided by AppWizard, and then provide any additional overrides and functions needed. The functions and TModule overrides the developer may need to implement or update are described in the following sections.

3.2.1 Constructor

The setup block constructor is invoked when the setup block is created. It is in the constructor that the class data and properties should be initialized.

3.2.1.1 Setup Block Properties

Properties are something very specific in an Xpert application. A setup block typically has various properties associated with it that are edited using the block's properties dialog. Some examples are SDI addresses, I/O Module numbers and channels, calibration coefficients, etc.

A property is realized in code as an instance of the class TProperty. The properties are "added" to the block's property list (which is provided by the base class) in the constructor. Once these properties have been added to the properties list, the properties are saved and restored to and from the setup file automatically.

When a project is created, the AppWizard identifies and creates many default properties. Properties used to store output data are created, as are properties used to store I/O module and id and channel information. The AppWizard adds code in the constructor to initialize these properties and add them to the internal property list.

The developer should declare any additional properties needed in the header file, and then initialize and add the properties to the property list in the constructor.

The example that follows initializes four properties, adds them to the internal property list, and initializes the user-defined attribute m_iCount to 0.

```
CMyBlock::CMyBlock()
   : TModule(_T("MyBlock"), MyLibSLL.hResource)
{
   // Add analog I/O properties.
   AddProperty(_T("AIOChannel"), m_propAIOChannel = 0);
   AddProperty(_T("AIOModule"), m_propAIOModule = 1);

   // Add digital I/O properties.
   AddProperty(_T("DIOChannel"), m_propDIOChannel = 0);
   AddProperty(_T("DIOModule"), m_propDIOModule = 1);

   // Add SDI properties.
   AddProperty(_T("SDIAddress"), m_propSDIAddress = 0);

   // Initialize class member data.
   m_iCount = 0;
}
```

3.2.2 ShowProperties()

Xpert users are used to seeing and editing properties in a dialog box opened via the Edit Properties menu item, gained from selecting a block icon on the setup screen. This dialog is invoked modally within the ShowProperties method. The Xpert application framework calls ShowProperties when it is time to actually show the dialog.

A skeleton of this dialog box is provided by the AppWizard and may be found under the "resources" tab of the EVT workspace under the resource id IDD_<block name>. The dialog

already contains I2C and/or SDI controls, if such were selected during the project's creation. The developer typically populates the dialog with controls for any properties or data values added outside of the AppWizard framework.

The source code for the dialog resides in the files <block name>Dlg.h and <block name>Dlg.cpp.

The following example shows how the dialog of type CMyBlockDlg is used to update properties.

```
bool CMyBlock::ShowProperties(CWnd* pParent)
{
   // This method is called whenever the properties dialog of this block
   // should be shown. The call to this method typically occurs across module
   // boundaries and typically loads resources. Hence, we use TResourceKey
   // to ensure resources are loaded from the correct module.
   TResourceKey key(MyLibSLL);
   CMyBlockDlg dlg(pParent);

   dlg.m_iAIOChannel = m_propAIOChannel;
   dlg.m_iAIOModule = m_propAIOModule;
   dlg.m_iDIOChannel = m_propDIOChannel;
   dlg.m_iDIOModule = m_propDIOModule;
   dlg.m_iSDIAddressIdx = m_propSDIAddress;
   if (dlg.DoModal() == IDOK)
   {
      // TODO: Incorporate data from dialog.
      Engine.IOModList.ClearChannelInUse(ANALOG, m_propAIOModule,
            m_propAIOChannel);
      m_propAIOChannel = dlg.m_iAIOChannel;
      m_propAIOModule = dlg.m_iAIOModule;
      Engine.IOModList.SetChannelInUse(ANALOG, m_propAIOModule,
            m_propAIOChannel);

      Engine.IOModList.ClearChannelInUse(DIGITAL, m_propDIOModule,
            m_propDIOChannel);
      m_propDIOChannel = dlg.m_iDIOChannel;
      m_propDIOModule = dlg.m_iDIOModule;
      Engine.IOModList.SetChannelInUse(DIGITAL, m_propDIOModule,
            m_propDIOChannel);

      m_propSDIAddress = dlg.m_iSDIAddressIdx;
      return true;
   }
   return false;
}
```

3.2.3 Initialize()

Initialize is called by the Xpert application framework for every setup block just after a user presses the Start button, and just before the Engine begins executing scheduled actions. Generally speaking, any data or I/O Module initialization that should occur prior to each start of recording should be performed by Initialize.

The AppWizard adds code to reinitialize the block's output data to a default state. The Initialize method is probably a good place to reinitialize any other data added by the developer.

Blocks using Digital I/O Modules often need to initialize their connected device to prepare for performing cyclic actions following start, as in the following example:

```
DigitalIO* pDigIO = Engine.IOModList.GetDigitalIO(m_propDIOModule);
if (pDigIO)
{
   pDigIO->SetAsCounter(m_propDIOChannel);
   pDigIO->SetSamplingSpeed(0.5); //set to max speed, see i2c device spec
   pDigIO->StartRequest();
}
else
   Report.Error(_T("Failed to get digital module.\r\n"));
```

Blocks that want to listen for I/O Module alarms typically need to initialize their connected module to prepare for generating alarms following start:

```
DigitalIO* pDigIO = Engine.IOModList.GetDigitalIO(m_propDIOModule);
if (pDigIO)
   pDigIO->AlarmOnSingleEdge(m_propDIOChannel);
   pDigIO->SetAlarm(m_propDIOChannel, 1);
   pDigIO->ActivateAlarm(m_propDIOChannel);
   pAlarmHandler = new I2CEVENTHANDLER(m_propDIOChannel, *this);
   pMod->SetEventHandler(*pAlarmHandler);
   pDigIO->StartRequest();
}
else
   Report.Error(_T("Failed to get digital module.\r\n"));
```

If the AppWizard was told to create a “scheduled” block (i.e., one that initiates it’s own processing, as opposed to responding to the push or pull of other blocks), then code is added to register its schedule for execution with the engine as part of the Initialize method. It does this by calling Engine’s SetSchedule method with the appropriate timing parameters. This call tells Engine to invoke this method’s Execute method according to the schedule provided. See the Engine API for a more detailed description of SetSchedule.

```
Engine.SetSchedule(m_propOffset.AsCString(), m_propInterval.AsCString(),
      *this);
```

3.2.4 Execute()

The Execute method is called as part of a push or pull of data through the system initiated by Engine. When the Execute method is invoked, it is a signal to the block to perform the function the block was created to perform. Because sensor blocks have an Execute method that is usually very different from non-sensor and scheduled blocks, they are treated separately in the following.

3.2.4.1 Execute() for Sensor Blocks

The invocation of Execute for a sensor block means that it’s time for the sensor to take its measurement, perform any necessary calculations, and assign the results to the output property data created by the AppWizard.

Since an invocation of Execute does not happen instantly, it buffers output data to stack data and only assigns data to the output properties once all data has been completely determined. The

assignment to the output properties occurs within a data lock in order to ensure a consistent data set.

The basic course of events within the Execute method for a sensor block follows:

1. Prior to taking the measurement:
   a. Use the passed parameter tScheduled to set the buffered sensor data's scheduled time value.
   b. Initialize the buffered sensor data's actual time value to the current time.
   c. Initialize the buffered sensor data's quality flag to bad.
   d. Initialize the buffered sensor data's data value to 0.
2. Take the measurement. This largely consists of making calls to either the I2C or SDI API, depending on the way the sensor hardware communicates with Xpert. Note that these calls likely configure the sensor prior to reading its measurement.
3. After the measurement, buffer the results within a data lock. The methods LockData() and UnlockData() are accessible from the TModule base class.

The Execute method of a module taking a simple voltage measurement would be defined as follows. Note that the AppWizard provides all of the following except the part that actually takes the measurement.

```
void CMyBlock::Execute(TTime tScheduled)
{
   // Initialize intermediate Output1 data quality to bad.
   CSensorData Output1Data = m_Output1Data;
   Output1Data.TimeScheduled = tScheduled;
   Output1Data.TimeActual = CTime::GetCurrentTime();
   Output1Data.Quality = CSensorData::BAD;
   Output1Data.Data = 0.0;
   CSensorData RawData = LastData;

   // Get handle to analog module.
   AnalogIO* pAnalogIO = Engine.IOModList.GetAnalogIO(m_propAIOModule);
   if (!pAnalogIO)
   {
      Report.Error(_T("CMyBlock::Execute: Failed to get module.\r\n"));
      return;
   }

   // Take the measurement.
   double Voltage;
   I2CCODE code = pAnalogIO->SingleVoltageReading(m_propAIOModule,
         Voltage);
   if (code == I2C_OK)
   {
      Output1Data.Data = Voltage;
      Output1Data.Quality = CSensorData::GOOD;
   }
   else
      Report.Error(_T("CMyBlock::Execute: Volt reading failed.\r\n"));

   // Buffer output data.
   LockData();
   m_Output1Data = Output1Data;
   UnlockData();
}
```

3.2.4.2 Execute() for Passive, Non-Sensor Blocks

Blocks that are not of type input and not scheduled, typically retrieve data from one or more of the blocks connected as inputs, process the data, and then assign the results to the output property data created by the AppWizard.

The following example demonstrates a block taking its two inputs and adding them together to produce its output.

```
void CMyBlock::Execute(TTime tScheduled)
{
   // Initialize intermediate Output1 data quality to bad.
   CSensorData Output1Data = m_Output1Data;
   Output1Data.TimeScheduled = tScheduled;
   Output1Data.TimeActual = CTime::GetCurrentTime();
   Output1Data.Quality = CSensorData::BAD;
   Output1Data.Data = 0.0;

   // Retrieve inputs.
   CSensorData sdInput1, sdInput2;
   GetInputData(1, sdInput1);   // input1 connected to input point 1
   GetInputData(3, sdInput2);   // input2 connected to input point 3
   Output1Data.Data = sdInput1.AsInteger() + sdInput2.AsInteger();
   if (sdInput1.Quality == CSensorData::GOOD &&
         sdInput2.Quality == CSensorData::GOOD &&
         Output1Data.Data.AsInteger() > 0)
      Output1Data.Quality = CSensorData::GOOD;

   // Buffer the output data.
   LockData();
   m_Output1Data = Output1Data;
   UnlockData();
}
```

Note how this example tests the quality of the inputs and the range of the result to determine if the result is valid. In general, if something goes wrong in the calculation, or if the inputs or result do not meet expectations, the quality should be set to bad, as it is initially in this example.

Also note the call to GetInputData() in the example. This function retrieves the data from the module connected to the specified input. The next paragraph describes how to tell what input to specify.

3.2.4.2.1 Identifying Input and Output Indices

Every block can have up to five inputs and the inputs are enumerated from 0 to 4. When a block has only one input, its connection point is always at point 2. When a block has two inputs, the top input is at point 1 and the bottom input is at point 3. When a block has three inputs, the top input is at point 0, the middle input is at point 2, and the bottom input is at point 4. When a block has four inputs, the top input is at point 0, the first middle input is at point 1, the second middle input is at point 3, and the bottom input is at point 4. When a block has five inputs, the points run 0 to 4, from top to bottom.

Indices are assigned to outputs in the same way they are assigned to inputs. Hence, the center output point is indexed as point 2, and so on.

3.2.4.3 Execute() for Scheduled Blocks

Blocks that are scheduled are “pulled” by the Engine by default when it is time to run. This means that whenever any other block pulls the scheduled block (as would be the case when another scheduled, or in some way active, block performed a pull), the scheduled block would behave as if it were it running on schedule. This may or may not be the desired behavior. Determining as much depends on the unique requirements of the block being developed.

Typically, the desire is to have scheduled blocks ignore pushes and pulls from other blocks, and to only execute when it is told to do so by the engine on schedule. Achieving this behavior is simple, but requires an understanding of how blocks are told to execute by the engine on schedule. The following diagram helps to illustrate how this occurs. Note: in the diagram, an asterisk indicates a lock request (i.e., could result in a block), a subscripted “v” indicates the function is virtual, and a dashed line indicates a change in TModule context (a call to a different block).

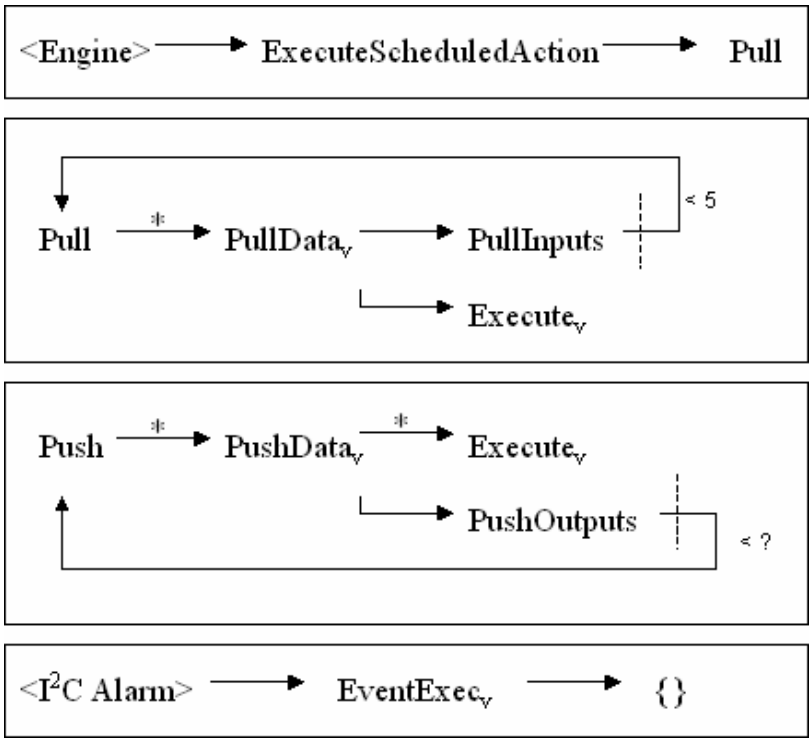


Figure 9: Scheduled Pulls and Event-Driven Pushes

From the diagram it is apparent that, to stop responding to pulls and pushes by other modules, the virtual functions PullData and PushData can be overridden to do nothing but return. But this has the unwanted side-effect of also ignoring the engine’s pull of the block on schedule. To restore this functionality, ExecuteScheduledAction can be overridden to call PullInputs, Execute, and PushOutputs successively, which must occur within a lock of PullLock, as in the following example:

```
void CMyBlock::ExecuteScheduledAction(TTime tScheduled)
{
   TSingleLock SingleLock(PullLock);
   if (SingleLock.Lock(INFINITE))
```

```
    {
        PullInputs(tScheduled, false);
        Execute(tScheduled);
        PushOutputs(tScheduled);
    }
}
```

An alternate form of PushOutputs() is available which will push only a single output point instead of the default of pushing all of them. For instance to push only the blocks connected up to the middle output (#2), PushOutputs(tScheduled, 2) can be called. For instance, one output point might typically be connected to a binary output block while another may be connected to a log block. It may be undesirable to force data to be logged everytime the binary output needs to be changed.

When the AppWizard is told to create a “scheduled” block, the proper overrides are added by default.

Also apparent from the diagram is that I2C alarms don’t actually translate to event-driven pushes as a matter of course. Typically, EventExec is overridden to call PushOutputs when the alarm information passed-in meets the correct criteria.

3.2.5 Stop()

The Stop method is called by the Xpert application framework when the user has pressed the Stop recording button. If the sensor uses a Digital I/O Module and has made a previous start request, then the Stop method should be overridden to request stop, as in the following example:

```
void CMyBlock::Stop()
{
    DigitalIO* pDigIO = Engine.IOModList.GetDigitalIO(m_propDIOModule);
    if (pDigIO)
        pDigIO->StopRequest();
    else
        Report.Error(_T("CMyBlock::Stop: Failed to get module.\r\n"));
}
```

3.2.6 AfterReadSetup()

AfterReadSetup is called by the framework after a setup file is read in. In versions prior to 2.0, the AppWizard would put code in this method to claim I/O module channel usage. This functionality is now provided by SetChannelsInuse.

```
void CMyBlock::AfterReadSetup(int BaseIndex)
{
    // Place any code that should be run when a new setup is read-in here
    TModule::AfterReadSetup(BaseIndex);
}
```

3.2.7 SetChannelsInuse()

SetChannelsInuse() is called by the framework after a setup file is read in, or whenever a change to the channel or module property is made. When using I2C I/O devices, the AppWizard overrides this method to claim channel usage.

```
void CMyBlock::SetChannelsInuse()
{
```

```
    Engine.IOModList.SetChannelInUse(DIGITAL, m_propDIOModule,
          m_propDIOChannel);
}
```

3.2.8 ClearChannelsInuse()

ClearChannelsInuse() is called before the channel or module properties of a block are changed. When using I2C I/O devices, the AppWizard overrides this method to release channel usage.

```
void CMyBlock::ClearChannelsInuse()
{
    Engine.IOModList.ClearChannelInUse(DIGITAL, m_propDIOModule,
          m_propDIOChannel);
}
```

3.2.9 GetModuleType()

GetModuleType() is called by the framework to determine the type of the setup block, which can be one of the following as defined by TModule::ModuleType: *INPUT*, *OUTPUT*, *PROCESSING*, *CALCULATION*, *LOGGING*, *TELEMETRY*, or *OTHER*. The AppWizard overrides this method to return the type selected in the wizard dialog.

```
void CMyBlock::GetModuleType()
{
    return TModule::INPUT;
}
```

3.2.10 GetDeviceType()

GetDeviceType() is called by the framework to determine the type of input/sensor block, which can be one of the following as defined by the global enum CIODeviceType: *UNKNOWN_DEVICE*, *ANALOG*, *DIGITAL*, *DISPLAY*, *SDI12*, *RS232*, *RS485*. The AppWizard overrides this method to return a type that corresponds to the user's device selections (I/O module, SDI, etc.).

Note: When developing a block that uses an analog or digital device (not both) by hand (i.e., not using the AppWizard), then it is possible to simplify the code by deriving your block (TModule) from either TAnalogModule or TDigitalModule. These classes provide default implementations of several methods to reduce the amount of code that needs to be written. The methods provided are: GetDeviceType(), ClearChannelsInuse(), SetChannelsInuse(), GetIOAddrAsString(), AssignDefaultChannel(), GetModuleProperty(), and GetChannelProperty().

```
void CIODeviceType::GetDeviceType()
{
    return ANALOG;
}
```

3.2.11 GetModuleProperty()

This method returns a handle to the property that identifies the I/O module used by the block. The When I2C I/O modules are used, the AppWizard overrides this method to return the indicated property.

This method supports the use of the block in the context of *EZSetup Measurements*.

```
TProperty* CMyBlock::GetModuleProperty()
{
   return &m_propAIOModule;
}
```

3.2.12 GetChannelProperty()

This method returns a handle to the property that identifies the device channel, com port, or SDI address used by the block. When I2C I/O modules are used, the AppWizard overrides this method to return the indicated property.

This method supports the use of the block in the context of *EZSetup Measurements*.

```
TProperty* CMyBlock::GetChannelProperty()
{
   return &m_propAIOChannel;
}
```

3.2.13 AssignDefaultChannel()

This is called by the framework when a new input block is created to find and set default channel and module properties of the block. Typically Engine.IOModList.FindChannel() is called to find an unused I2C channel, but this is handled automatically if the block is derived from TAnalogModule or TDigitalModule and only requires a single channel.

```
void CMyBlock::AssignDefaultChannel()
{
   Engine.IOModList.FindChannel(ANALOG, IOModule.AsInteger(),
      IOChannel.AsInteger());
   Engine.IOModList.FindChannel(ANALOG, IOModule.AsInteger(),
       IOExcitationChannel.AsInteger());
}
```

3.2.14 EventExec()

EventExec() is called by the Engine when a block has indicated it responds to I/O module alarms (i.e., it has created an instance of I2CEVENTHANDLER; see Initialize above) and an alarm has occurred. Override this method to perform processing when a registered alarm occurs. For example, to have the block output its data to all blocks connected to its outputs, the override might look as follows:

```
void CMyBlock::EventExec(BYTE EventType, UINT32 Time)
{
   PushOutputs(TTime::GetCurrentTime());
}
```

3.2.15 Calibrate()

This method is invoked by the framework when the user presses the “Cal…” button on the Sensors page. By default, a message is displayed indicating no calibration is necessary. Override this method to guide the user through a calibration procedure, if necessary. For example:

```
bool CMyBlock:Calibrate()
{
   double dOrigVal, dNewVal;
   dOrigVal = dNewVal = LastData.Data.AsDouble();
   if (IDOK == ChangeNumberDlgReal(NULL, dNewVal, _T("Enter current value")))
   {
      CalOffset = dNewVal - dOrigVal + CalOffset.AsDouble();
      return true;
   }
   return false;
}
```

3.2.16 I2CCalibrate()

This method is invoked by the framework when a user selects calibrate from a connected I2C display. By default, setup blocks do not support this type of calibration. To provide support, override this method to perform the calibration and override TModule::SupportsI2CCalibration() to return true, indicating the setup block supports calibration via the I2C display. For example:

```
bool CMyBlock::I2CCalibrate()
{
   DisplayIO::EditStatus Status;
   double OrigVal, NewVal;
   DisplayIO* pDisp = Engine.IOModList.GetDisplayIO(1);
   if (pDisp)
   {
      OrigVal = NewVal = LastData.Data.AsDouble();
      Status = pDisp->EditFloat( NewVal, _T("Cur.Val"),true, -1000, 5000);
      if (Status == DisplayIO::EDIT_OK)
      {
         CalOffset = NewVal - OrigVal + CalOffset.AsDouble();
         return true;
      }
   }
   return false;
}
```

3.2.17 GetScheduleInfo()

This method is invoked by the framework for scheduled blocks to retrieve a string describing the block's schedule. This string is displayed in the control panel under *Graphical Setup* for each of the input blocks shown there. When "scheduled" is selected, the AppWizard overrides this method to return the indicated string.

```
CString CMyBlock: GetScheduleInfo()
{
   CString str;
   CTime timeNext = CTime(0);
   if (Engine.IsRunning())
   {
      CTimeSpan tsTime = StrToTimeSpan(Time);
      CTimeSpan tsInterval = StrToTimeSpan(Interval);
      timeNext = NextScheduledTime(CTime::GetCurrentTime(),
            tsInterval, tsTime);
   }
```

```
   str.Format(_T("%s (Next: %02d:%02d:%02d)"), Interval.AsLPCTSTR(),
         timeNext.GetHour(), timeNext.GetMinute(), timeNext.GetSecond());
   return str;
}
```

3.2.18 Setup Block Icon

The icon displayed on the setup page for the block is determined by the AppWizard based on the type of block being created. This icon is stored in a bitmap file in the "/res" project subdirectory. The icon may be replaced with a custom bitmap simply by replacing or editing the bitmap file. The EVT provides bitmap editing tools.

3.2.19 Adding Multiple Blocks to a Single Library

1. By default, the AppWizard allows the developer to add only one setup block per library. This restriction can be overcome manually through the following steps:
2. In <library name>.cpp, modify TFactory::TFactory constructor to initialize its module list with all required blocks. This typically invloves updating the definitions for both Modules and ModuleCount. For example:

```
TFactory::TFactory()
{
   static TCHAR* Modules[]={_T("MyFirstBlock"), _T("MySecondBlock")};
   ModuleCount = 2;
   ModuleList  = Modules;
}
```

3. In <library name>.cpp, modify TFactory::CreateModule() to create multiple blocks, based on the index received (which ranges from 0 to ModuleCount-1). For example:

```
TModule* TFactory::CreateModule(int Index)
{
   switch(Index)
   {
      case 0: return dynamic_cast<TModule *>(new CMyFirstBlock());
      case 1: return dynamic_cast<TModule *>(new CMySecondBlock());
      default: return NULL;
   }
}
```

4. Create a bitmap to serve as an icon for the new setup block. Start with a copy of the bitmap generated by AppWizard since it already has the correct color depth and size attributes. Add this new bitmap to the project in EVT.
5. Use the source and header files of the AppWizard generated setup block as a template for new source and header files for the new setup block. Add these files to the project. Repeat this step for the files to be used for the new block's properties dialog.
6. Create the dialog resource for the properties dialog. Update the resource identifier referenced in the properties dialog header file with the new resource identifier.

3.2.20 Adding Inputs and/or Outputs

Sometimes it is necessary to add inputs or outputs to a block after AppWizard has already been run. This can be done by updating the methods of the block class that define the number of inputs (outputs) exist, whether the inputs (outputs) are active, and the corresponding names. When the number of output points changes, it is usually necessary to update the output point buffering scheme.

3.2.20.1 Update Input/Output Methods

The number of inputs is defined by the method InputCount().The number of outputs is defined by the method OutputCount().

The method InputActive() is used to define whether a given input is active (i.e., connectable). The corresponding method for outputs is OutputActive(). These methods should return true for any connection point that is active. For example, if input point 2 (the center input[3]) is connectable, then InputActive(2) should return true. These methods should return false for any connection point that is not active.

The method InputName() is used to define the name, or label, of a given input. The corresponding method for outputs is OutputName(). These methods should return a CString object containing the name of the input (or output).

3.2.20.2 Update Output Buffering Scheme

When the number of outputs changes, it is usually necessary to update the output point buffering scheme, which consists of buffer variables and accessor methods.

Whenever a block asks for data from another block using GetInputData(), the data that is returned comes from the provider block's internal buffer associated with the output. In the simplest case of one output, the variable *LastData*, provided by the TModule base class, is used to buffer the output for point 2. The AppWizard provides code that automatically manages this buffering.

When a block has more than one output, separate buffers are added as class variables for each output. When the values for the outputs are determined (typically during Execute()) they are assigned to the buffered output variables inside a data lock. The accessor methods GetData() and SetData() serve as the public interface to this data. All of this, of course, happens through code automatically provided by AppWizard when the number of outputs is known when AppWizard is run. To change this buffering scheme manually, the internal buffer variables and accessor methods must be updated accordingly.

3.3 Creating Property Pages

If Property Page is selected during project creation, then the AppWizard creates an empty property page in the files <page name>.h and <page name>.cpp. The page is encapsulated within a class named C<page name> derived from CModPropPage. The developer uses standard Windows' dialog controls to present and obtain data to and from the user.

[3] For a detailed discussion of how to identify the index of an input or output point, see "3.2.4.2.1 Identifying Input and Output Indices".

3.3.1 Adding Multiple Pages to a Single Library

1. By default, the AppWizard allows the developer to add only one property page per library. This restriction can be overcome manually through the following steps:
2. In <library name>.cpp, modify TFactory::TFactory constructor to initialize its page list with all required pages. This typically invloves updating the definitions for both Pages and PageCount. For example:

```
TFactory::TFactory()
{
   static TCHAR* Pages[]={_T("MyFirstPage"), _T("MySecondPage")};
   PageCount = 2;
   PageList  = Pages;
}
```

3. In <library name>.cpp, modify TFactory::CreatePage() to create multiple pages, based on the index received (which ranges from 0 to PageCount-1). For example:

```
TModule* TFactory::CreatePage(int Index)
{
   switch(Index)
   {
      case 0: return dynamic_cast<CModPropPage*>(new CMyFirstPage());
      case 1: return dynamic_cast<CModPropPage*>(new CMySecondPage());
      default: return NULL;
   }
}
```

4. Use the source and header files of the AppWizard generated property page as a template for new source and header files for the new property page. Add these files to the project.
5. Create the dialog resource for the property page. Update the resource identifier referenced in the property page header file with the new resource identifier.

3.4 Creating Control Panel Entries

If Control Panel Entry is selected during project creation, then the AppWizard creates an empty control panel entry in the files <entry name>.h and <entry name>.cpp. The entry is encapsulated within a class named C<entry name> derived from CControlPanelEntry. The developer accesses this entry using standard Windows' tree control routines to present data to the user.

3.4.1 Control Panel Buttons

When a node of a tree is selected, the EditItem method is called which in turn instantiates and invokes modally a dialog intended to allow the user to edit the selected item. This dialog is created by the AppWizard, encapsulated in a class named C<entry name>Dlg, and appears in the files <entry name>Dlg.h and <entry name>Dlg.cpp. The developer uses standard Windows' dialog controls to present and obtain data to and from the user to edit the selected item.

The control panel also supports two other buttons (labeled New and Delete by default). They may be activated and named by overriding GetButtonLabels() and implemented by overriding NewItem() and DeleteItem() methods.

3.4.2 Making and Saving Changes to Setup Data

The control panel is where the user makes changes to data that is typically related to system setup. It often the case that these changes must occur with recording stopped. Also, it is often the case that these changes need to be saved upon leaving the control panel. The base class of the control panel entry provided by the AppWizard (CControlPanelEntry) provides support for these special situations.

When the system is recording, it is using system setup data. If changes are to be made to this data, system recording must be stopped first. This is typically done by calling PromptStopEngine() before the changes are made. This method of CControlPanelEntry prompts the user for permission to stop recording. If the user agrees, recording is stopped by calling Engine.Stop() and then a flag is set (m_bRecStopped) to true so that the system prompts to turn recording back on once the user leaves the control panel.

When changes are made to system setup data, it is the system's convention to save these changes automatically when the user tabs away from the setup tab/control panel page. To ensure this is done, set m_bSaveNeeded to true after the changes are made. This causes the system to save the system setup automatically when the user leaves the control panel (just before prompting to turn recording back on, if it was turned off).

3.5 Creating "Empty" SLLs

It is possible to create an SLL that does not contain a setup block, property page, nor control panel entry. Such an SLL could be programmed to perform countless functions given the developer has access to the complete Windows CE API, in addition to the Xpert API. To create an empty SLL, simply uncheck the setup block, property page, and control panel check boxes during step 2 of the AppWizard.

3.6 Signaling an SLL on Application Init/Exit

It is possible to have Xpert "signal" an SLL at both application initialization and termination by defining and exporting the functions "extern "C" _declspec(dllexport) void AppInit()" and "extern "C" _declspec(dllexport) void AppExit()", respectively. When the Xpert application starts, it searches for the AppInit function in all loaded SLLs and calls them if found. At application termination (when the user presses "Exit App" on the status page), Xpert searches each SLL for the function AppExit, and executes it if found.

The call to AppInit() is the ideal point from which to spawn new execution threads, should this be required. The call to AppExit() is the ideal point from which to signal those threads to exit. An example of this type of processing is included in the examples section of this document.

4 APIs

The set of functions and data available from Xpert libraries are divided into different groups based on source and purpose. Note: See the EVT's online help for documentation of the Windows CE API.

4.1 Engine API

The Xpert Engine consists of both an engine object and a set of exported functions. The engine object is an instantiation of CEngine named “Engine” that exists following boot. The exported functions are exported as standard “C” functions.

4.1.1 The Engine Object

This section contains descriptions of the engine object’s public methods and data. Since these methods and data belong to the instance of CEngine named “Engine”, they are accessed using the dot qualifier, as in the following examples:

```
Engine.hStartEvent
Engine.IOMOdList.GetAnalogIO()
etc…
```

4.1.1.1 hStartEvent

This event handle is signaled when the user has pressed the Start recording button. It is reset when the user presses Stop. Use PowerMgr.WaitForSingleObject() and/or PowerMgr.WaitForMultipleObjects() to wait/test this event handle. (Note: the engine method “IsRunning()” can also be used to determine if this event handle is set).

```
HANDLE hStartEvent
```

Header

Engine/Engine.h

4.1.1.2 hStopEvent

This event handle is signaled when the user has pressed the Stop recording button. It is reset when the user presses Start. Use PowerMgr.WaitForSingleObject() and/or PowerMgr.WaitForMultipleObjects() to wait/test this event handle. (Note: the engine method “IsRunning()” can also be used to determine if this event handle is cleared).

```
HANDLE hStopEvent
```

Header

Engine/Engine.h

4.1.1.3 ModuleList

This member is an array containing handles to each of the setup blocks defined on the setup page. Note: both TObArray and TModule are defined in module.h.

```
TObArray<TModule> ModuleList;
```

Header

Engine/Engine.h

4.1.1.4 Run()

This method is used to programatically start recording. Note: This method does not validate the contents of the setup before starting recording.

```
void Run();
```

Parameters

None.

Return Value

None.

Header

Engine/Engine.h

4.1.1.5 Stop()

This method is used to programatically stop recording.

```
void Stop();
```

Parameters

None.

Return Value

None.

Header

Engine/Engine.h

4.1.1.6 IsRunning()

This method is used to determine whether recording is currently stopped or started.

```
BOOL IsRunning();
```

Parameters

None.

Return Value

TRUE if recording is On, false otherwise.

Header

Engine/Engine.h

4.1.1.7 SetSchedule()

This method is used to establish the execution schedule of a TModule object. After the scheduling call is made, the Engine will execute ExecuteScheduledAction() associated with the module

provided. The default action of ExecuteScheduledAction is to pull the module's inputs and invoke the module's Execute method.

```
BOOL SetSchedule(
      CString SyncTime,
      CString IntTime,
      TModule& module);

BOOL SetSchedule(
      CTimeSpan SyncTime,
      CTimeSpan IntTime,
      TModule& module);
```

Parameters

SyncTime	-	A string or timespan representing the offset into the interval in which to invoke the module's ExecuteScheduledAction() routine. The string should be in the format "HH:MM:SS".
IntTime	-	A string or timespan representing the interval at which to invoke the module's ExecuteScheduledAction() routine. The string should be in the format "HH:MM:SS".
Module	-	A reference to the module being scheduled.

Return Value

TRUE is returned.

Header

Engine/Engine.h

4.1.1.8 ForceSchedule()

This method causes a scheduled thread for the specified module to fire immediately. The bEvent flag is set to true when passed to ExecuteScheduledAction() to indicate that the event was forced. This allows a block to have both a regular execution interval as well as an event driven trigger input. When the trigger event occurs, Engine.ForceSchedule() can be called to allow the block to process the data immediately.

```
bool ForceSchedule(const TModule& Module);
```

Parameters

Module	-	A reference to a previously scheduled module to be that's to be forced.

Return Value

True is returned if a scheduling thread for 'Module' can be located and notified.

Header

Engine/Engine.h

4.1.1.9 LockGUI()

This method is used to guarantee exclusive access to the user interface. This method blocks on a semaphore until exclusive access is available. This method is typically used by worker threads that need to update some element of the GUI (e.g., threads that update control panel entries).

```
bool LockGUI();
```

Parameters

None.

Return Value

Returns false immediately if GUI is disabled (not running). Otherwise, once the lock is obtained, true is returned.

Header

Engine/Engine.h

4.1.1.10 UnlockGUI()

This method is used to release exclusive access to the user interface after it has been obtained by calling LockGUI().

```
void UnlockGUI();
```

Parameters

None.

Return Value

None.

Header

Engine/Engine.h

4.1.1.11 AutoSaveSetup()

This method is used to force a save of the setup to file. If a name has been previously identified by opening or saving a setup file, then that name is used in the automatic save. If no name has been identified, “default.ssf” is used.

```
bool AutoSaveSetup(DWORD dwWait = 0);
```

Parameters

dwWait	-	Access to the setup must be locked before the autosave can complete successfully. This parameter is the number of milliseconds to wait for the lock to become available, if it is not available already. “INFINITE” may be specified to wait indefinitely.

Return Value

True is returned if the function is successful. False is returned otherwise.

Header

Engine/Engine.h

4.1.1.12 LockSetup()

This method is used to lock access to the setup file for either read-only or exclusive write access. Read-only access is granted to any thread that requests it as long as no write access is active. Hence, multiple threads can obtain read access concurrently. Write access is exclusive, causing all other requests, whether read-only or write, to block. The dwWait parameter determines how long a thread desires to wait for the requested access. If the lock is successful, true is returned. If the lock attempt times-out, false is returned. The thread must call UnlockSetup() to release the lock, specifying whether read-only access was originally requested as a parameter.

```
bool LockSetup(DWORD dwWait = 0, bool bReadOnly = true);
```

Parameters

dwWait	-	The number of milliseconds to wait for the lock to become available, if it is not available already. “INFINITE” may be specified to wait indefinitely.
bReadOnly	-	When true, read-only access is requested. When false, exclusive write-access is requested.

Return Value

True is returned when the lock is successful. False is returned otherwise.

Header

Engine/Engine.h

4.1.1.13 UnlockSetup()

This method is used to unlock access to the setup file.

```
void UnlockSetup(bool bReadOnly = true);
```

Parameters

bReadOnly	-	Specify true when read-only access was requested in the call to LockSetup(). Otherwise, specify false.

Return Value

None.

Header

Engine/Engine.h

4.1.1.14 StationName

A string containing the name of the station.

```
CString StationName
```

Header

Engine/Engine.h

4.1.1.15 AlarmMgrList

The AlarmMgrList is an array which contains a list of all the installed alarm managers (CAlarmMgr objects) in the system. An alarm manager is typically contained in an SLL (for example Coms.sll) and defines what should occur when an alarm or an alert condition occurs and all other aspects of alarm and alert handling. Be sure to always use LockTags() before and UnLockTags() after accessing the AlarmMgrList directly.

```
TObArray<CAlarmMgr> AlarmMgrList;
```

4.1.1.16 TagList

The TagList is an array which contains a list of all the communication tags in the system known as CTag. Tags may be looked up by name, or the list may be traversed from top to bottom. Tags are used to mark data values in the setup that need to be transmitted via telemetry or displayed to the user (see the “CTag class” section for more information). Since the TagList is a shared resource, all access to the list must be surrounded by calls to LockTags() and UnLockTags().

```
TMapStringToRef<CTag> TagList;
```

4.1.1.17 LockTags()

Must be called before the TagList is accessed or any Tag in the list is used. This is also used to protect access to the AlarmMgrList.

```
void LockTags();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.1.18 UnLockTags()

Must be called when code is done accessing the TagList or Tags from the list, or the AlarmMgrList so that other sections of the code may access the list.

```
void UnLockTags();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.1.19 InAlarm()

Returns true if the system is in alarm. An alarm condition is defined as one or more sensors exceeding their alarm limits.

```
bool InAlarm();
```

Parameters

None

Return Value

True if the system is in alarm.

Header

Engine/Engine.h

4.1.1.20 InAlert()

Returns true if the system is in alert. An alert condition is defined as a state caused by a change in the alarm condition requiring a transmission to occur.

```
bool InAlert();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.1.21 RaiseAlert()

Puts the system in to an Alert state causing transmissions to occur as appropriate.

```
void RaiseAlert(int ComPort=0);
```

Parameters

ComPort	-	May be used to indicate which port should respond to the Alert. A value of 0 indicates that an Alert should be sent out on all appropriate ports.

Return Value

None

Header

Engine/Engine.h

4.1.1.22 ClearAlert()

Clears an existing Alert State, putting a stop to any Alert transmissions as soon as possible.

```
void ClearAlert(int ComPort=0);
```

Parameters

ComPort - May be used to indicate which port the alert should be cleared for, otherwise all alerts on all ports are cleared.

Return Value

None

Header

Engine/Engine.h

4.1.1.23 ChangeAlarm()

May be called by an Alarm block to inform the system that the Alarm status has changed.

```
void ChangeAlarm(bool Alarming);
```

Parameters

Alarming - Should be set true if a sensor has gone in to alarm. This saves a lot of overhead because by definition if any tag is in alarm the entire system is in alarm, otherwise the system state must be determined by examing every tag.

Return Value

None

Header

Engine/Engine.h

4.1.1.24 ClearAlarm()

Clears all alarm flags in every tag in the system, hence taking the system out of the alarm state (at least until the next measurement cycle begins and tags start to return to the alarm state).

```
void ClearAlarm();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.1.25 EnableAlarm()

Enables Alarm/Alert transmissions in the system.

```
void EnableAlarm();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.1.26 DisableAlarm()

Disable Alarm/Alert transmissions in the system.

```
void DisableAlarm();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.1.27 AlarmsEnabled()

Returns the system alarm enable status.

```
bool AlarmsEnabled();
```

Parameters

None

Return Value

True if Alarm/Alert transmissions are enabled.

Header

Engine/Engine.h

4.1.1.28 GetAlarmStatus()

Returns a string representing the status of all the Alarm Managers in the system. They typically report back the time of next transmission, and/or the time of previous ones.

```
CString GetAlarmStatus();
```

Parameters

None

Return Value

A multi line text message CR/LF delimeted prepared by each of the Alarm Managers in the system.

Header

Engine/Engine.h

4.1.1.29 IOModList

This member is an array containing handles to each of the connected I/O modules (instances of CIOMod: see iomod.h).

```
CIOModList IOModList;
```

Header

Engine/IOMod.h

4.1.1.30 IOModList.GetAnalogIO()

This method is used to retrieve a pointer to the Analog I/O Module indicated by ModuleNumber.

```
AnalogIO* GetAnalogIO(
      int ModuleNumber);
```

Parameters

ModuleNumber - The one-based id of the desired analog module.

Return Value

A pointer to the analog module is returned if the module is found. NULL is returned if the module is not found.

Header

Engine/IOMod.h

4.1.1.31 IOModList.GetDigitalIO()

This method is used to retrieve a pointer to the Digital I/O Module indicated by ModuleNumber.

```
DigitalIO* GetDigitalIO(
      int ModuleNumber);
```

Parameters

ModuleNumber - The one-based id of the desired digital module.

Return Value

A pointer to the digital module is returned if the module is found. NULL is returned if the module is not found.

Header

Engine/IOMod.h

4.1.1.32 IOModList.GetDisplayIO()

This method is used to retrieve a pointer to the I2C Display Module indicated by ModuleNumber.

```
DigitalIO* GetDisplayIO(
      int ModuleNumber);
```

Parameters

ModuleNumber - The one-based id of the desired I2C display module.

Return Value

A pointer to the display module is returned if the module is found. NULL is returned if the module is not found.

Header

Engine/IOMod.h

4.1.1.33 IOModList.GetIOMod()

This method is used to retrieve a pointer to the I/O Module indicated by Type and ModuleNumber.

```
CIOMod* GetIOMod(
      CIODeviceType Type,
      int ModuleNumber);
```

Parameters

Type - Possible values are defined by the enum CIODeviceType: ANALOG, DIGITAL, or DISPLAY.

ModuleNumber - The one-based id of the desired module.

Return Value

A pointer to the IO module is returned if the module is found. NULL is returned if the module is not found.

Header

Engine/IOMod.h

4.1.2 Exported Engine Functions

This section contains descriptions of the functions exported from the Engine library.

4.1.2.1 ChangeNumberDlgInt()

This function invokes a dialog used to obtain an integer from the user.

```
int ChangeNumberDlgInt(
      CWnd* pParent,
      int& nInput);
```

Parameters

pParent	-	Specifies the parent window.
nInput	-	Reference to the number to change.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.2.2 ChangeNumberDlgReal()

This function invokes a dialog used to obtain an real number from the user.

```
int ChangeNumberDlgReal(
      CWnd* pParent,
      realtype& rInput);
```

Parameters

pParent	-	Specifies the parent window.
rInput	-	Reference to the number to change.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.2.3 FileNameDlg()

This function invokes a dialog used to obtain a file selection from the user.

```
int FileNameDlg(
      CWnd* pParentWnd,
      CString& sReturn,
      LPCTSTR lpszDir = _T("\\"),
      LPCTSTR lpszFilters = _T("*.*"),
      LPCTSTR lpszDefaultExt = _T(""),
      LPCTSTR lpszDefaultName = NULL);
```

Parameters

pParentWnd	-	Specifies the parent window.
sReturn	-	The name of the file selected by the user.
lpszDir	-	The initial directory.

lpszFilters	-	A file specification used to filter the list of files available for the user's selection.
lpszDefaultExt	-	An extension to apply to the user's selection if the selection does not already have an extension.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.2.4 KeypadDlg()

This function invokes a dialog used to obtain a string from the user.

```
int KeypadDlg(
      CWnd* pParent,
      CString& text,
      CString Caption,
      CString strType = _T(“”));
```

Parameters

pParent	-	Specifies the parent window.
text	-	The string entered by the user.
Caption	-	String to display in the dialog title.
strType	-	A string describing the type of entry to be retrieved from user. Enter one of two strings: “PASSWORD” –characters typed by user appear as an asterisk (“*”) in dialog; or “FILENAME” – the characters of the text entered are validated as filename candidates when “Ok” is pressed.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.2.5 MessageDlg()

This function invokes a dialog to display a message to the user. The function accepts a time argument that determines how long the dialog will wait for user input before choosing a default response automatically.

```
int MessageDlg(
      CWnd* pParent,
      const LPCTSTR tstrMsg,
      UINT nWaitSec = 0,
      UINT nType = MB_OK,
      UINT nDefaultResponse = NULL);
```

Parameters

pParent	-	Specifies the parent window.
tstrMsg	-	The message to be displayed.
nWaitSec	-	The number of seconds to wait for user input before choosing the default response. A value of 0 indicates wait indefinitely.
nType	-	The type of message box to display to the user. MB_OK – Dialog has “OK” button. MB_OKCANCEL – Dialog has “OK” and “Cancel” buttons. MB_YESNO – Dialog has “Yes” and “No” buttons. MB_YESNOCANCEL – Dialog has “Yes”, “No”, and “Cancel” buttons.
nDefaultResponse	-	The response to choose automatically when the user does not respond to the dialog within the time specified. Typically IDOK, IDCANCEL, IDYES, or IDNO, to correspond with the dialog type. If this argument is NULL, then the default response is selected based on the type of the dialog: MB_OK – Response is IDOK. MB_OKCANCEL – Response is IDCANCEL. MB_YESNO – Response is IDNO. MB_YESNOCANCEL – Response is IDCANCEL.

Return Value

The value of the response either selected by the user or chosen automatically.

Header

Engine/Module.h

4.1.2.6 PasswordDlg()

This function invokes a dialog used to obtain a password from the user. An asterisk character (*) is displayed for each character the user types.

```
int PasswordDlg(
      CWnd* pParent,
      CString& text);
```

Parameters

pParent	-	Specifies the parent window.
text	-	The password entered by the user.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.2.7 SetDateTimeDlg()

This function invokes a dialog used to obtain a SYSTEMTIME structure as set by the user.

```
int SetDateTimeDlg(
      CWnd* pParentWnd,
      CTime& time,
      SYSTEMTIME& SystemTime);
```

Parameters

pParentWnd	-	Specifies the parent window.
time	-	An initial time to display in the dialog.
SystemTime	-	The SYSTEMTIME structure containing the time entered by the user.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.2.8 SetTimeDlg()

This function invokes a dialog used to obtain a string representation of time from the user.

```
int SetTimeDlg(
      CString& text,
      CWnd* pParentWnd,
      CString& title,
      BOOL fMSec = FALSE);
```

Parameters

text	-	The time entered by the user.
pParentWnd	-	Specifies the parent window.
title	-	A string to display as the title of the dialog box displayed to the user.
fMSec	-	If TRUE, milliseconds are shown on the dialog for the user to enter.

Return Value

IDOK is returned if the user selected OK. IDCANCEL is returned if the user selected Cancel.

Header

Engine/Module.h

4.1.3 CTag Class

Tags are used to mark data values in the setup that need to be transmitted via telemetry or displayed to the user. The CTag class is an abstract class. An SLL such as the Coms SLL typically creates and defines a CTag object for each item it wishes to make available and overrides the appropriate

virtual methods to define the functionality. CEngine::TagList contains the list of all tags in the system.

Be careful when naming tags, as tag names must be unique.

4.1.3.1 CTag()

Constructs a tag.

```
CTag();

or

CTag(Cstring NewName);
```

Parameters

NewName - Defines the initial name for the tag. If a name is specified the tag is automatically added to the TagList.

Return Value

None

Header

Engine/Engine.h

4.1.3.2 ~CTag()

Destroys a CTag, removing it from the TagList if it had been previously added.

```
~CTag();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.3.3 SetName()

Changes the name of the tag. Often tag names are user-defined and can be changed on the fly. Calling SetName() whenever this occurs will remove the old entry in the TagList, and create a new entry with the new name.

Tag names must be unique withing the system. Call CTag::CheckName to determine if a given name is unique.

```
void SetName(CString NewName);
```

Parameters

NewName - Defines the new name for the tag. If NewName is not empty, then the tag is added to the TagList under the name.

Return Value

None

Header

Engine/Engine.h

4.1.3.4 CheckName()

Checks to see if the specified name is unique relative to the taglist. If the name is not in the tag list, or if the name is in the taglist for the current CTag, then true is returned.

This method should be called to determine if a potential tag name is unique before the tag is added to the taglist by SetName().

```
bool CheckName(CString strName);
```

Parameters

strName - The name to check against the tag list.

Return Value

True if the name is not in the tag list, or if the name is in the taglist for the current CTag.

Header

Engine/Engine.h

4.1.3.5 GetNumValues()

A tag can contain one or more values. This returns how many the tag will support. Under SSP a tag is expected to have at least two values, where value 0 contains the primary data reading, and value 1 contains the alarm status. In the Xpert the Coms SLL supports value 2 which returns the same data as value 0, but performs a live reading first by performing an EvalTag().

```
virtual int GetNumValues() = 0;
```

Parameters

None

Return Value

The number of defined values, usually 2.

Header

Engine/Engine.h

4.1.3.6 GetAlarm()

Returns the alarm status for the tag directly. The status is also typically available by using GetTag() for value 1. CSensorData::TAlarmStatus contains the definitions of the various possible alarm bits.

The bits used by the Xpert include: HiLimitA, LowLimitA, DigitalA. These are the “alarm” bits and indicate that one or more of the three possible alarm condition exists. The HiLimitC, LowLimitC, and DigitalC bits are called the change bits and indicate that the respective alarm bit has changed state resulting in an alert condition. The “Digital” alarm bit is currently used in the Xpert for indicating Rate of Change alarms, while the other two are used for indicating a high or low limit have been exceeded.

```
virtual int GetAlarm() = 0;
```

Parameters

None

Return Value

An integer representing a bit mask defined by CSensorData::TAlarmStatus.

Header

Engine/Engine.h

4.1.3.7 SetAlarm()

The opposite of GetAlarm, SetAlarm can be used to force the alarm state to the specified value. See the discussion of GetAlarm() for information about the possible alarm states.

```
virtual void SetAlarm(int AlarmState) = 0;
```

Parameters

AlarmState	-	An integer representing a bit mask defined by CSensorData::TAlarmStatus.

Return Value

None

Header

Engine/Engine.h

4.1.3.8 GetTag()

GetTag is used to read values from a tag. This is called in response to an SSP Get Tag message, or when the user views tag in the View Data screen.

```
virtual bool GetTag(int ValueNumber, int& DataType, TValue& Data,
CSensorData::QualityType Quality) = 0;
```

Parameters

ValueNumber	-	Since a tag can support multiple values, this specifies which one to retrieve. Typically either 0 or 1, but can be more.
DataType	-	Returns the SSP data type of the value as defined in TDataType in ssp.h. Here are the supported data types: dt_long 32-bit integers

	dt_real	double precision floating point
	dt_alarm	alarm status information
	dt_longstr	null terminated strings
	dt_char	a single character
	dt_boolean	a 1 byte boolean 0/1 value
	dt_cardinal	a 16-bit unsigned int
	dt_integer	a 16-bit signed int
	dt_nil	a null value
Data	-	The actual data value, TValue can only represent 32-bit integers, doubles, and strings, so other data types (if used) must be derived from these types.
Quality	-	Quality of the data, can be CSensorData::GOOD, CSensorData::BAD, or CSensorData::Undefined.

Return Value

Returns false if the ValueNumber wasn't defined.

Header

Engine/Engine.h

4.1.3.9 SetTag()

Sets a tag value to the specified data. This is called in response to an SSP Set Tag message, or when the user tries to change a tag in the View Data screen.

```
virtual bool SetTag(int ValueNumber, int DataType, TValue& Data,
CSensorData::QualityType Quality)  = 0;
```

Parameters

ValueNumber	-	Since a tag can support multiple values, this specifies which one to set. Typically either 0 or 1, but can be more.
DataType	-	The SSP data type of the value as defined in TDataType in ssp.h. See the discussion under GetTag() for more information.
Data	-	The string, integer, or double precision value to set the specified tag value to.
Quality	-	Quality of the data, can be CSensorData::GOOD, CSensorData::BAD, or CSensorData::Undefined.

Return Value

Returns false if the ValueNumber wasn't defined.

Header

Engine/Engine.h

4.1.3.10 StartTag()

StartTag is called whenever an SSP Start Tag is received for the specifed tag. For data only tags it doesn't usually serve a purpose, but for a tag which implemented a control loop, it would typically initialize and begin execution of the thread which performs the control loop activity.

```
virtual bool StartTag() = 0;
```

Parameters

None.

Return Value

Returns false if the operation failed.

Header

Engine/Engine.h

4.1.3.11 StopTag()

StopTag is called whenever an SSP Stop Tag is received for the specified tag. For data only tags it doesn't usually serve a purpose, but for a tag which implemented a control loop, it would typically safely terminate execution of the thread which performs the control loop activity.

```
virtual bool StopTag() = 0;
```

Parameters

None

Return Value

Returns false if the operation failed.

Header

Engine/Engine.h

4.1.3.12 EvalTag()

EvalTag is called whenever an SSP Eval Tag message is received for the specified tag. The purpose is to evaluate the tag, which might mean take a reading, or execute a control function.

```
virtual bool EvalTag() = 0;
```

Parameters

None

Return Value

Returns false if the operation failed.

Header

Engine/Engine.h

4.1.3.13 IsCurDataTag()

A flag indicating whether a tag should be included in SSP Current Data and Alarm messages. Even if this method returns false, the tag is still accessable via other telemetry methods such as the SSP GetTag or SendTag messages.

```
virtual bool IsCurDataTag() = 0;
```

Parameters

None

Return Value

True if the tag should be included in SSP Current Data and Alarm messages.

Header

Engine/Engine.h

4.1.3.14 IsViewableTag()

A flag indicating whether a tag should be displayed in the View Sensor display.

```
virtual bool IsViewableTag() = 0;
```

Parameters

None

Return Value

True if the tag should be included in View Sensor screen.

Header

Engine/Engine.h

4.1.4 CAlarmMgr Class

An Alarm Manager is a class which manages alarms and alerts for a telemetry SLL. The Engine maintains a list of all Alarm Managers in the system in CEngine::AlarmMgrList and uses this list to notify all the managers when an alarm or alert occurs. The alarm or alert may be generated either by the standard Xpert Alarm block, or by a custom routine that has hooked into the engine's alert and alarm interface (see Engine.RaiseAlert() and Engine.ChangeAlarm()).

4.1.4.1 CAlarmMgr ()

The constructor for the class automatically adds the instance to the Engine's Alarm Manager List.

```
CAlarmMgr();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.4.2 ~ CAlarmMgr()

The destructor for the class automatically removes the instance from the Engine's Alarm Manager List..

```
~CAlarmMgr();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.4.3 OnRaiseAlert()

This is a call back method which is called whenever CEngine::RaiseAlert() is called.

```
virtual void OnRaiseAlert(int ComPort);
```

Parameters

ComPort	-	The ComPort the alert should be sent out on, or 0 indicating all ports. This is the same parameter that was passed to CEngine::RaiseAlert().

Return Value

None

Header

Engine/Engine.h

4.1.4.4 OnClearAlert()

This is a call back method which is called whenever CEngine::ClearAlert() is called.

```
virtual void OnClearAlert(int ComPort);
```

Parameters

ComPort	-	The ComPort the alert should be cleared on, or 0 indicating all ports. This is the same parameter that was passed to CEngine::ClearAlert(). Clearing the Alert condition occurs when an Alert (or Alarm) message is acknowledged. Clearing it should prevent further Alert messages from ocurring until a new Alert is raised.

Return Value

None

Header

Engine/Engine.h

4.1.4.5 OnChangeAlarm()

This is a call back method which is called whenever CEngine::ChangeAlarm() is called.

```
virtual void OnChangeAlarm();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.4.6 OnEnableAlarm()

This is a call back method which is called whenever CEngine::EnableAlarm() is called.

```
virtual void OnEnableAlarm();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.4.7 OnDisableAlarm()

This is a call back method which is called whenever CEngine::DisableAlarm() is called.

```
virtual void OnDisableAlarm();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.4.8 GetStatus()

This is a call back method which is called whenever CEngine::GetAlarmStatus() is called.

```
virtual CString GetStatus();
```

Parameters

None

Return Value

A CR/LF delimited string representing the current state of the alarm manager and any status information that may be helpful to the user.

Header

Engine/Engine.h

4.1.4.9 OnEngineRun()

This is a call back method which is called whenever CEngine::Run() is called.

```
virtual void OnEngineRun();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.1.4.10 OnEngineStop()

This is a call back method which is called whenever CEngine::Stop() is called.

```
virtual void OnEngineStop();
```

Parameters

None

Return Value

None

Header

Engine/Engine.h

4.2 I/O Module API

The I/O Module API provided by the Xpert application framework is used to communicate with the I/O Modules connected to the Xpert via an I2C bus. The API consists of five different classes: IODevice, AnalogIO, DigitalIO, DisplayIO, and CIOMod. The IODevice is the parent of the

AnalogIO and DigitalIO classes, and so contains methods and data that are common to each. The AnalogIO, DigitalIO, and DisplayIO classes represent Analog I/O Modules, Digital I/O Modules, and I2C Display Modules, respectively. CIOMod “wraps” the AnalogIO, DigitalIO, and DisplayIO classes into a more generic class and introduces the concept of an event handler.

The developer typically accesses I/O Modules using a pointer of type AnalogIO or DigitalIO. The AppWizard creates these pointers automatically in places where module manipulation typically occurs (e.g., at the beginning of the TModule::Execute method). Of course, there may be other locations where module access is desired. The following examples demonstrate creating and initializing pointers to access existing modules:

```
DigitalIO* pDigIO = Engine.IOModList.GetDigitalIO(m_IOMOD);
AnalogIO* pAnalogIO = Engine.IOModList.GetAnalogIO(m_IOMOD);
CIOMod* pMod = Engine.IOModList.GetIOMod(DIGITAL, m_IOMOD);
```

4.2.1 IODevice

The IODevice class is the parent of the AnalogIO and DigitalIO classes. As such, it contains methods and data that are common to both Analog and Digital I/O Modules.

4.2.1.1 StartRequest()

This method is used to register the module’s need to start. The Engine starts all modules that have requested such when recording is started. Note: “starting” a module translates to configuring the module, commanding the module to run, and starting to listen for unsolicited events.

```
I2CCODE StartRequest();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The possible values for I2CCODE and their meanings are defined as follows (from Engine\i2cmgr.h):

I2C_OK	-	Success/no error.
I2C_NAK	-	Message received negative acknowledgment.
I2C_TIMEOUT	-	Timed-out waiting for response.
I2C_LOST ARBITRATION	-	Lost arbitration of the bus.
I2C_OVERFLOW	-	Unused.
I2C_BUSERROR	-	An error occurred on the I2C bus. Specifically, a misplaced start or stop condition was detected.
I2C_RXERROR	-	Error during receive. Specifically, receive did not contain start bit.
I2C_SLAVETX	-	Data was received in the slave transmit mode. Xpert only supports the master transmit mode.
I2C_CHECKSUM	-	Computed checksum did not match received checksum.
I2C_STOP	-	A premature stop was detected when more bytes were expected.
I2C_BUSBUSY	-	Could not access bus.

I2C_RESTART - Received start bit indicating arrival of a new message while reading in a message.
I2C_BAD_CHNL - The commanded channel is not valid.

Header

Engine\I2CDeviceClass.h

4.2.1.2 StopRequest()

This method is used to register a request to command the i/o module to stop (send it a stop command opcode). When the number of stop requests total the number of previous start requests, the stop is commanded.

```
I2CCODE StopRequest();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for StartRequest().

Header

Engine\I2CDeviceClass.h

4.2.1.3 AuxOnRequest()

This method requests that the “Aux” line (switched battery) be turned on. It is a “request” (as opposed to command) since the number of *on* requests versus the number of *off* requests (via AuxOffRequest) determines the state of the line. If more *on* requests than *off* requests have been received, the line will be switched on.

```
I2CCODE AuxOnRequest();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for StartRequest().

Header

Engine\I2CDeviceClass.h

4.2.1.4 AuxOffRequest()

This method requests that the “Aux” line (switched battery) be turned off. It is a “request” (as opposed to command) since the number of *on* requests (via AuxOnRequest) versus the number of

off requests determines the state of the line. If more *off* requests than *on* requests have been received, the line will be switched off.

```
I2CCODE AuxOffRequest();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for StartRequest().

Header

Engine\I2CDeviceClass.h

4.2.2 AnalogIO

The AnalogIO class contains methods and data specific to Analog I/O Modules. Many of the methods are measurement command methods that depend on the module having been previously configured using one or more of the configuration command methods. The configuration consists of nine (9) parameters including channel, gain, excitation parameters, etc. Not all measurement commands require that all configuration parameters be set. The tables below define which parameters are required by which measurement commands, and which functions are used to set parameters, respectively.

Meas. Command	**Configuration Parameter (see key for description)**								
	Ch	G	S/D	E	EV	ECh	EH	FN	WD
SingleVoltageReading	X	X	X	X	X	X	X	X	X
DoubleVoltageReading	X	X	X	X	X	X	X	X	X
SingleCurrentReading	X	X		X	X	X	X	X	X
SingleCurrent420maReading	X	X						X	X
SingleResistanceDCReading	X	X	X	X	X	X	X	X	X
SingleResistanceACReading	X	X	X	X	X	X	X	X	X
SingleThermistorReading	X	X	X	X	X	X	X	X	X
RMYoungReading									

Table 1: Analog Measure Config Requirements

Param	**Description**	**Default Value**	**Functions to Set Parameter**
Ch	- Measurement Channel	N/A	None. Provided by measurement command.
G	- Gain	1	SetConfigurationGain()
S/D	- Single or Differential	Single	SetConfigurationSingleEnded(), SetConfigurationDifferential()
E	- Excitation On/Off	OFF	SetExcitationVoltageOn(), SetExcitationVoltageOff()
EV	- Excitation Voltage	0	SetExcitationVoltage()
ECh	- Excitation Channel	0	SetExcitationChannel()
EH	- Excitation Hold	0	SetConfigurationExcitationHoldOn(), SetConfigurationExcitationHoldOff()
FN	- Filter Notch	60 hz	SetFilterNotch()
WD	- Warm-Up Delay	50 ms	SetWarmUpDelay()

Table 2: Config Parameters Defined

Measurements are typically made in TModule::Execute(). While there are several places the configuration could be commanded, the best place to do it is also in TModule::Execute(), just before the commands to take the measurement. This ensures that reconfigurations due to other module users do not interfere.

The following sections describe the methods provided by the AnalogIO class.

4.2.2.1 SingleVoltageReading()

This method is used to perform a voltage measurement on the indicated channel.

```
I2CCODE SingleVoltageReading(
      const CAnalogChannel& channel,
      double& voltage_measurement);
```

Parameters

channel	-	The channel on which to measure.
voltage_measurement	-	Reference to a double in which to store the measurement.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.2 DoubleVoltageReading()

This method is used to perform a double voltage measurement on the indicated channel.

```
I2CCODE DoubleVoltageReading(
      const CAnalogChannel& voltage_channel,
      double& voltage_measurement,
      double& excitation_measurement);
```

Parameters

voltage_channel	-	The channel on which to measure.
voltage_measurement	-	The voltage measured on the voltage channel.
excitation_measurement	-	The voltage measured on the excitation channel.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.3 SingleCurrentReading()

This method is used to perform a current measurement on the indicated channel.

```
I2CCODE SingleCurrentReading(
      const CAnalogChannel& channel,
      double& current_measurement);
```

Parameters

channel	-	The channel on which to measure.
current_ measurement	-	Reference to a double in which to store the measurement.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.4 SingleCurrent420maReading()

This method is used to perform a passive current measurement on the indicated channel.

```
I2CCODE SingleCurrent420maReading(
      const CAnalogChannel& channel,
      double& current_measurement);
```

Parameters

channel	-	The channel on which to measure.
current_ measurement	-	Reference to a double in which to store the measurement.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.5 SingleResistanceDCReading()

This method is used to perform a resistance measurement using DC excitation on the indicated channel.

```
I2CCODE SingleResistanceDCReading(
      const CAnalogChannel& channel,
      double& resistancedc_measurement);
```

Parameters

channel	-	The channel on which to measure.
resistancedc_ measurement	-	Reference to a double in which to store the measurement.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.6 SingleResistanceACReading()

This method is used to perform a resistance measurement using AC excitation on the indicated channel.

```
I2CCODE SingleResistanceACReading(
      const CAnalogChannel& channel,
      double& resistanceac_measurement);
```

Parameters

channel	-	The channel on which to measure.
resistanceac_ measurement	-	Reference to a double in which to store the measurement.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.7 SingleThermistorReading()

This method is used to perform a thermistor measurement on the indicated channel.

```
I2CCODE SingleThermistorReading(
      const CAnalogChannel& channel,
      double& thermistor_measurement);
```

Parameters

channel	-	The channel on which to measure.
thermistor_ measurement	-	Reference to a double in which to store the measurement.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.8 RMYoungReading()

This method is used to perform an RMYoung measurement.

```
I2CCODE RMYoungReading(
      UINT32& count,
      UINT32& time);
```

Parameters

count	-	The count result.
time	-	Time of the measured count.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.9 SetConfigurationGain()

This method is used to set the gain configuration component for the indicated channel.

```
void SetConfigurationGain(
      const CAnalogChannel& Channel,
      int Gain);
```

Parameters

Channel	-	The channel to configure.
Gain	-	The gain to set. Valid values are 1 and 16.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.10 SetConfigurationSingleEnded()

This method is used to set the S/D configuration component of the indicated channel to S (single ended).

```
void SetConfigurationSingleEnded(
      const CAnalogChannel& Channel);
```

Parameters

Channel	-	The channel to configure.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.11 SetConfigurationDifferential()

This method is used to set the S/D configuration component of the indicated channel to D (differential).

```
void SetConfigurationDifferential(
      const CAnalogChannel& Channel);
```

Parameters

Channel - The channel to configure.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.12 SetConfigurationExcitationHoldOn()

This method is used to set the excitation hold configuration component of the indicated channel to On.

```
I2CCODE SetConfigurationExcitationHoldOn(
      const CAnalogChannel& Channel);
```

Parameters

Channel - The channel to configure.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.13 SetConfigurationExcitationHoldOff()

This method is used to set the excitation hold configuration component of the indicated channel to Off.

```
I2CCODE SetConfigurationExcitationHoldOff(
      const CAnalogChannel& Channel);
```

Parameters

Channel - The channel to configure.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.14 SetExcitationChannel()

This method is used to set the excitation channel configuration component of the indicated measurement channel.

```
void SetExcitationChannel(
      const CAnalogChannel& Channel,
      const CAnalogChannel& ExcitationChannel);
```

Parameters

Channel - The measurement channel to configure.
ExcitationChannel - The channel to use as an excitation channel.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.15 SetExcitationVoltage()

This method is used to set the excitation voltage configuration component of the indicated measurement channel.

```
void SetExcitationVoltage(
      const CAnalogChannel& Channel,
      int Voltage);
```

Parameters

Channel - The measurement channel to configure.
Voltage - The desired excitation voltage. Valid range: -5 to +5.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.16 SetExcitationVoltageOn()

This method is used to set the excitation voltage On/Off configuration component of the indicated measurement channel to On.

```
void SetExcitationVoltageOn(
      const CAnalogChannel& Channel);
```

Parameters

Channel	-	The measurement channel to configure.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.17 SetExcitationVoltageOff()

This method is used to set the excitation voltage On/Off configuration component of the indicated measurement channel to Off.

```
void SetExcitationVoltageOff(
      const CAnalogChannel& Channel);
```

Parameters

Channel	-	The measurement channel to configure.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.18 SetFilterNotch()

This method is used to set the filter notch configuration component of the indicated channel. Note that whenever the notch is changed, the A/D module must be recalibrated. The Xpert takes care of this recalibration automatically, however, it may take 3-5 seconds for the recalibration to complete. For this reason, don't change the filter notch from the default value unless there is time for this recalibration or it is changed for all the sensors that will be measured.

```
void SetFilterNotch(
      const CAnalogChannel& Channel,
      UINT16 FilterNotch);
```

Parameters

Channel	-	The channel to configure.
FilterNotch	-	The desired filter notch in Hz. Valid range: 10 to 2000.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.19 SetWarmUpDelay()

This method is used to set the warm-up delay configuration component of the indicated channel.

```
void SetWarmUpDelay(
      const CAnalogChannel& Channel,
      int WarmUpDelay);
```

Parameters

Channel	-	The channel to configure.
WarmUpDelay	-	The desired warm-up delay in ms. Valid range: 0 to 0xffff.

Return Value

None.

Header

Engine/AnalogIO.h

4.2.2.20 SetPolyAdjust()

When calibrations are applied to voltage measurements that are close to 0, the result can be less accurate than the raw measurement. This method controls whether the calibration is applied.

```
I2CCODE SetPolyAdjust(
      const CAnalogChannel& Channel,
      BOOL poly_adjust);
```

Parameters

Channel	-	The channel to configure.
poly_adjust	-	Set to TRUE to cause the polynomial calibration to be applied. Set to FALSE to not apply the polynomial calibration.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.21 CmdSetAux1()

This method sets the digital output Aux1 to either high or low.

```
I2CCODE CmdSetAux1(
      bool High);
```

Parameters

High	-	Set to true to cause Aux1 to be set high. Set to false to cause Aux1 to be set low.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.22 CmdPulseOut()

This method causes the digital output Aux1 to pulse either high or low, for an indicated time period, and then revert back to its previous state.

```
I2CCODE CmdPulseOut(
      bool High,
      UINT16 PulseWidth_ms);
```

Parameters

High	-	Set to true to cause Aux1 to be pulsed high. Set to false to cause Aux1 to be pulsed low.
PulseWidth_ms	-	The width of the pulse in ms.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.23 ReadResistance()

This method configures the channel with the specified excitation data and performs a thermistor reading to measure resistance.

```
I2CCODE ReadResistance(
      const CAnalogChannel& Channel,
      const CAnalogChannel& nExcitationVoltage,
      double& ReadData);
```

Parameters

Channel	-	The channel on which to measure resistance.
nExcitationVoltage	-	The excitation channel.
ReadData	-	The resistance result.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.2.24 ReadFrequency()

This method is used to obtain a frequency measurement from an RMYoung sensor. The analog module has a single channel capable of measuring the output of an RMYoung type wind speed sensor. This type of sensor has a frequency less than 1000 hz and a low level output signal.

```
I2CCODE ReadFrequency(
      int Period,
      bool TakeTwoReadings,
      double& Data);
```

Parameters

Period	-	When taking two readings, this contains the time in milliseconds between the two readings. Ignored when TakeTwoReadings is false.
TakeTwoReadings	-	When true, instructs the method to make two readings with Period amount of time between them. When false, uses the last reading made during the last call to this method as the initial reading.
Data	-	The frequency result, in Hz.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/AnalogIO.h

4.2.3 DigitalIO

The DigitalIO class contains methods and data specific to Digital I/O Modules. The following sections describe the methods provided by this class.

4.2.3.1 ReadCount()

This method reads the count associated with the indicated channel.

```
I2CCODE ReadCount(
      const CDigitalChannel& Channel,
      UINT32& CountValue);
```

Parameters

Channel	-	The channel from which to read the count.
CountValue	-	The count result.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.2 ReadCountAndTime()

This method reads the count associated with the indicated channel, along with the time at which the count was detected. The time is not an absolute time but is relative within each I/O module. The time has units of 1/32768 seconds and can be used to compute frequency (delta counts / delta time).

```
I2CCODE ReadCountAndTime(
      const CDigitalChannel& Channel,
      UINT32& CountValue,
      UINT32& TimeValue);
```

Parameters

Channel	-	The channel from which to read the count.
CountValue	-	The count result.
TimeValue	-	The time result in units of 1/32768 seconds.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.3 ReadFilteredInputDataBits()

This method reads the input state of the indicated channel.

```
I2CCODE ReadFilteredInputDataBits(
      const CDigitalChannel& Channel,
      BOOL& Data);
```

Parameters

Channel	-	The channel to read.
Data	-	TRUE if the input is high. FALSE if the input is low.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.4 ReadAllFilteredInputDataBits()

This method reads the input state of all inputs and stores the result as a bitmap within an integer.

```
I2CCODE ReadAllFilteredInputDataBits(
      int& Data);
```

Parameters

Data	-	An integer representing the input state for all inputs. Test bits using bit mask operations to discover which inputs are high and which are low.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.5 SetSamplingSpeed()

This method is used to set the rate at which the input lines are sampled when the module is running. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
I2CCODE SetSamplingSpeed(
      double speed_ms);
```

Parameters

speed_ms	-	The rate in milliseconds at which the input lines should be sampled. Valid range: 0.489 to 1985.9.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.6 SetLineAsInput()

This method is used to set the indicated channel to an input. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
void SetLineAsInput(
      const CDigitalChannel& Channel);
```

Parameters

Channel	-	The channel to set as an input.

Return Value

None.

Header

Engine/DigIO.h

4.2.3.7 SetLineAsOutput()

This method is used to set the indicated channel to an output. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
void SetLineAsOutput(
      const CDigitalChannel& Channel);
```

Parameters

Channel	-	The channel to set as an output.

Return Value

None.

Header

Engine/DigIO.h

4.2.3.8 SetOutputData()

This method is used to set the indicated channel's output either high or low. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
void SetOutputData(
      const CDigitalChannel& Channel,
      bool Value);
```

Parameters

Channel	-	The channel to set.
Value	-	If true, the indicated channel will be set high following the next call to Configure().If false, the indicated channel will be set low following the next call to Configure().

Return Value

None.

Header

Engine/DigIO.h

4.2.3.9 InvertIO()

This method is used to command the module to invert the indicated channel's input. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL InvertIO(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel to invert.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.10 UnInvertIO()

This method is used to command the module to uninvert the indicated channel's input. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL UnInvertIO(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel to invert.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.11 SetAsShaftEncoder()

This method is used to set the indicated channel to act as a shaft encoder input. Always follow this command with a call to Configure() to actually send the new configuration to the module. The shaft encoder input is designed to measure sensors with a quadrature output. The quadrature output uses two channels. The I/O module can measure the quadrature output to track the measurement as it goes up and/or down.

```
void SetAsShaftEncoder(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel to act as a shaft encoder input.

Return Value

None.

Header

Engine/DigIO.h

4.2.3.12 SetAsCounter()

This method is used to set the indicated channel to act as a counter input. A counter input is designed for simple switch closure devices such as tipping buckets or frequency type devices such as wind sensors. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
void SetAsCounter(
      const CDigitalChannel& Channel);
```

Parameters

Channel	-	The channel to act as a counter input.

Return Value

None.

Header

Engine/DigIO.h

4.2.3.13 ConfigureFilters()

This method is used to set the value of the digital filter to the counter associated with the indicated channel. The filter is an up-down counter that counts between 0 and the specified threshold value. The counter will not count up if it is at its upper threshold, and it won't count down when its count is zero. The output of the of the filter only changes state when the counter reaches zero or its upper threshold. Thus, if the output state of the filter is a one, it will stay a one until the counter reaches zero. It will then remain zero until the counter counts up to its upper threshold.

Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL ConfigureFilters(
      const CDigitalChannel& Channel,
      int FilterValue);
```

Parameters

Channel	-	The channel to act as a counter input.
FilterValue	-	The new filter value for the indicated channel. Valid range: 1 to 255.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.14 SetSensitivityHigh()

This method is used to set the sensitivity of the indicated RMYoung channel to high. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL SetSensitivityHigh(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel on which to set sensitivity. Must be either 6 or 7.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.15 SetSensitivityLow()

This method is used to set the sensitivity of the indicated RMYoung channel to low. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL SetSensitivityLow(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel on which to set sensitivity. Must be either 6 or 7.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.16 AlarmOnSingleEdge()

This method is used to set the alarm associated with the indicated channel to count only a single edge (rising or falling depends on the inversion state). Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL AlarmOnSingleEdge(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel on which to set the alarm edge control.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.17 AlarmOnBothEdges()

This method is used to set the alarm associated with the indicated channel to count both edges of a signal edge. Always follow this command with a call to Configure() to actually send the new configuration to the module.

```
BOOL AlarmOnBothEdges(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel on which to set the alarm edge control.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.18 Configure()

This method is used to send the current configuration to the module.

```
I2CCODE Configure();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.19 SetPulseHigh()

This method is used to set the level of the pulse configuration to high so that a subsequent call to PulseOut will drive the output of the indicated channel high for the duration specified in PulseOut.

```
BOOL SetPulseHigh(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel on which to configure the pulse level.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.20 SetPulseLow()

This method is used to set the level of the pulse configuration to low so that a subsequent call to PulseOut will drive the output of the indicated channel low for the duration specified in PulseOut.

```
BOOL SetPulseLow(
      const CDigitalChannel& Channel);
```

Parameters

Channel - The channel on which to configure the pulse level.

Return Value

On success, TRUE is returned, otherwise, FALSE is returned.

Header

Engine/DigIO.h

4.2.3.21 PulseOut()

This method is used to drive the output according to the current pulse configuration level (as set by either SetPulseHigh or SetPulseLow) for the duration specified.

```
BOOL PulseOut(
      double time_ms);
```

Parameters

time_ms - The desired duration of the pulse in milliseconds.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.22 ReadInput()

This method reads and returns the state of the indicated channel.

```
I2CCODE ReadInput(
      const CDigitalChannel& Channel,
      bool Invert,
      bool& Data);
```

Parameters

Channel - The channel to read.
Invert - Flag to invert result. If true, the data read from the channel is inverted before returning. If false, no inversion is applied.
Data - The result of the read and inversion (if applicable).

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.3.23 ReadFrequency()

This method is used to obtain a frequency measurement from the indicated channel.

```
I2CCODE ReadFrequency(
      const CDigitalChannel& Channel,
      int Period,
      bool TakeTwoReadings,
      double& Data);
```

Parameters

Channel	-	The channel on which to measure frequency.
Period	-	When taking two readings, this contains the time in milliseconds between the two readings. Ignored when TakeTwoReadings is false.
TakeTwoReadings	-	When true, instructs the method to make two readings with Period amount of time between them. When false, uses the last reading made during the last call to this method as the initial reading.
Data	-	The frequency result.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DigIO.h

4.2.4 DisplayIO

The DisplayIO class contains methods and data specific to interacting with an I2C Display (not the GUI display!). The following is an example of how an attached I2C Display is manipulated programmatically:

```
DisplayIO::EditStatus Status;
DisplayIO* pDisp = Engine.IOModList.GetDisplayIO(1);
if (pDisp)
{
   OrigVal = NewVal = LastData.Data.AsDouble();
   Status = pDisp->EditFloat(NewVal, _T("Cur.Val"),true, -1000, 5000);
   if (Status == DisplayIO::EDIT_OK)
   {
      Offset = NewVal - OrigVal + Offset.AsDouble();
      Engine.AutoSaveSetup();
   }
}
```

The following sections describe the methods provided by this class.

4.2.4.1 WrStringToLCD()

This method writes a string on the I2C display.

```
I2CCODE WrStringToLCD(
      bool bClrB4Wr,
      BYTE byLineNum,
      BYTE byCurPosition,
      LPCTSTR szDispString,
      bool bCenter = true);
```

Parameters

bClrB4Wr	-	When “true”, the display will be cleared before the string is written. When false, the display is not cleared before the string is written.
byLineNum	-	The number of the line on which to write the string. Valid range: 1 – 2.
byCurPosition	-	The number of the column on which to write the string. Valid range: 0 – 19.
szDispString	-	the string to write to display.
bCenter	-	When “true”, the string written is centered on the display. When “false”, the string is written left justified. This parameter defaults to true.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.2 DisplayLines()

This method writes strings to both lines of the I2C display.

```
I2CCODE DisplayLines(
      LPCTSTR szLine1,
      LPCTSTR szLine2,
      bool bCenter = true);
```

Parameters

szLine1	-	The string to write to line 1 of the display.
szLine2	-	The string to write to line 2 of the display.
bCenter	-	When “true”, the strings are written centered on the display. When “false”, the strings are written left justified. This parameter defaults to true.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.3 ShowCursor()

This method shows the cursor at the position specified.

```
I2CCODE ShowCursor(
      BYTE LineNum,
      BYTE CurPosition);
```

Parameters

LineNum	-	The number of the line on which to display the cursor. Valid range: 1 – 2.
CurPosition	-	The number of the column on which to display the cursor. Valid range: 0 – 19.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.4 HideCursor()

This method hides the cursor.

```
I2CCODE HideCursor();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.5 StartBlinkingCursor()

This method blinks the cursor at the position specified.

```
I2CCODE StartBlinkingCursor(
      BYTE LineNum,
      BYTE CurPosition);
```

Parameters

LineNum	-	The number of the line on which to blink the cursor. Valid range: 1 – 2.
CurPosition	-	The number of the column on which to blink the cursor. Valid range: 0 – 19.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.6 StopBlinkingCursor()

This method stops the cursor from blinking.

```
I2CCODE StopBlinkingCursor();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.7 ClearDisplay()

This method clears the I2C display.

```
I2CCODE ClearDisplay();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/DisplayIO.h

4.2.4.8 DisplayOff()

This method turns the I2C display off.

```
I2CCODE DisplayOff();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.9 KeyPressed()

This method checks to see if a key press from the I2C display is waiting to be processed by a call to Read().

```
bool KeyPressed();
```

Parameters

None.

Return Value

If a key press is waiting, true is returned. Otherwise, false is returned.

Header

Engine/ DisplayIO.h

4.2.4.10 Read()

This method attempts to read a character from the I2C display. If a character is not immediately available, an efficient wait state is entered until either a character arrives, or the specified timeout expires. Note: if a tiemout occurs, ResetTimeout() must be called before a call to Read() will succeed.

```
bool Read(
      char& ch,
      long lTimeout);
```

Parameters

ch	-	A reference to the variable to contain the character read.
lTimeout	-	The number of milliseconds the routine should wait for a character.

Return Value

If a character is read, true is returned. Otherwise, false is returned.

Header

Engine/ DisplayIO.h

4.2.4.11 EditFloat()

This method manages the editing of a float via the I2C display.

```
EditStatus EditFloat(
      double& dVal,
      CString Label,
      bool bCheck = false,
      double dLowLim = 0.0,
      double dHiLim = 0.0);
```

Parameters

dVal	-	A reference to the double to edit.
Label	-	The text to display as a label, or prompt, as the double is being edited.
bCheck	-	When “true”, the editing routine checks the value entered by the user against hi and low limits. When “false”, the value entered by the user is not checked.
dLowLim	-	When bCheck is “true”, the editing routine requires the user to enter a value greater than or equal to this low limit. This parameter defaults to 0.0.
dHiLim	-	When bCheck is “true”, the editing routine requires the user to enter a value less than or equal to this high limit. This parameter defaults to 0.0.

Return Value

On success, EDIT_OK is returned. If the user cancels the editing process, EDIT_CANCEL is returned.

Header

Engine/ DisplayIO.h

4.2.4.12 EditHEX()

This method manages the editing of a string representing a hexidecimal number via the I2C display.

```
EditStatus EditHex(
      CString& szVal,
      CString Label);
```

Parameters

szVal	-	A reference to the CString containing the string to edit.
Label	-	The text to display as a label, or prompt, as the string is being edited.

Return Value

On success, EDIT_OK is returned. If the user cancels the editing process, EDIT_CANCEL is returned.

Header

Engine/ DisplayIO.h

4.2.4.13 EditInteger()

This method manages the editing of an integer via the I2C display.

```
EditStatus EditInteger(
      int& iVal,
      CString Label,
      bool bCheck = false,
      int iLowLim = 0,
      int iHiLim = 0);
```

Parameters

iVal	-	A reference to the integer to edit.
Label	-	The text to display as a label, or prompt, as the integer is being edited.
bCheck	-	When “true”, the editing routine checks the value entered by the user against hi and low limits. When “false”, the value entered by the user is not checked.
iLowLim	-	When bCheck is “true”, the editing routine requires the user to enter a value greater than or equal to this low limit. This parameter defaults to 0.
iHiLim	-	When bCheck is “true”, the editing routine requires the user to enter a value less than or equal to this high limit. This parameter defaults to 0.

Return Value

On success, EDIT_OK is returned. If the user cancels the editing process, EDIT_CANCEL is returned.

Header

Engine/ DisplayIO.h

4.2.4.14 EditString()

This method manages the editing of a string via the I2C display.

```
EditStatus EditString(
      CString& szVal,
      CString Label,
      bool bBypassOKCancel = false);
```

Parameters

szVal	-	A reference to the CString containing the string to edit.
Label	-	The text to display as a label, or prompt, as the string is being edited.
bBypassOKCancel	-	When “true”, the edit routine returns with the changed string as soon as the user cursors off the edit area. When “false”, the edit routine prompts for OK/Cancel as usual. This parameter defaults

to false.

Return Value

On success, EDIT_OK is returned. If the user cancels the editing process, EDIT_CANCEL is returned.

Header

Engine/ DisplayIO.h

4.2.4.15 EditTime()

This method manages the editing of a string representing time via the I2C display.

```
EditStatus EditString(
      CString& szStr,
      CString Label);
```

Parameters

szStr	-	A reference to the CString containing the string to edit.
Label	-	The text to display as a label, or prompt, as the string is being edited.

Return Value

On success, EDIT_OK is returned. If the user cancels the editing process, EDIT_CANCEL is returned.

Header

Engine/ DisplayIO.h

4.2.4.16 SetTimeout()

This method sets the default timeout value used by DisplayIO API methods when they call Read().

```
void SetTimeout(
      long lTimeout);
```

Parameters

lTimeout	-	The default timeout specified in milliseconds.

Return Value

None.

Header

Engine/ DisplayIO.h

4.2.4.17 ResetTimeout()

This method resets an internal state that tracks whether a timeout has occurred. Note: this method must be called following a timeout before a call to Read() will succeed.

```
bool Read(
      char& ch,
      long lTimeout);
```

Parameters

ch	-	A reference to the variable to contain the character read.
lTimeout	-	The number of milliseconds the routine should wait for a character.

Return Value

If a character is read, true is returned. Otherwise, false is returned.

Header

Engine/ DisplayIO.h

4.2.4.18 TimedOut()

This method returns the value of the internal timeout state.

```
bool TimedOut();
```

Parameters

None.

Return Value

If a character read has timed-out (i.e., the user did not respond within the timeout period) with no subsequent call to ResetTimeout(), then true is returned. Otherwise, false is returned.

Header

Engine/ DisplayIO.h

4.2.4.19 DisplayDisplayBlocks()

This method writes a series of strings to the I2C display containing the data as defined by the display setup blocks in the system setup.

```
I2CCODE DisplayDisplayBlocks(
      DispMode mode = MANUAL);
```

Parameters

mode	-	When MANUAL (1), the user scrolls the list forward and/or backward by pressing the display keys, and may also force a measurement. When “AUTO” (0), the list is scrolled automatically and a button press by the user will cancel the operation. This parameter defaults to MANUAL.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.20 DisplayStatus()

This method writes the system status to the I2C display. The system status has the format:

```
Station: <station name>
Status: <station status>
```

where *station status* is either “running” or “stopped”.

```
I2CCODE DisplayStatus();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.4.21 RunCalProcs()

This method executes the calibrate methods for each of the sensor modules attached to a display setup block in the system setup.

```
I2CCODE RunCalProcs();
```

Parameters

None.

Return Value

On success, I2C_OK is returned. The other possible values for I2CCODE and their meanings are defined in the entry for IODevice::StartRequest().

Header

Engine/ DisplayIO.h

4.2.5 CIOMod

The CIOMod class is a helper class to the AnalogIO and DigitalIO classes. Its purpose is to contain the methods and data that are common across I/O Modules.

4.2.5.1 GetAnalogPtr()

This method is used to retrieve an analog-compatible pointer to the current module.

```
AnalogIO* GetAnalogPtr();
```

Parameters

None.

Return Value

An analog-compatible pointer to the current I/O module is returned if the current module is actually of type analog. NULL is returned if the module is not of type analog.

Header

Engine/IOMod.h

4.2.5.2 GetDeviceType()

This method is used to retrieve the type of the current device.

```
CIODeviceType GetDeviceType();
```

Parameters

None.

Return Value

The type of the current module (either CIODeviceType::ANALOG or CIODeviceType::DIGITAL).

Header

Engine/IOMod.h

4.2.5.3 GetDigitalPtr()

This method is used to retrieve a digital-compatible pointer to the current module.

```
DigitalIO* GetDigitalPtr();
```

Parameters

None.

Return Value

A digital-compatible pointer to the current I/O module is returned if the current module is actually of type digital. NULL is returned if the module is not of type digital.

Header

Engine/IOMod.h

4.2.5.4 GetModuleNumber()

This method is used to retrieve the one-based id of the current module.

```
int GetModuleNumber();
```

Parameters

None.

Return Value

The one-based id of the current module.

Header

Engine/IOMod.h

4.2.5.5 GetSerialNo()

This method is used to retrieve the serial number of the current module.

```
int GetSerialNo();
```

Parameters

None.

Return Value

The serial number of the current module.

Header

Engine/IOMod.h

4.2.5.6 SetEventHandler()

This method adds an event handler to the list of event handlers maintained by the current module. The EventExec() method of the TModule registering the event handler should be overridden to perform the event handler function.

```
void SetEventHandler(I2CEVENTHANDLER& EventHandler);
```

Parameters

EventHandler - A data structure containing a reference to the TModule registering the event handler, and the associated module channel.

Return Value

None.

Header

Engine/IOMod.h

4.3 SDI API

The Xpert application framework exports a variable and four functions for use in communicating with SDI-aware devices. These functions and their use is described following:

4.3.1 szSDIAddrSet

This variable contains the set of possible SDI addresses as characters in a constant string. The Xpert AppWizard automatically generates code to use this character array when SDI is selected. The code generated stores the index into this array as a setup block property.

4.3.2 SendCmd()

This function sends a command string to the SDI bus and returns after the initial response from the sensor. It is intended for non-measurement commands and interactive user input.

```
SDIerror SendCmd(
      LPCTSTR szCmd,
      TCHAR* szReturn,
      DWORD dwBufferSize,
      DWORD* pdwReturn);
```

Parameters

szCmd	-	Fully formatted command string to send out the bus. This string should include the address (ex. “aM!”, where a is the address).
szReturn	-	The buffer in which to store the command response.
dwBufferSize	-	Maximum size in bytes of the return buffer.
pdwReturn	-	Pointer to a DWORD in which to store the size of the response.

Return Value

If the send and response retrieval is successful, then SDI_OK is returned. Otherwise, an indicator of the error type is returned. See the definition of the enum SDIerror in SDIclass.h for the possible return values and their meaning.

Header

SDI/SDIInterface.h

4.3.3 CollectData()

This function sends a command string to the SDI bus and waits for a data response. The function does not return until the data is received or a timeout occurs.

```
SDIerror CollectData(
      LPCTSTR szCmd,
      double* pdReturn,
      DWORD dwBufferSize,
      DWORD* pdwReturn,
      DWORD dwTimeout,
      BOOL NoWait);
```

Parameters

szCmd	-	Fully formatted command string to send out the bus. This string should include the address (ex. “aM!”, where a is the address).
pdReturn	-	The buffer in which to store the command response.
dwBufferSize	-	Maximum size in bytes of the return buffer.
pdwReturn		Pointer to a DWORD in which to store the size of the response.
dwTimeout	-	Maximum amount of time in milliseconds this function will wait before returning with an error code.
NoWait	-	If TRUE, the bus will be freed after the data request as if the command were concurrent (in order to support sensors that use the “M” command but still run concurrently).

Return Value

If the send and data retrieval is successful, then SDI_OK is returned. Otherwise, an indicator of the error type is returned. See the definition of the enum SDIerror in SDIclass.h for the possible return values and their meaning.

Header

SDI/SDIInterface.h

4.3.4 Abort()

This function causes an abort of any in-progress reading initiated by CollectData (which may be waiting for the SDI bus to become available).

```
void Abort();
```

Parameters

None.

Return Value

None. However, calling this function should cause the in-progress CollectData call to return ABORTED.

Header

SDI/SDIInterface.h

4.3.5 ClearAbort()

This function clears the aborted state caused by calling Abort so that additional SDI communication attempts can be made.

```
void ClearAbort();
```

Parameters

None.

Return Value

None.

Header

SDI/SDIInterface.h

4.4 Utilities API

The Utilities API consists of classes and objects used to perform utility type functions, including reporting, power management, user management, and others.

4.4.1 Report Management

The Report API displays messages passed to its various messaging methods on the status page. Messages are also output the Xpert terminal port. In addition, the Report API offers hooks allowing the developer to define callback functions called on the occurrence of message types the developer indicates when the callback is registered. The API is accessed through a global instance of the TReport class named “Report”.

4.4.1.1 Debug()

This method is used to submit a debug message to Report. Debug messages are those messages strictly meant to be used by a developer. If the current global filter includes messages of type TMsgLevel::msg_Debug, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes debug, will be called to process the message.

```
void Debug(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt - A string containing the format specification for the message. See the EVT 3.0 help topic “wvsprintf” for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.2 Warning()

This method is used to submit a warning message to Report. Warning messages are messages indicating that the software detected a potential problem or expected error but can recover gracefully. If the current global filter includes messages of type TMsgLevel::msg_Warning, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes warning, will be called to process the message.

```
void Warning(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt - A string containing the format specification for the message. See the EVT 3.0 help topic “wvsprintf” for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.3 Error()

This method is used to submit an error message to Report. Error messages are messages indicating that the software encountered a problem that was unexpected and could not be remedied. The error is not fatal to the operation of the system, however. If the current global filter includes messages of type TMsgLevel::msg_Error, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes error, will be called to process the message.

```
void Error(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt - A string containing the format specification for the message. See the EVT 3.0 help topic “wvsprintf” for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.4 Fatal()

This method is used to submit a fatal error message to Report. Fatal error messages are messages indicating that the software encountered a problem that was unexpected, could not be remedied, and is likely to be fatal to the system. If the current global filter includes messages of type TMsgLevel::msg_Fatal, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes fatal, will be called to process the message.

```
void Fatal(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt - A string containing the format specification for the message. See the EVT 3.0 help topic “wvsprintf” for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.5 Status()

This method is used to submit a status message to Report. Status messages are informational messages meant to aid the user in determining that the unit is actually doing something. If the current global filter includes messages of type TMsgLevel::msg_Status, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes status, will be called to process the message.

```
void Status(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt - A string containing the format specification for the message. See the EVT 3.0 help topic “wvsprintf” for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.6 Maintenance()

This method is used to submit a maintenance message to Report. Maintenance messages are messages meant to capture the details of a maintenance event performed on the system. If the current global filter includes messages of type TMsgLevel::msg_Maintenance, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes maintenance, will be called to process the message.

```
void Maintenance(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt - A string containing the format specification for the message. See the EVT 3.0 help topic “wvsprintf” for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.7 Note()

This method is used to submit a note message to Report. Note messages are messages meant to capture the details of user site visits. If the current global filter includes messages of type TMsgLevel::msg_Note, then the message will be displayed on the status page and output to the terminal port. Any functions that have been registered as message handlers via Hook(), and have a filter level that includes note, will be called to process the message.

```
void Note(
      LPCTSTR Fmt, ...);
```

Parameters

Fmt	-	A string containing the format specification for the message. See the EVT 3.0 help topic "wvsprintf" for a description of the content of the string and the variable arguments that may be passed.

Return Value

None.

Header

Utils/Report.h

4.4.1.8 SetFilter()

This method sets the filter level for the function defined by the MsgFunc parameter.

```
void SetFilter(
      TMsgFunc MsgFunc,
      int Level);
```

Parameters

MsgFunc	-	Address of function to which the filter level applies. The function must have been previously registered as a message hook via a call to TReport::Hook().
Level	-	The filter level to apply to the indicated function. The set of possible values is defined by the enum TReport::TMsgLevel in Report.h.

Return Value

None.

Header

Utils/Report.h

4.4.1.9 GetFilter()

This method returns the filter level of a specific hook or, if no message function is provided, the global filter level that determines which message types are processed.

```
int GetFilter();

int GetFilter(
      TMsgFunc MsgFunc);
```

Parameters

MsgFunc	-	The address of the function whose filter level should be returned. The function must have been previously registered as a message hook via a call to TReport::Hook().

Return Value

If a MsgFunc argument is provided, then the filter level associated with the hook function is returned. If MsgFunc is not provided, this method returns the global filter level that determines which message types are processed (output to the status page and to the terminal port).

Header

Utils/Report.h

4.4.1.10 Hook()

This method is used to register a function as a message handler, that is, a function Xpert calls on to handle messages generated through Report. By default, a message handler is registered to handle status, warning, and error messages (see the definition of the enum TMsgLevel for all possible message types). The SetFilter() method can be used to change the types of messages a handler is called-upon to process.

```
void Hook(
      TMsgFunc MsgFunc,
      LPVOID Info);
```

Parameters

MsgFunc	-	Address of the message handler. An example prototype of the handler follows: void MyHandler(LPVOID Info, int Level, LPCTSTR Msg)
Info	-	A pointer that will be passed to the handler whenever it is called upon to handle a message.

Return Value

If a MsgFunc argument is provided, then the filter level associated with the hook function is returned. If MsgFunc is not provided, this method returns the global filter level that determines which message types are processed (output to the status page and to the terminal port).

Header

Utils/Report.h

4.4.1.11 UnHook()

This method is used to stop a function from acting as a message handler. See the description of Hook() for more information on message handlers.

```
void UnHook(
      TMsgFunc MsgFunc);
```

Parameters

MsgFunc - Address of the message handler to unhook.

Return Value

None.

Header

Utils/Report.h

4.4.2 Power Management and Efficient Sleeping

The Xpert contains power management code designed to efficiently wait for events to occur, including timed events. This power management code is made available to SDK users through an object named “PowerMgr”.

The PowerMgr object’s purpose is to set the system’s power management state according to the needs of the system’s threads. Threads “notify” the PowerMgr of their needs by way of calls to the functions defined in this section.

When a thread needs to wait for time to pass, the thread should call PowerMgr.Sleep(). When a thread needs to wait for one or more events, the thread should call either PowerMgr.WaitForSingleObject() or PowerMgr.WaitForMultipleObjects(). The time that any of these functions actually wait is affected by the current PowerMgr “speed mode”. The “speed mode” is set by calling PowerMgr.SetSpeed(), and must be set correctly prior to any sleep or wait in order for the wait to last as long as the caller intended. See the section on SetSpeed for information on how to set this value correctly.

4.4.2.1 Sleep()

This method returns after the specified sleep period expires.

```
void Sleep(DWORD dwMilliseconds);
```

Parameters

dwMilliseconds - The number of milliseconds to sleep.

Return Value

None.

Header

Utils/Power.h

4.4.2.2 WaitForSingleObject()

This method wraps the standard Win32 API call to WaitForSingleObject. See the online help in Microsoft eMbedded Toolkit for more information.

```
DWORD WaitForSingleObject(
      HANDLE hHandle,
      DWORD dwMilliseconds);
```

Parameters

hHandle	-	Handle to the event on which to wait.
dwMilliseconds	-	The number of milliseconds to sleep waiting for the specified handle. May be INFINITE.

Return Value

An integer defining the result of the wait is returned. The valaue WAIT_TIMEOUT is returned when the wait times out. The value WAIT_OBJECT_0 is returned when the event is signaled.

Header

Utils/Power.h

4.4.2.3 WaitForMultipleObjects()

This method wraps the standard Win32 API call to WaitForMultipleObjects. See the online help in Microsoft eMbedded Toolkit for more information.

```
DWORD WaitForMultipleObjects(
      DWORD nCount,
      CONST HANDLE *lpHandles,
      BOOL bWaitAll,
      DWORD dwMilliseconds);
```

Parameters

nCount	-	The number of event handles on which to wait.
lpHandles	-	Array of event handles on which to wait.
bWaitAll	-	The wait type. This must be set to FALSE. The wait always ends when at least one event is satisfied.
dwMilliseconds	-	The number of milliseconds to sleep waiting for one of the specified handles. May be INFINITE.

Return Value

An integer defining the result of the wait is returned. The valaue WAIT_TIMEOUT is returned when the wait times out. The value WAIT_OBJECT_0 is returned when the first event of the array is signaled. The value WAIT_OBJECT_0 + 1 is returned when the second event of the array is signaled, and so on.

Header

Utils/Power.h

4.4.2.4 SetSpeed()

This method sets the current PowerMgr “speed” mode and returns its previous value.

In Minute mode, the processor enters Suspend when there is nothing to do, and the RTC checks every minute to see if the Suspend should end. In Second mode, the processor is again put into Suspend when there is nothing to do, but the the RTC checks every second to see if the Suspend should end. In Standby mode, the processor is put into Standby when there is nothing to do. In Fast mode, the processor is never put into any kind of power saving mode.

All threads automatically register a default desired power management mode with PowerMgr when they are created. This happens “behind the scenes” when the module the thread is in dynamically links to utils.dll. The default mode is Minute mode. In this mode, threads that sleep can do so accurately only to the minute. When a thread needs to sleep accurate to the second, the mode should be set to “second”. When a thread needs resolution in the milliseconds, the mode to choose is “standby”. When you absolutely don't care about power consumption, set the mode to “fast” and the system never tries to enter any kind of low power mode.

```
TMode SetSpeed(TMode Mode);
```

Parameters

Mode - The new speed mode of the system.

Return Value

The previous speed mode.

Header

Utils/Power.h

4.4.3 User Management

The Xpert maintains a list of users and associated data in a file named “flash disk\users.dat”. This data is manipulated programatically with the help of the classes CUsers and CUser. The class CUsers represents the entire user data set while individual instances of the class CUser are used to contain data specific to single users.

Associated with each user are a name, password, user group, and timeout interval. The user group defines the type of access the user has to the system. The possible values for user group are DATA_RETRIEVAL_MODE, INSTALLATION_MAINTENANCE_MODE, and SETUP_MODE. Each of these groups are associated with the similarly named buttons appearing on the Xpert login screen. When users are defined for a particular user group and the associated button is pressed at the login screen, a list of those users is presented for selection.

The timeout interval represents the number of minutes a user can be logged-in without activity before the system goes to sleep.

There are also 10 CUSTOM defined groups CUSTOM_GROUP1 to CUSTOM_GROUP10. Custom groups can be created by an SLL with the AddCustomGroup() function and the name of the group will become available to be assigned in the user group setup under the control panel. Both login and command processing can be customized by the Custom SLL. Each Custom SLL to

be loaded must have a unique group number. Also see the AddCustomCommandParser() function as well as the CSocketComm class for more information pertaining to creating custom groups.

4.4.3.1 CUsers

The purpose of this class is to provide a convenient mechanism for managing the data contained in the user data file. When an instance of this class is created, the user data file is opened and read. the file is rewritten when the instance is destroyed. The following methods are used to manage the set of users.

4.4.3.1.1 Add()

This method is used to add a user to the user data file.

```
bool Add(
      const CUser& user);

bool Add(
      const CString& strName,
      const CString& strPassword,
      TUserGroup ug,
      unsigned int nTimeout);
```

Parameters

user	-	An instance of CUser containing the user data to add to the data file.
strName	-	The name of the user. The characters used must be from the set available on the Xpert keypad dialog.
strPassword	-	The user's password. The characters used must be from the set available on the Xpert keypad dialog.
ug	-	The user's group. Must be one of DATA_RETRIEVAL_MODE (0), INSTALLATION_MAINTENANCE_MODE (1), or SETUP_MODE (2).
nTimeout	-	The user's timeout. Valid values: 0, 1, 5, 10, 30, and 60.

Return Value

When the parameters supplied are valid, the user is added and "true" is returned. If any of the parameters are not valid, then the user is not added and "false" is returned.

Header

Utils/Users.h

4.4.3.1.2 Remove()

This method is used to remove a user from the user data file.

```
bool Remove(
      const CString& strUser);
```

Parameters

strUser - The name of the user to remove from the set of users.

Return Value

If the user is found and removed, “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.3 GetUser()

This method is used to retrieve the user at a specified index, subject to filtering, if applied. For example, if *i* is set to 3 and no filter is currently applied, then the third user is returned in *u*. If *i* is set to 3 and a filter of data retrieval is applied, then the third user belonging to the data retrieval group is returned in *u*.

```
bool GetUser(
      CUser& u,
      int i);

bool GetUser(
      CUser& u,
      CString strUser);
```

Parameters

u - A reference to the instance of CUser in which to return the user data, if found.

i - The index of the user to retrieve, subject to filtering.

strUser - The name of the user to retrieve.

Return Value

If the specified user exists, “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.4 UpdateUser()

This method is used to update the data associated with a particular user. If the user with the specified name exists, it is updated with the data provided.

```
bool UpdateUser(
      const CString& strUser,
      const CString& strName,
      const CString& strPassword,
      TUserGroup ug,
      unsigned int nTimeout);
```

Parameters

strUser - The name of the user to update.

strName - The new name to assign to the user. The characters used must be

from the set available on the Xpert keypad dialog.

strPassword	-	The password to assign to the user. The characters used must be from the set available on the Xpert keypad dialog.
ug	-	The user group to assign to the user. Must be one of DATA_RETRIEVAL_MODE (0), INSTALLATION_MAINTENANCE_MODE (1), or SETUP_MODE (2).
nTimeout	-	The timeout to assign to the user. Valid values: 0, 1, 5, 10, 30, and 60.

Return Value

If the user with name strUser exists, “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.5 GetUserCount()

This method is used to retrieve the number of users currently defined.

```
int GetUserCount();
```

Parameters

None.

Return Value

Returns the number of users.

Header

Utils/Users.h

4.4.3.1.6 SetFilter()

This method is used to set the user group filter to be applied to subsequent calls to GetUser() and GetUserCount().

```
bool SetFilter(
      TUserGroup ug);
```

Parameters

ug	-	The user group to use as a filter.

Return Value

If the user group is valid, “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.7 RemoveFilter()

This method is used to remove the user group filter so that subsequent calls to GetUser() and GetUserCount() operate from the entire user set.

```
void RemoveFilter();
```

Parameters

None.

Return Value

None.

Header

Utils/Users.h

4.4.3.1.8 IsValidUserName()

This method is used to test the validity of the user name provided. A user name is “valid” when it is not empty and all of its characters are selectable from the Xpert keypad dialog.

```
bool IsValidUserName(
      const CString& str);
```

Parameters

str - The user name to validate.

Return Value

If the string is not empty and all of its characters are selectable from the Xpert keypad dialog, then “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.9 IsValidPassword()

This method is used to determine if a given string can be used as a password. A string can be used as a password when all of its characters are selectable from the Xpert keypad dialog.

```
bool IsValidPassword(
      const CString& str);
```

Parameters

Str - The string to evaluate.

Return Value

If all characters in string are selectable from the Xpert keypad dialog, then “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.10 IsValidUserGroup()

This method is used to determine if the integer provided represents a valid user group.

```
bool IsValidUserGroup(
      int ug);
```

Parameters

ug - The integer to evaluate.

Return Value

If the integer represents a valid user group, then “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.1.11 Commit()

This method is used to commit the set of users in memory to the user data file.

```
bool Commit();
```

Parameters

None.

Return Value

If the set of users is successfully saved to the user data file, then “true” is returned. Otherwise, “false” is returned.

Header

Utils/Users.h

4.4.3.2 CUser

The purpose of this class is to provide a container for the data associated with single users. The following methods are used to operate on instances of this class.

4.4.3.2.1 GetName()

This method is used to retrieve the name of this user.

```
CString GetName();
```

Parameters

None.

Return Value

Returns the name assigned to this user.

Header

Utils/Users.h

4.4.3.2.2 GetPassword()

This method is used to retrieve the password of this user.

```
CString GetPassword();
```

Parameters

None.

Return Value

Returns the password assigned to this user.

Header

Utils/Users.h

4.4.3.2.3 GetUserGroup()

This method is used to retrieve the user group of this user.

```
TUserGroup GetUserGroup();
```

Parameters

None.

Return Value

Returns the user group assigned to this user, which is an enumeration with the following values: DATA_RETRIEVAL_MODE, INSTALLATION_MAINTENANCE_MODE, SETUP_MODE.

Header

Utils/Users.h

4.4.3.2.4 GetTimeoutInterval()

This method is used to retrieve the timeout interval of this user.

```
unsigned int GetTimeoutInterval();
```

Parameters

None.

Return Value

Returns the timeout interval in minutes assigned to this user. Typical values: 0, 1, 5, 10, 30, and 60.

Header

Utils/Users.h

4.4.3.3 AddCustomGroup()

This method is used to retrieve the timeout interval of this user.

```
bool AddCustomGroup(
   TUserGroup Group,
   LPCTSTR Description,
   LPFNCUSTOMLOGIN LoginFunct);
```

Parameters

Group	-	A custom group to define. CUSTOM_GROUP1 to CUSTOM_GROUP10.
Description	-	Name that will appear in the User control panel setup screen.
LoginFunct	-	A function that will be called whenever a user logs in under a username belonging to the specified custom group. This only applies for logins via the serial port, and not via the LCD display. A custom login function might output a report to the user using the CSocketComm class API, or it might install a setup a list of custom commands to enhance Remote's builtin functionality. A custom login function looks like this: `bool CustomLoginFunction(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName)` The CustomLoginFunction should return 'false' if it has completely handled the user interaction and Remote should hangup. If instead 'true' is returned, Remote will continue on from the login stage to the command prompt. The login function should complete its work in under 1 minute to avoid a timeout from occuring. If the function requires more then 1 minute, it should spawn a thread to perform the necessary work, and return 'true' immediately.

Return Value

Returns true if the group wasn't already defined.

Header

Utils/Users.h

4.4.3.4 AddCustomCommandParser()

This method is used to identify a function to be called whenever the user issues a custom command to Remote's command prompt.

```
bool AddCustomCommandParser(
   TUserGroup Group,
   LPFNCUSTOMCOMMANDPARSER CommandParser);
```

Typically a custom comand parser will open the serial port using the CSocketComm class, parse the custom command, and output a message.

A custom command parser function looks like this:

```
bool CustomCommandParser(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName,
LPCTSTR Command)
```

The CustomCommandParser should return ‘true’ if it has completely processed the command and Remote should emit a new command prompt. If instead ‘false’ is returned then Remote performs no additional output, but does wait for a new command.

The parser should complete it’s work in under 1 minute to avoid a timeout from occuring. If the parser requires more then 1 minute, it should spawn a thread to perform the necessary work, and return immediately.

Parameters

Group	-	A custom group to define. CUSTOM_GROUP1 to CUSTOM_GROUP10.
CommandParser	-	A function which will be called whenever the user enters a custom command in to Remote’s command prompt.

Return Value

Returns true if the group wasn’t already defined.

Header

Utils/Users.h

4.4.4 Serial Communications

The Xpert SDK provides a serial communications API via the class “CSerialComm.” This class wraps standard WIN32 serial API functions to simplify the task of communicating over Xpert’s serial ports.

4.4.4.1 CSerialComm()

This is the default constructor for the class. The default settings are as follows: COM1, 115200 baud, 8 bits per byte, no parity, one stop bit, and hardware flow control.

```
CSerialComm();
```

Parameters

None.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.2 CSerialComm()

This is an optional constructor for the class allowing the port to be passed in.

```
CSerialComm(const TCHAR* CommPort);
```

Parameters

CommPort	-	A string identifying the port to use, e.g., “COM1:”, “COM2:”, etc. Note the use of the colon. Xpert currently supports COM1 through COM5.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.3 OpenComm()

Tries to open the com port. This method must be called before sending or receiving data over the port.

```
bool OpenComm();
```

Parameters

None.

Return Value

Returns true if the port could be opened.

Header

Utils/SerialCommClass.h

4.4.4.4 CloseComm()

Closes the com port. This is performed automatically by the destructor.

```
bool CloseComm();
```

Parameters

None.

Return Value

Returns true if the port was closed, or false if it wasn’t open to begin with.

Header

Utils/SerialCommClass.h

4.4.4.5 IsOpen()

Tests whether the port is currently opened.

```
bool IsOpen();
```

Parameters

None.

Return Value

Returns true if the port is open.

Header

Utils/SerialCommClass.h

4.4.4.6 SetConfiguration()

Sets port configuration parameters.

```
void SetConfiguration(
   DWORD BaudRate,
   BYTE ByteSize,
   BYTE Parity,
   BYTE StopBits,
   BOOL FlowCtrl);
```

Parameters

BaudRate	-	Specifies the baud rate at which the communication device operates. It can be set to an actual baud rate value, or to one of the following constants: CBR_110, CBR_300, CBR_600, CBR_1200, CBR_2400, CBR_4800, CBR_9600, CBR_14400, CBR_19200, CBR_38400, CBR_56000, CBR_57600, CBR_115200, CBR_128000, or CBR_256000.
ByteSize	-	Specifies the number of bits in the bytes transmitted and received. Typically 7, 8, or 9.
Parity	-	Specifies the parity scheme to be used. Set to one of the following constant values: EVENPARITY, MARKPARITY, NOPARITY, ODDPARITY, or SPACEPARITY.
StopBits	-	Specifies the number of stop bits to be used. Set to one of the following constant values: ONESTOPBIT, ONE5STOPBITS, or TWOSTOPBITS.
FlowCtrl	-	Specifies whether to use hardware flow control.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.7 SetCommPort()

Sets the CommPort to opened by OpenComm().

```
void SetCommPort(const TCHAR* CommPort);
```

Parameters

CommPort - A string identifying the port to use, e.g., “COM1:”, “COM2:”, etc. Note the use of the colon.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.8 SetBaudRate()

Sets the baud rate of the port.

```
void SetBaudRate(const DWORD BaudRate);
```

Parameters

BaudRate - Specifies the baud rate at which the communication device operates. It can be set to an actual baud rate value, or to one of the following constants: CBR_110, CBR_300, CBR_600, CBR_1200, CBR_2400, CBR_4800, CBR_9600, CBR_14400, CBR_19200, CBR_38400, CBR_56000, CBR_57600, CBR_115200, CBR_128000, or CBR_256000.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.9 SetTimeouts()

Sets the timeout values for reading and writing the port.

```
void SetTimeouts(COMMTIMEOUTS& CommTimeouts);
```

Parameters

CommTimeouts - This structure is defined in the Win32 API. See the EVT 3.0 help topic “COMMTIMEOUTS” for a description of the content and purpose of this structure.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.10 Input Functions

The following functions all read input from the com port allowing various data types to be read.

```
bool GetChar(char * ch);

bool GetChar(UCHAR * uch);

bool GetChar(TCHAR * wch);

int  GetStr(UCHAR * Str, int StrLen);

int  GetStr(char *  Str, int StrLen);

int  GetStr(TCHAR * Str, int StrLen);

int Get(void* Buffer, int BufferLen);
```

Parameters

ch, uch, wch	-	A single character of data.
Str	-	A string of data.
StrLen	-	Number of characters to request.
Buffer	-	A raw binary buffer.
BufferLen	-	Number of raw bytes to request.

Return Value

Character functions return *true* if the operation succeeded. String functions return the number of characters processed.

Header

Utils/SerialCommClass.h

4.4.4.11 Output Functions

The following functions all output data to the com port allowing various data types to be sent. The "AndWait()" method does not return until after all data has been sent.

```
bool Put(void* Buffer, int BufferLen);

bool PutChar(const char  ch);

bool PutChar(const UCHAR uch);

bool PutChar(const TCHAR wch);

bool PutStr(const char * Str);

bool PutStr(const char * Str, int StrLen);

bool PutStr(const UCHAR * Str);

bool PutStr(const UCHAR * Str, int StrLen);

bool PutStr(TCHAR * Str);

bool PutStr(TCHAR * Str, int StrLen);
```

```
bool PutStr(CString Str);

bool PutAndWait(void* Buffer, int BufferLen);
```

Parameters

ch, uch, wch	-	A single character of data.
Str	-	A string of data.
StrLen	-	Number of characters to send
Buffer	-	A raw binary buffer
BufferLen	-	Number of raw bytes to send

Return Value

True if the operation succeeded.

Header

Utils/SerialCommClass.h

4.4.4.12 NumberBytesInputBuffer()

Returns the number of bytes in the input buffer.

```
int NumberBytesInputBuffer();
```

Parameters

None.

Return Value

Number of bytes in the input buffer.

Header

Utils/SerialCommClass.h

4.4.4.13 KeyPressed()

Returns true if there is at least one byte in the input buffer.

```
bool KeyPressed();
```

Parameters

None.

Return Value

True/false.

Header

Utils/SerialCommClass.h

4.4.4.14 FlushInput ()

Removes all bytes in the input buffer.

```
void FlushInput();
```

Parameters

None.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.15 GetHandle()

Retrieves the internal HANDLE used for performing Win32 API-level communications.

```
HANDLE GetHandle();
```

Parameters

None.

Return Value

Handle of the comm port.

Header

Utils/SerialCommClass.h

4.4.4.16 WaitOnRx()

Waits for data to be received. Note that this function clears the input buffer before waiting.

```
void WaitOnRx();
```

Parameters

None.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.4.17 WaitForTxEmpty ()

Waits for the serial port to finish sending data.

```
void WaitForTxEmpty();
```

Parameters

None.

Return Value

None.

Header

Utils/SerialCommClass.h

4.4.5 Remote Communications

The Xpert has an API which allows communication with any of the communication ports managed by the Remote program called SocketCommClass. The API uses Socket communication to send I/O operations over to Remote.exe, which then carries out the requests. Ports can be completely taken over from Remote, or a user SLL can work with Remote to enhance the standard services.

Most of the functions in the API will fail if the connection with the remote socket is closed. One simple way this can occur is if the Remote.exe application is terminated by the user.

Here's a list of some of the things that can be done with the API:

- Monitor any COM port controlled by Remote.
- Take over full or partial control of any COM port controlled by Remote.
- Add new command line options in conjunction with functions in Users.dll
- Add custom login screens, again in conjunction with functions in Users.dll

Each port behaves differently depending on how the port was configured on Remote's command line during startup.

Port Type	**Description**
COM:	Standard interactive direct connect port for connecting an Xpert to a notebook or desktop computer. Supports login, command line, and SSP. SSP is automatically detected and processed. May also be used to connect to a smart radio or smart modem that for looks like a direct connect and transparently manages connection.
SSP:	Used to interface an Xpert directly to another Xpert or to a base station. Supports only SSP communication. May also be used to connect to a smart radio or smart modem that looks like a direct connect and transparently manages connection.
RADIO:	Used to interface the Xpert to a "dumb" half-duplex multi-drop UHF/VHF radio. Supports only SSP communication. Uses CSMA to prevent collisions.
MODEM:	Used to interface the Xpert to Hayes compatible telephone modem. No provisions are made for power-saving. The modem is expected to be pre-configured such that CD is raised when

	someone dials in, and so that toggling DTR causes a hangup.
VOICE:	Used to interface to the Sutron Voice modem. This modem has special circuitry that will raise CD and DSR when the phone rings allowing the Xpert to raise DTR to fully power up the modem circuitry. However because the modem is always fully powered down between calls, the only settings it ever remembers are the ones programmed in to it's non-volatile memory.
RS:	Used to interface two Xperts together over a multi-drop RS-485 connection. Supports only SSP communication.

Here are some tables that explain the differences between how the various RS-232 control lines are managed:

Port	**Effect of DTR**
COM:	Raised on Connect (DSR or RX Data), Dropped on logout.
SSP:	when transmitting, Dropped after.
RADIO:	Raised when transmitting, followed by a 1sec carrier delay, dropped
MODEM:	Raised normally to allow the modem to operate. Toggled to force a hangup.
VOICE:	Raised to power on the Sutron Speech Modem. Dropped to hangup, or power it down.
RS:	Normally raised to allow RS485 reception, lowered when transmitting.

Port	**Effect of RTS**
COM:	H/W handshaking
SSP:	H/W handshaking
RADIO:	Raised to key the radio transmitter, followed by a 1sec carrier delay, then dropped. (Same as DTR)
MODEM:	H/W handshaking
VOICE:	H/W handshaking
RS:	Raised to perform an RS485 transmission, lowered afterwards.

Port	**Effect of DSR**
COM:	May be used to wake-up Remote and start a session. Drop it to end the session. Simply simply sending data can also be used start a session.

SSP:	May be used to wake-up Remote and start a session. Drop it to end the session. Simply simply sending data can also be used start a session.
RADIO:	Not used.
MODEM:	Not used.
VOICE:	Not used.
RS:	Not used.

Port	**Effect of CD (RLSD)**
COM:	Not used.
SSP:	Not used.
RADIO:	Goes high when a message is being received. A message will not be transmitted while CD is high (this is called CSMA). The Xpert is capable of receiving a message even if CD is low, but it won't be able to prevent collisions on transmit.
MODEM:	Going high indicates the beginning of a session, going low indicates the end.
VOICE:	Going high indicates the beginning of a session, going low indicates the end.
RS:	Not used.

Port	**Effect of CTS**
COM:	H/W handshaking
SSP:	H/W handshaking
RADIO:	Not used.
MODEM:	H/W handshaking
VOICE:	H/W handshaking
RS:	Not used.

4.4.5.1 Remote SSP Operations

These functions may be called directly to perform SSP operations on the selected COM port. Remote manages the lower levels of the protocol directly and the user need only supply the necessary data structures.

4.4.5.1.1 RemoteRequest()

Send SSP data and wait for an approprate response. Can be used on a port that has been opened using CSocketComm Class and locked using CSocketComm::LockComm(), but be sure to call CSocketComm::SetComOptions() to enable the flags: ENABLESSP and ENABLESSPPARSER or otherwise reply messages won't be processed. This situation occurs when custom code is needed to create a connection before SSP messaging can occur.

```
int RemoteRequest(int PortIndex, CString Send_To, CString Send_From, DWORD
Send_SeqNum, TSSPData& Send_Data, int Count, OPMATCH Match[], CString&
Reply_To, CString& Reply_From, DWORD& Reply_SeqNum, TSSPData& Reply_Data, int
Retries, int AckDelay);
```

Parameters

PortIndex	-	Port number to send the message out. 1 for COM1, 2 for COM2, 3 for COM3, etc. The port selected must be a port controlled by Remote.exe
Send_To	-	SSP Unit ID to send the message to. "*" may be selected to indicate that all stations receive the message.
Send_From	-	SSP Unit ID that the message is from. Typically Engine.StationName is used here.
Send_SeqNum	-	Every SSP Message has a sequence number used to identify duplicate messages (retranmissions). Normally GetFlagSeq() is called to create a correct and varying sequence number.
Send_Data	-	An SSP Data packet containing one or more opcodes and associated data. See the SSP Technical Reference for more information about the data format of various SSP opcodes.
Count	-	The number of elements in the Match array (see following).
Match	-	An array of opcodes to expect in response to the message. Each element in the array contains a sequence number to match (typically 0 to match any sequence) and opcode to match (for instance an OpAck or OpNak is often sent in reply to a message), and a piece of the data may be matched as well. If the data match value is 0, then the field is ignored. The opcode being acked is typically the "data" in an ack or nak message so this is typically passed in the data match field as follows: Ex. OPMATCH Matches[2] = {OPMATCH(0, OpAck, OpAlarm), OPMATCH(0, OpNak, OpAlarm)} Only replies that match an item in this array will be returned, others will be processed in the default manner by Remote.
Reply_To	-	The address the reply message was sent to, which should match the Send_From field.
Reply_From	-	The source of the reply message, which will normally match the Send_To field (when a message is sent to "*" the Reply_From field will have the unit ID of the station which responded).
Reply_SeqNum	-	The sequence number of the reply message.
Reply_Data	-	The SSP message itself that was sent in reply.
Retries	-	Number of times to retry sending the message if a response

isn’t received.

AckDelay - How long remote should wait for a response before attempting a retry (ms).

Return Value

-3 could not contact remote

-2 remote could not perform the operation

-1 timeout waiting for a response

0-(Count-1) index of matching message received

Header

Engine/RemoteOps.h

4.4.5.1.2 RemoteSend()

Send SSP data and waits for it to to go out.

```
bool RemoteSend(int PortIndex, CString Send_To, CString Send_From, DWORD
Send_SeqNum, TSSPData& Send_Data, int SendDelay);
```

Parameters

PortIndex - Port number to send the message out. 1 for COM1, 2 for COM2, 3 for COM3, etc. The port selected must be a port controlled by Remote.exe.

Send_To - SSP Unit ID to send the message to. “*” may be selected to indicate that all stations receive the message.

Send_From - SSP Unit ID that the message is from. Typically Engine.StationName is used here.

Send_SeqNum - Every SSP Message has a sequence number used to identify duplicate messages (retranmissions). Normally GetFlagSeq() is called to create a correct and varying sequence number.

Send_Data - An SSP Data packet containing one or more opcodes and associated data. See the SSP Technical Reference for more information about the data format of various SSP opcodes.

SendDelay - How long to wait for Remote to send the message in (ms). The time it takes to compete sending a message depends on the baud rate, the message length, and how busy the port is with sending or receiving other messages.

Return Value

True if Remote was able to send the message.

Header

Engine/RemoteOps.h

4.4.5.1.3 RemoteWaitMessage()

Waits for an SSP Message to be received. Can be used on a port that has been opened using CSocketComm Class and locked using CSocketComm::LockComm(), but be sure to call CSocketComm::SetComOptions() to enable the flags: ENABLESSP and ENABLESSPPARSER or otherwise reply messages won't be processed. This situation occurs when custom code is needed to create a connection before SSP messaging can occur.

```
int RemoteWaitMessage(int PortIndex, CString Wait_To, CString Wait_From, int
Count, OPMATCH Match[], CString& Reply_To, CString& Reply_From, DWORD&
Reply_SeqNum, TSSPData& Reply_Data, int Reply_Delay);
```

Parameters

PortIndex	-	Port number to send the message out. 1 for COM1, 2 for COM2, 3 for COM3, etc. The port selected must be a port controlled by Remote.exe.
Wait_To	-	SSP Unit ID of a station to wait for a message address to. Use "*" to select a message addressed to any station.
Wait_From	-	SSP Unit ID of a station to wait for a message from. Use "*".
Count	-	The number of elements in the Match array (see following).
Match	-	An array of opcodes used to filter out and select a specific message to return. Each element in the array contains a sequence number to match (typically 0 to match any sequence) and opcode to match (for instance an OpAck or OpNak is often sent in reply to a message), and a piece of the data may be matched as well. If the data match value is 0, then the field is ignored. The opcode being acked is typically the "data" in an ack or nak message so this is typically passed in the data match field as follows: Ex. OPMATCH Matches[2] = {OPMATCH(0, CurDataReq, 0), OPMATCH(0, OpAlarm, 0)} Only messages that match an item in this array will be returned, others will be processed in the default manner by Remote. OpEOT may be specified (ex. OPMATCH(0, OpEOT, 0)) to specify that any message is acceptable.
Reply_To	-	The address the received message was sent to, which should match the Send_From field.
Reply_From	-	The source of the received message, which will normally match the Send_To field (when a message is sent to "*" the Reply_From field will have the unit ID of the station which responded).
Reply_SeqNum	-	The sequence number of the message received.

Reply_Data - The SSP message itself that was received.

Reply_Delay - How long remote should wait for a message before returnin with a timeout error (ms).

Return Value

-3 could not contact remote

-2 remote could not perform the operation

-1 timeout waiting for a response

0-(Count-1) index of matching message received

Header

Engine/RemoteOps.h

4.4.5.2 CSocketComm Class

Create an instance of this class if you wish to take over or monitor a serial port controlled by Remote.

4.4.5.2.1 CSocketComm()

This is the default constructor for the class.

```
CSocketComm();
```

Parameters

None.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.2 CSocketComm()

This is an optional constructor for the class allowing the port to be passed in.

```
CSocketComm(const TCHAR* CommPort);
```

Parameters

CommPort - The port to access. The Xpert currently supports COM1:, COM2:, COM3:, COM4: and COM5:.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.3 OpenComm()

Tries to open the com port, if successful automatic capture of incoming data will be enabled, but Remote will still be in control of the port.

```
bool OpenComm();
```

Parameters

None.

Return Value

Returns true if the port could be opened.

Header

Utils/SocketCommClass.h

4.4.5.2.4 CloseComm()

Closes the com port, terminating the socket session with Remote if it was still open. This is performed automatically by the destructor.

```
bool CloseComm();
```

Parameters

None.

Return Value

Returns true if the port was closed, or false if it wasn't open to begin with.

Header

Utils/SocketCommClass.h

4.4.5.2.5 IsOpen()

Tests whether the port is currently opened.

```
bool IsOpen();
```

Parameters

None.

Return Value

Returns true if the port is open.

Header

Utils/SocketCommClass.h

4.4.5.2.6 SetConfiguration()

Sets port configuration parameters. (FUTURE USE)

```
void SetConfiguration(DWORD BaudRate, BYTE ByteSize, BYTE Parity, BYTE
StopBits, BOOL FlowCtrl);
```

Parameters

BaudRate ByteSize Parity StopBits FlowCtrl	-	All parameters are currently ignored, the port settings are determined by Remote. The default is 115200,n,8,1 with h/w flow control.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.7 SetCommPort()

Sets the CommPort to opened by OpenComm().

```
void SetCommPort(const TCHAR* CommPort);
```

Parameters

CommPort	-	The port to use.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.8 SetBaudRate()

Sets the baud rate of the port. (FOR FUTURE USE)

```
void SetBaudRate(const DWORD BaudRate);
```

Parameters

BaudRate	-	The rate to use. Default is 115200.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.9 SetTimeouts() and SetCommTimeouts()

Sets the timeout values for reading and writing the port. SetCommTimeouts is the same as SetTimeouts and exists for easier porting of Win32 code.

```
void SetTimeouts(COMMTIMEOUTS& CommTimeouts);

BOOL SetCommTimeouts(LPCOMMTIMEOUTS lpCommTimeouts);
```

Parameters

CommTimeouts	-	This structure is defined in the Win32 API. Its use is not an exact match for Socket communications, but it's close. The main difference is that socket communication is done by sending blocks of data at a time, and not single bytes. Additionally, since all communication with the port is indirect via Remote, additional time should be allowed for data to be sent or received.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.10 INPUT FUNCTIONS

The following functions all read input from the remote com port allowing various data types to ber read.

```
bool GetChar(char  * ch);

bool GetChar(UCHAR * uch);

bool GetChar(TCHAR * wch);

int  GetStr(UCHAR * Str, int StrLen);

int  GetStr(char *  Str, int StrLen);

int  GetStr(TCHAR * Str, int StrLen);

int Get(void* Buffer, int BufferLen);

bool Read(TSSPPacket& Packet, DWORD Timeout);
```

Parameters

ch, uch, wch	-	A single character of data.
Str	-	A string of data.
StrLen	-	Number of characters to request
Buffer	-	A raw binary buffer
BufferLen	-	Number of raw bytes to request
Packet	-	An SSP Packet

Timeout - Timeout value in milli-seconds

Return Value

True if the operation succeeded.

Header

Utils/SocketCommClass.h

4.4.5.2.11 OUTPUT FUNCTIONS

The following functions all output data to the remote com port allowing various data types to be sent. The “AndWait()” methods do not return until after Remote has sent all the bytes, and they have left the UART fifos.

```
bool Put(void* Buffer, int BufferLen);

bool PutChar(const char  ch);

bool PutChar(const UCHAR uch);

bool PutChar(const TCHAR wch);

bool PutStr(const char * Str) {return PutStr((UCHAR*)Str);};

bool PutStr(const char * Str, int StrLen) {return PutStr((UCHAR*)Str,
StrLen);};

bool PutStrAndWait(const char * Str);

bool PutStrAndWait(const char * Str, int StrLen);

bool PutStr(const UCHAR * Str) {return (PutStr(Str, strlen((char*)Str)));};

bool PutStr(const UCHAR * Str, int StrLen);

bool PutStr(TCHAR * Str);

bool PutStr(TCHAR * Str, int StrLen);

bool PutStr(CString Str);

bool PutAndWait(void* Buffer, int BufferLen);

bool PutStrAndWait(const UCHAR * Str);

bool PutStrAndWait(const UCHAR * Str, int StrLen);

bool PutStrAndWait(TCHAR * Str);

bool PutStrAndWait(TCHAR * Str, int StrLen);

bool PutStrAndWait(CString Str);

bool Write(LPVOID lpBuffer, DWORD nNumberOfBytesToRead);
```

```
bool WriteAndWait(LPVOID lpBuffer, DWORD nNumberOfBytesToWrite);

bool Write(TSSPPacket& Packet);

bool WriteAndWait(TSSPPacket& Packet);
```

Parameters

ch, uch, wch	-	A single character of data.
Str	-	A string of data.
StrLen	-	Number of characters to send
Buffer	-	A raw binary buffer
BufferLen	-	Number of raw bytes to send
lpBuffer	-	A raw binary buffer
nNumberOfBytesToWrite	-	Number of raw bytes to send.
Packet	-	An SSP Packet

Return Value

True if the operation succeeded.

Header

Utils/SocketCommClass.h

4.4.5.2.12 WIN32 COMM COMPATIBILITY FUNCTIONS

The following functions all are socket equivalents of the Win32 Comm functions. Basically the Win32 parameters are packetized, sent over to Remote, executed directly on the Com port, and any result is passed back. WaitCommEvent() and Read() are slightly different then their Win32 counterparts in that they support a timeout value (millseconds).

```
void EscapeCommFunction(DWORD Func);

bool GetCommModemStatus(LPDWORD lpModemStat);

BOOL SetCommMask(DWORD dwEvtMask);

BOOL WaitCommEvent(LPDWORD lpEvtMask, DWORD Timeout = INFINITE);

BOOL GetCommMask(LPDWORD lpEvtMask);

BOOL GetCommState(LPDCB lpDCB);

BOOL SetCommState(LPDCB lpDCB);

BOOL GetCommTimeouts(LPCOMMTIMEOUTS lpCommTimeouts);

bool Read(LPVOID lpBuffer, DWORD nNumberOfBytesToRead, LPDWORD
lpNumberOfBytesRead, DWORD Timeout);
```

Parameters

See Win32 Documentation.

Return Value

See Win32 Documentation.

Header

Utils/SocketCommClass.h

4.4.5.2.13 NumberBytesInputBuffer()

Returns the number of bytes available to be read. Capture must be enabled.

```
int  NumberBytesInputBuffer();
```

Parameters

None.

Return Value

Number of bytes.

Header

Utils/SocketCommClass.h

4.4.5.2.14 KeyPressed()

Returns true if there is at least one byte available to be read. Capture must be enabled.

```
bool KeyPressed();
```

Parameters

None.

Return Value

True/false.

Header

Utils/SocketCommClass.h

4.4.5.2.15 FlushInput ()

Removes all bytes in the receiver buffer.

```
void FlushInput();
```

Parameters

None.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.16 GetClient ()

Retrieves the internal SocketClient class used for performing the socket level communications.

```
TSocketClient& GetClient();
```

Parameters

None.

Return Value

A reference to the Client object used for socket communications with remote.

Header

Utils/SocketCommClass.h

4.4.5.2.17 WaitOnRx()

Waits for incoming data to arrive.

```
void WaitOnRx();
```

Parameters

None.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.18 WaitForTxEmpty ()

Waits for the remote serial port to finish sending data.

```
void WaitForTxEmpty ();
```

Parameters

None.

Return Value

None.

Header

Utils/SocketCommClass.h

4.4.5.2.19 SetCapture()

Enables/disables capturing of incoming serial data and state information.

```
bool SetCapture(bool State);
```

Parameters

State - True to enable capture

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.20 LockComm()

Attempts to gain exclusive access to the serial port.If successful, Remote hands over operation of the port. If at anytime the connection is broken or an inactivity timeout occurs, remote will break the connection and take back control. SSP processing and parsing is by disabled by default when a port is locked. They can be enabled using SetComOptions(), this is necessary if RemoteRequest(), RemoteWaitMessage(), or RemoteSend() are to be used.

```
bool LockComm(DWORD Timeout);
```

Parameters

Timeout - How long to wait for access (ms)

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.21 UnLockComm()

Returns control of the port back to Remote. If NoHangup is false (the default), then remote will hangup and terminate the conversation, otherwise if the connection is still live, Remote will activate it's command line and SSP functions. For instance, to perform voice AND data answering of the telephone, the Coms application first takes full control of the port with the LockComm() function. If the phone rings, it answers in voice mode. But if the user is actually dialing in over a modem, it switches to answering in data mode, then releases the port back to Remote with UnLockComm(true).

```
bool UnLockComm(bool NoHangup=false);
```

Parameters

NoHangup - Normally false causing Remote to hangup and terminate an active

conversation.

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.22 Logout()

Instructs remote to Logout a user (go back to the login prompt), and optionally hangup on the user.

```
bool Logout(bool NoHangup=false);
```

Parameters

NoHangup - Normally false causing Remote to hangup and terminate an active conversation.

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.23 SetHost()

By default OpenComm() will open a session with the copy of Remote.exe running on the local machine (ie localhost), if networking is available SetHost() can be used to connect to a copy of Remote running somewhere else on the internet or network. Call SetHost() before calling OpenComm().

```
void SetHost(LPCTSTR NewHost);
```

Parameters

NewHost - A URL or IP address in string form, the default is _T("localhost")

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.24 GetPortList ()

Retrieves the list of ports that Remote is managing.

```
bool GetPortList(TSSPData& Reply);
```

Parameters

Reply - An SSP Data packet containing the port list information. The port

list itself contains a port and a description string such as:

COM1:<0>MODEM1:115200<0>COM3:<0>RADIO3:1200<0>

// It's parsed as follows:

```
TSSPData Reply;
if (Port.GetPortList(Reply))
{
TprotoOpcode Opcode;
int Len;
Reply.Read(Opcode, Len);
for (;;)
{
   CString ComStr;
   CString DescStr;
   Reply.Read(ComStr);
   if (ComStr.IsEmpty())
      break;
   Reply.Read(DescStr);
   // Process the ComStr and DescStr here

    };
}
else
   // an error occurred, we must be connected to the
server.
```

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.25 GetComOptions()

Retrieves a number of bit mapped status flag pertaining to the com port.

```
bool GetComOptions(int& Options);
```

Parameters

Options - IGNORECD: Remote was waked via Rx data, and hence the state of CD or DTR is ignored for determining whether the connection is still live.

LOGGINGIN: A user is logging in.

LOGGEDIN: A user has completed log in.

ISMODEM: A modem connection.

ISRADIO: A radio connection.

ISDIRECT: A direct connection.

ISVOICE: A Sutron voice modem.

DEBUGCOMMANDS: Debug commands enabled.

QUICKPROTOCOL: SSP Quick Protocol is enabled.

DIALIN: A user has dialed in via a modem.

SSPLOGIN: True when an SSP login occurred (xterm).

ENABLECOMMANDPROMPT: Command prompt is enabled.

ENABLESSP: SSP Packet handling is enabled. SSP Packets are automatically detected and passed on in their entirety.

ENABLECOMMANDPARSER: Command parsing is enabled.

ISSSPONLY: An SSP: port

ISRS485: An RS: port for hooking up two Xperts via RS-485

ENABLESSPPARSER: The SSP Command Parser is enabled. The SSP Command Parser processes various default SSP commands.

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.26 SetComOptions ()

SetComOptions can be used to change the state of Remote.

```
bool SetComOptions (int Options, int Mask);
```

Parameters

Options	-	A bit map of options to set or clear. Most of the Options are status oriented. See GetComOptions for a list. The options to disable the command parser can be usefull, and also a command prompt is automatically output to the user when the comand prompt is enabled.
Mask	-	A bit mask to determine which fields in the options should be set and which ones should be ignored.

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.27 SetExtendedCommands ()

This command is used by a command line enhancement application which wishes to handled additional commands. It is used in conjunction with the AddCustomCommandParser() and AddCustomGroup() functions in Users.h. It specifies the list of commands which the command line enhancer wishes to support.

```
bool SetExtendedCommands(CString CommandList);
```

Parameters

CommandList - A list of commands with commas before and after each one.

For instance, _T(“,test,xpert,get,”) would cause the commands test, xpert, or get to be passed along to a custom command parser.

All commands may be interecepted by specifying _T(“*”) for the CommandList.

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.5.2.28 RunCommand ()

Causes Remote to execute a command as if a user had typed it in to the command line.

```
bool RunCommand (CString CommandLine);
```

Parameters

CommandLine - The command to execute. For instance the command _T(“dir”) will cause remote to display a file list to the user.

Return Value

Result of the operation.

Header

Utils/SocketCommClass.h

4.4.6 TResourceKey

When Sutron Link Libraries load resources, they must first indicate from where the resource is to come. This is typically accomplished by creating an instance of TResourceKey, providing the library’s handle as a parameter, as in the following example:

```
void CSDI::ShowProperties(CWnd* pParent)
{
   TResourceKey key(DefLibSLL);
   CSDIDlg dlg(pParent);
   dlg.m_iAddressIdx = m_propAddressIdx;
```

```
      dlg.m_strCommand = m_propCommand;
      if (dlg.DoModal() == IDOK)
      {
         m_propAddressIdx = dlg.m_iAddressIdx;
         m_propCommand = dlg.m_strCommand;
      }
   }
```

In the example, the definition of “key” actually translates to a call to the MFC function AfxSetResourceHandle() to set the current resource handle to that of the library. When “key” is destroyed on return from the function, another call to AfxSetResourceHandle() occurs to set the resource handle back to its original value. This ensures that any resources used in the context of this function will be loaded from the correct library. If the current resource handle is not set properly, then the wrong resource may be loaded.

The code that is automatically generated by the AppWizard adds TResourceKey definitions to those functions where resource loads are known to occur.

TResourceKey is defined in Utils/ResourceKey.h.

4.4.7 Exported Utils Functions

This section contains descriptions of the functions exported from the Utils library.

4.4.7.1 StrToTime()

This function converts a string representing time to an actual CTime.

```
CTime StrToTime(const CString& string);
```

Parameters

string - String having the format “MM/DD/YYYY HH:MM:SS”.

Return Value

A CTime value containing the time indicated by the string.

Header

Utils/Time.h

4.4.7.2 StrToTimeSpan()

This function converts a string representing a time-span to an actual CTimeSpan.

```
CTimeSpan StrToTimeSpan(const CString& string);
```

Parameters

string - String having the format “HH:MM:SS:MS” (MS, or milliseconds, are optional).

Return Value

A CTimeSpan value containing the time-span indicated by the string.

Header

Utils/Time.h

4.5 Setup API

It is often necessary to save and restore data to and from the setup file. Setup blocks have their properties (member data of type TProperty) stored and restored automatically whenever the setup is saved or read, respectively. However, any SLL may “hook” into the setup save and read process by defining and exporting specific functions that use a reference to an instance of CXMLSetup to save and read setup data. The following sections describe the application exports and methods of CXMLSetup required to support setup reading and writing.

4.5.1 Application Exports

The SLL application code must define and export the following four functions in order for Xpert to support the SLLs save and read of setup data:

```
bool InitSetup();
bool ReadSetup(CXMLSetup& XMLSetup);
bool WriteSetup(CXMLSetup& XMLSetup);
LPCTSTR GetSetupTag();
```

Descriptions of how each of these functions should be implemented follow.

4.5.1.1 InitSetup()

Implement this function to initialize setup data to a default state. The Xpert application framework calls this function when the user selects *Setup File::New* from the control panel on the Setup page.

```
extern "C" bool _declspec(dllexport) InitSetup();
```

Parameters

None -

Return Value

Return “true” to indicate a successful init, false otherwise.

Example

```
extern "C" bool _declspec(dllexport) InitSetup()
{
   // Set common settings to defaults.
   m_iPort = COM2;
   m_strSatID = _T("00000000");
   m_bInitSatlink = true;

   // Set self-timed and random settings to defaults.
   m_SelfTimedMsgr.InitSetup();
   m_RandomMsgr.InitSetup();

   return true;
}
```

4.5.1.2 ReadSetup()

Implement this function to read the setup data using the XML object provided. The Xpert application framework calls this function when the setup tag defined by the GetSetupTag() function is encountered while reading the setup file. It is this function's responsibility to read in all of the data it "owns" and to stop when the last value of owned data has been read (i.e., reading past owned data will likely crash the system).

```
extern "C" bool _declspec(dllexport) ReadSetup(CXMLSetup& XMLSetup);
```

Parameters

XMLSetup	-	Provides access to the contents of the setup file. See the section on CXMLSetup for a description of the methods of this object.

Return Value

Return "true" to indicate a successful read, false otherwise.

Example

```
extern "C" bool _declspec(dllexport) ReadSetup(CXMLSetup& XMLSetup)
{
   CXMLToken XMLToken;
   XMLSetup.ReadNextToken(XMLToken);
   while (XMLToken.nType == CXMLToken::START_TAG)
   {
      CString strTag = XMLToken.GetText();
      if (!strTag.Compare(_T("Common")))
         ReadCommonSetup(XMLSetup);
      else if (!strTag.Compare(_T("SelfTimed")))
         m_SelfTimedMsgr.ReadSetup(XMLSetup);
      else if (!strTag.Compare(_T("Random")))
         m_RandomMsgr.ReadSetup(XMLSetup);
      else
      {
         // Unknown tag entry. Eat and discard all entries for this tag.
         XMLSetup.ReadNextToken(XMLToken);
         while (XMLToken.nType == CXMLToken::ATTR_NAME)
         {
            CString strName = XMLToken.GetText();
            XMLSetup.ReadNextToken(XMLToken);
            CString str;
            str.Format(_T("Eating unknown token: %s."), strName);
            Report.Warning(str);
            XMLSetup.ReadNextToken(XMLToken);
         }
      }
      XMLSetup.ReadNextToken(XMLToken);
   }
   return true;
}

bool ReadCommonSetup(CXMLSetup& XMLSetup)
{
   CXMLToken XMLToken;
```

```
   // Read and validate common config.
   XMLSetup.ReadNextToken(XMLToken);
   while (XMLToken.nType == CXMLToken::ATTR_NAME)
   {
      CString strName = XMLToken.GetText();
      XMLSetup.ReadNextToken(XMLToken);
      if (!strName.Compare(_T("Port")))
         m_iPort = _ttoi(XMLToken.GetText());
      else if (!strName.Compare(_T("SatID")))
         m_strSatID = XMLToken.GetText();
      else if (!strName.Compare(_T("InitSatlink")))
         m_bInitSatlink = _ttoi(XMLToken.GetText()) ? true : false;
      else
      {
         CString str;
         str.Format(_T("Eating unknown token: %s."), strName);
         Report.Warning(str);
      }
      XMLSetup.ReadNextToken(XMLToken);
   }
   return true;
}
```

The above expects a “Satlink” section having the following format. The partitioning into subsections (Common, SelfTimed, and Random in the example) is required by the Xpert XML parser. The SelfTimed and Random sections are handled by routines not shown here. NOTE: Spaces are not allowed in token names (e.g., “SatID” is acceptable as a token name, “Sat ID” is not).

```
   <Satlink>
         Common
               Port = "0"
               SatID = "00000000"
               InitSatlink = "1"
         />
         <SelfTimed
               . . .
         />
         <Random
               . . .
         />
   </Satlink>
```

4.5.1.3 WriteSetup()

Implement this function to store the desired setup data using the XML object provided.

```
extern "C" bool _declspec(dllexport) WriteSetup(CXMLSetup& XMLSetup);
```

Parameters

XMLSetup	-	Provides access to the contents of the setup file. See the section on CXMLSetup for a description of the methods of this object.

Return Value

Return “true” to indicate a successful save, false otherwise.

Example

```
extern "C" bool _declspec(dllexport) WriteSetup(CXMLSetup& XMLSetup)
{
   CString str;

   // Open outermost Satlink entry.
   XMLSetup.WriteStartTag(_T("<Satlink>"));

   // Write common config
   XMLSetup.WriteStartTag(_T("<Common"));
   str.Format(_T("Port = \"%d\""), m_iPort);
   XMLSetup.WriteText(str);
   str.Format(_T("SatID = \"%s\""), m_strSatID);
   XMLSetup.WriteText(str);
   str.Format(_T("InitSatlink = \"%d\""), m_bInitSatlink);
   XMLSetup.WriteText(str);
   XMLSetup.WriteEndTag(_T("/>"));

   // Write self-timed and random configs.
   m_SelfTimedMsgr.WriteSetup(XMLSetup);
   m_RandomMsgr.WriteSetup(XMLSetup);

   // Close outermost Satlink entry.
   XMLSetup.WriteEndTag(_T("</Satlink>"));

   ValidateSetup();
   return true;
}
```

The above results in a “Satlink” section having the following format. The partitioning into subsections (Common, SelfTimed, and Random in the example) is required by the Xpert XML parser. The SelfTimed and Random sections are handled by routines not shown here. NOTE: Spaces are not allowed in token names (e.g., “SatID” is acceptable as a token name, “Sat ID” is not).

```
   <Satlink>
         <Common
               Port = "0"
               SatID = "00000000"
               InitSatlink = "1"
         />
         <SelfTimed
               . . .
         />
         <Random
               . . .
         />
   </Satlink>
```

4.5.1.4 GetSetupTag ()

Implement this function to return a pointer to a string to be used as the name of the section within the setup file that belongs to the SLL.

```
extern "C" LPCTSTR _declspec(dllexport) GetSetupTag();
```

Parameters

None.

Return Value

Pointer to a string containing the setup tag.

Example

```
extern "C" LPCTSTR _declspec(dllexport) GetSetupTag()
{
   return _T("Satlink");
}
```

4.5.2 CXMLSetup Methods

The exports defined by the SLL application code to support setup reading and writing use an instance of CXMLSetup to access the setup file. Descriptions of the required CXMLSetup methods follow.

4.5.2.1 WriteStartTag()

This method writes a section opening tag to the setup file and tracks the tag depth.

```
int CXMLSetup::WriteStartTag(
      LPTSTR lpszText);
```

Parameters

lpszText - Pointer to a string containing the start tag text.

Return Value

Integer containing the tag depth.

Header

Engine/XMLSetup.h

4.5.2.2 WriteEndTag()

This method writes a section closing tag to the setup file and tracks the tag depth.

```
int CXMLSetup::WriteEndTag(
      LPTSTR lpszText);
```

Parameters

lpszText - Pointer to a string containing the end tag text.

Return Value

Integer containing the tag depth.

Header

Engine/XMLSetup.h

4.5.2.3 WriteText()

This method writes the provided text to the setup file subject to the current tag depth.

```
void CXMLSetup::WriteText(
      LPTSTR lpszText);
```

Parameters

lpszText - Pointer to a string containing the text to write.

Return Value

None.

Header

Engine/XMLSetup.h

4.6 Log API

The system dll, “LogMgr.dll”, maintains the system’s list of available logs. This list is an instance of the class CLogList, named LogList, which is exported for use by other libraries. The list contains objects of type CLogDesc, which is a class used to encapsulate a single log.

Typically, a developer needs to programatically iterate through the list of available logs. The following is an example of how to do this:

```
POSITION pos = LogList.GetHeadPosition();
while (pos != NULL)
{
   CLogDesc*  pLog = LogList.GetNext(pos);
   // Use pLog here...
}
```

Here is an example of retrieving a log by name:

```
CLogDesc*  pLog = LogList.GetByName(_T("\\Flash Disk\\system.log"));
// Use pLog here...
```

4.6.1.1 CLogDesc

Instances of this class represent individual logs in the system. To read data from a log you use the LOG and LOGCURSOR classes documented in the next section. You can access to lower-level LOG class via the log member variable. For instance, you could retrieve the number of lines in the log file from the example above with the following code:

```
UINT32 LineCount = pLog->log.GetLineCount();
```

See LOG and LOGCURSOR for more information.

4.6.1.1.1 CLogDesc()

This is the class constructor.

```
CLogDesc(
      TCHAR* lpszName,
```

```
        int Size,
        bool Wrap,
        bool IgnoreBadData);
```

Parameters

lpszName	-	Full path of the log file (e.g., _T("\\Flash Disk\\new.log")
Size	-	The size of the log file in bytes.
Wrap	-	Flag indicating whether the log should “wrap” its data, that is, overwrite old data with new when the log fills up.
IgnoreBadData	-	Flag indicating whether the quality of data logged is relevant (e.g., when “true”, quality of logged data is not shown on View Log page).

Return Value

None.

Header

LogMgr/LogDesc.h

4.6.1.1.2 Create()

This method creates the log file.

```
bool Create();
```

Parameters

None.

Return Value

If the log file is successfully created, “true” is returned. Otherwise, “false” is returned.

Header

LogMgr/LogDesc.h

4.6.1.1.3 Open()

This method attempts to open the log file. If the log file does not exist, it is not created.

```
bool Open();
```

Parameters

None.

Return Value

If the log file is successfully opened, “true” is returned. Otherwise, “false” is returned.

Header

LogMgr/LogDesc.h

4.6.1.1.4 GetName()

This method returns the name of the log file.

```
LPTSTR GetName();
```

Parameters

None.

Return Value

A pointer to the internal buffer containing name of the log file.

Header

LogMgr/LogDesc.h

4.6.1.1.5 SetName()

This method sets the name of the log file.

```
void SetName(
      LPCTSTR lpszName);
```

Parameters

lpszName - Full path of the log file (e.g., _T("\\Flash Disk\\new.log")

Return Value

None.

Header

LogMgr/LogDesc.h

4.6.1.1.6 GetSize()

This method returns the size of the log file in bytes.

```
int GetSize();
```

Parameters

None.

Return Value

The size of the log file in bytes.

Header

LogMgr/LogDesc.h

4.6.1.1.7 IsWrap()

This method returns the wrap log attribute (a flag indicating whether new data overwrites old data once a log has been filled).

```
bool IsWrap();
```

Parameters

None.

Return Value

The value of the wrap attribute is returned. When “true”, new data overwrites old data once the log has been filled. When “false”, writes of new data fail once a log has been filled.

Header

LogMgr/LogDesc.h

4.6.1.1.8 IsIgnoreBadData()

This method returns the ignore-bad-data log attribute (a flag indicating whether the quality assigned to data is relevant).

```
bool IsIgnoreBadData();
```

Parameters

None.

Return Value

The value of the ignore-bad-data attribute is returned. When “true”, the quality of a log is not displayed in View Log.

Header

LogMgr/LogDesc.h

4.6.1.1.9 InUse()

This method returns an indication as to whether the log is in use by the current setup, where “in use” means a log-type setup block with this log as its selection exists in the setup. When logs are in use, their attributes cannot be manipulated, nor can they be deleted.

```
bool InUse();
```

Parameters

None.

Return Value

When the log is in use by the setup, “true” is returned. Otherwise, “false” is returned.

Header

LogMgr/LogDesc.h

4.6.1.1.10 AppendSensor()

This method adds sensor data to the log.

```
BOOL AppendSensor(
      CString Sensor,
      CSensorData& data);
```

Parameters

Sensor	-	The name of the sensor being logged.
data	-	The data to log. See Engine/Module.h for the definition of the CSensorData class.

Return Value

None.

Header

LogMgr/LogDesc.h

4.6.1.1.11 AppendNote()

This method adds a note (a text string) to the log.

```
BOOL AppendNote(
      LPCTSTR szNote);
```

Parameters

szNote	-	The note to log.

Return Value

None.

Header

LogMgr/LogDesc.h

4.6.1.2 LOG class

This is the lower level representation of a log file. The functionality not typically performed by the ClogDesc class is documented here.

4.6.1.2.1 GetLineCount()

Retrieves the number of lines in the log file.

```
UINT32 GetLineCount();
```

Parameters

None.

Return Value

The number of lines in the log file.

Header

Logger/Logger.h

4.6.1.2.2 Changed()

Is used to detect whether a change has been made to a log file..

```
bool Changed(UINT32& Counter);
```

Parameters

Counter - The Log keeps track of how many changes occur with a counter. If the Log's internal count differs from the count passed in, then Changed() returns true, and the new count is stored in Counter. Counter is typically a class variable and not a local variable. It can be initialized by calling Changed() and ignoring the result.

Return Value

True if the log has changed since the last time Changed() was called with the specified Counter variable.

Header

Logger/Logger.h

4.6.1.2.3 Flush()

Saves any unsaved log data out to disk.

```
void Flush(bool Force=true);
```

Parameters

Force - Data is normally saved based on a timer. If Force is false, then new data will not actually be written out to disk unless the timer has expired (the default is once per minute). Setting Force to true causes data to be written out imediately.

Return Value

None.

Header

Logger/Logger.h

4.6.1.3 LOGCURSOR class

The LOGCURSOR class is used to navigate and read data from a log file. It's primary function is to try to maintain a specific location in the log file even though new lines may be added and old ones deleted. Because data may be deleted dynamically, an absolute line number in the log has little meaning. For instance, the information at line 500 will not be the same after 50 lines are deleted. So typically a LOGCURSOR is used to navigate in a relative sense, such as moving forwards and backwards from a certain location. A log cursor also buffers a block of data from the log, capturing the state of a section of the log at a specific time. So even if the current line is rolled out of the log and deleted, the cursor will not become corrupt. The cursor resyncs with the log at various times

(rebuffering data as needed) such as whenever the cursor is moved to a new location, or the Sync() method is called.

4.6.1.3.1 LOGCURSOR()

Is used to construct a log cursor.

```
LOGCURSOR(LOG& log);
```

Parameters

log - A reference to the log to be navigated.

Return Value

None.

Header

Logger/Logger.h

4.6.1.3.2 ~LOGCURSOR()

Destroys a log cursor.

```
~LOGCURSOR();
```

Parameters

None.

Return Value

None.

Header

Logger/Logger.h

4.6.1.3.3 GotoBottom ()

Move to the most recent data in the log.

```
bool GotoBottom();
```

Parameters

None.

Return Value

Returns false if there is a fatal error in the log and can’t find the first line.

Header

Logger/Logger.h

4.6.1.3.4 GotoTop()

Moves to the oldest data in the log.

```
bool GotoTop();
```

Parameters

None.

Return Value

Returns false if there is a fatal error in the log and can't find the last line.

Header

Logger/Logger.h

4.6.1.3.5 MoveTo ()

Moves to a line in the log.

```
bool MoveTo(int AbsLine);
```

Parameters

AbsLine - An absolute line number between 0 and GetLineCount()-1

Return Value

Returns false if a move before the beginning of the log or after the end of the log occurs.

Header

Logger/Logger.h

4.6.1.3.6 MoveBy()

Move a relative number of lines in the log.

```
bool MoveBy(int RelLine);
```

Parameters

RelLine - Number of lines to move forward in time (positive values) or backwards in time (negative values) in the log.

Return Value

Returns false if a move before the beginning of the log or after the end of the log occurs.

Header

Logger/Logger.h

4.6.1.3.7 MoveNext ()

Moves to the next line in the log, skipping any bad.

```
bool MoveNext;
```

Parameters

None.

Return Value

False when a move after the bottom of the log is attempted.

Header

Logger/Logger.h

4.6.1.3.8 MovePrev ()

Moves to the previous line in the log, skipping any bad blocks.

```
bool MovePrev();
```

Parameters

None.

Return Value

False when a move before the top of the log is attempted.

Header

Logger/Logger.h

4.6.1.3.9 Search ()

Search backwards from the end of the log for the first data which is before the passed Time, and sets the cursor to point to the data after that point which would be at or after the Time. If no data is found false is returned and the position is set to the top.

```
bool Search(INT64 Time);
```

Parameters

Time	-	A time and date stamp compatible with the MFC API CTime::GetTime()

Return Value

False if no data could be located.

Header

Logger/Logger.h

4.6.1.3.10 IsNote ()

Returns true if the current record is a note, false if it contains Data. Always call this first in order to determine whether to call ReadNote() or ReadSensor() next, and so the data can be prepared.

```
bool IsNote();
```

Parameters

None.

Return Value

True if the Cursor is pointing to a log line that contains a note, and not sensor data.

Header

Logger/Logger.h

4.6.1.3.11 ReadNote ()

Read a log note from the current record. Always call IsNote() before calling this. The caller must allocate space for the note, the size depends on the longest note Appended (typically 128 characters).

```
bool ReadNote(INT64& Time, TCHAR* Note);
```

Parameters

Time	-	A variable to receive the time stamp of the log line. It can be converted to a CTime as follows: CTime TimeStamp((time_t) Time);
Note	-	A preallocated TCHAR array to receive the log note, allow enough space for 128 characters.

Return Value

False if there is a problem, such as no data was available.

Header

Logger/Logger.h

4.6.1.3.12 ReadTime ()

Reads just the current time of the current line, if the current. line is invalid, then it returns the base time of the bad block which contains the line.

```
INT64 ReadTime();
```

Parameters

None.

Return Value

A log time stamp for the current line compatible with “time_t” and CTime.

Header

Logger/Logger.h

4.6.1.3.13 ReadSensor ()

Reads sensor data from the current record. Always call IsNote() before calling this. The caller must allocate space for the Name, Units and Num, the size depends on the longest Names & Units stored in the log. Allocate room for at least 128 characters for each TCHAR array.

```
bool ReadSensor(INT64& Time, TCHAR* Name, TCHAR* Units, UINT8& Quality,
TCHAR* Num)
```

Parameters

Time	-	A variable to receive the time stamp of the log line. It can be converted to a CTime as follows: CTime TimeStamp((time_t) Time);
Name	-	The name of the sensor logged.
Units	-	The units the sensor was measured in.
Quality	-	The quality flag associated with the sensor. Possible values are contained in CSensorData::QualityType and include 0 for GOOD, 1 for BAD, and 2 for UNDEFINED.
Num	-	A measured value of the sensor that was logged for the specified time stamp.

Return Value

False if there is a problem, such as no data was available.

Header

Logger/Logger.h

4.6.1.3.14 AtTop ()

Detects whether the current line is the first line in the log..

```
bool AtTop();
```

Parameters

None.

Return Value

True if the cursor points to the oldest line in the log.

Header

Logger/Logger.h

4.6.1.3.15 AtBottom ()

Detects whether the current line is the last line in the log.

```
bool AtBottom();
```

Parameters

None.

Return Value

True if the cursor points to the newest line in the log.

Header

Logger/Logger.h

4.6.1.3.16 GetCurrentLine()

Returns the line number the cursor is position at, 0..LineCount-1.

```
int GetCurrentLine();
```

Parameters

None.

Return Value

The line number of the current line. This value may change as lines are added to the log and old lines are removed.

Header

Logger/Logger.h

4.6.1.3.17 Sync ()

Synchronizes the Cursor with the Log, the Move commands do this automatically but other commands do not. For instance if GetCurrentLine() returned 100, and then 5 lines were deleted from the log, GetCurrentLine() would keep returning 100 until a move occurs or Sync() is called, at which point the value would change to 95.

```
void Sync();
```

Parameters

None.

Return Value

None.

Header

Logger/Logger.h

5 Coding Guidelines

5.1 General

When creating dialog boxes for the Xpert, the dialogs should be instances of classes derived from TDialog, whenever possible. The TDialog class was created to fix a CE bug that causes dialogs to occasionally become inaccessible by disappearing behind other windows. TDialog is a class defined in Engine\Module.h.

5.2 GUI Guidelines

This section provides a set of guidelines governing the design of the Graphical User Interface (GUI) of Xpert applications. These guidelines should be followed in order to present the user with a consistent interface:

1. Set dialog fonts to Tahoma 10pt. Note that DLUs (the units used in the development tools and referred to below) are relative to the font size. So if you're using a font other than Tahoma 10pt., these sizes no longer apply.
2. Set dialog margins to 3 DLUs.
3. Change buttons:
   a. Set the caption of change buttons to "...".
   b. When the field label is above the data field, size the change button to 12x9 DLUs and place it right justified to the data field.
   c. When the field label precedes the data field, size the change button to 14x12 DLUs, and place it to the right of the data field.
   d. Some examples:

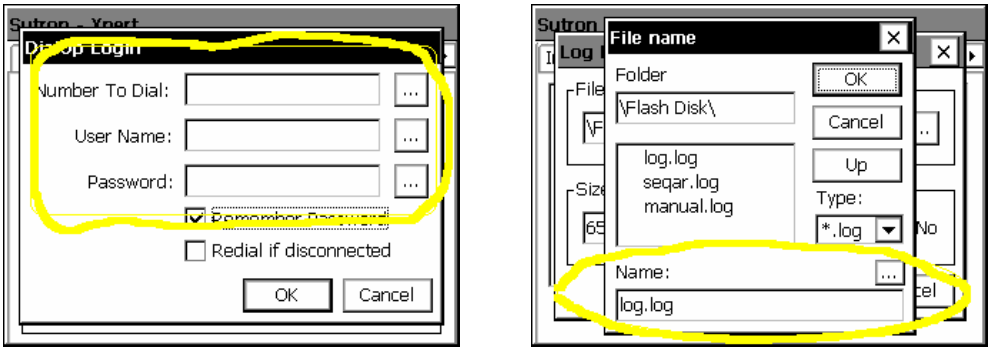
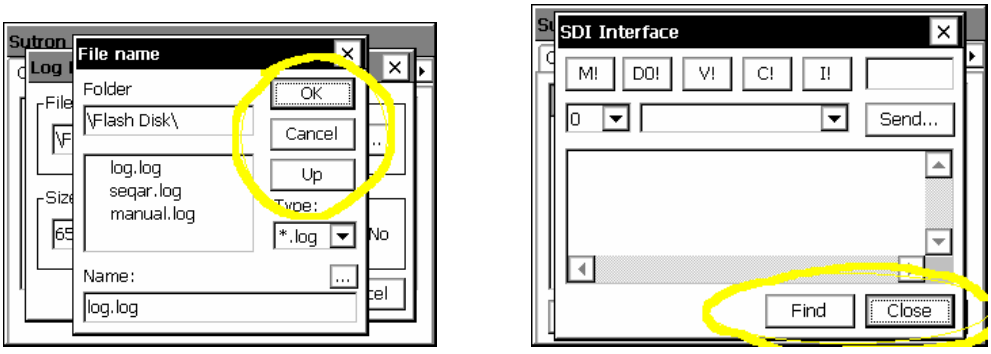


Figure 10: Location of Change Buttons

4. Set standard buttons to 36x12 DLUs.
5. Set the height of edit controls to 12 DLUs.
6. Dialog buttons:
   a. The standard placement of dialog buttons is top, right, and vertically aligned, with OK on top, followed by Cancel, followed by any other buttons (excluding control-specific buttons like the change button, of course). If Close exists in place of OK and Cancel, then Close should be on top.
   b. The alternative to the standard dialog button placement is bottom, justified right (or center*), and horizontally aligned, with OK left of Cancel, and Cancel left of any other buttons. If Close exists in place of OK and Cancel, then Close should be rightmost. *Center is typically used when there is either only one button, or enough buttons to span about 75% of the horizontal.
   c. Some examples:



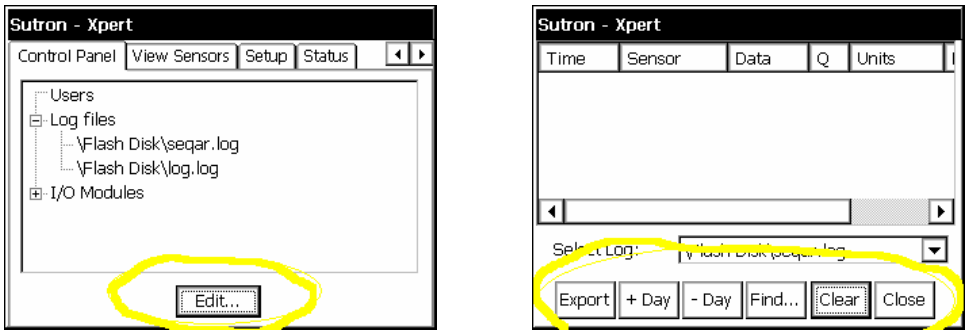


Figure 11: Alignment of Standard Buttons

7. The maximum size of a dialog in DLUs is 179x105.
8. The size of a property page in DLUs is 175x105.
9. Setup block icons should have a border no thicker than a single line, if any, so as not to cause the block to appear as active (the Xpert application handles darkening the borders of active blocks).

6 Sample Programs, SLL's, and Blocks

This section contains samples designed to help users understand how to use the various APIs.

6.1 Terminal Server

TerminalServer is a demonstration project which shows how the command line of Remote.Exe can be extended. The procedure involves the following steps:

1. TerminalServer creates a custom user group, and hooks in to Remote's login and command processing.
2. You need to then go in to the XPert's control panel and create a new user, and specify the group "TerminalServer".
3. Then the next time you login that user in to remote, you should see a custom prompt:

```
Hello *USERNAME, Terminal Server is Active. Use Help for a list of commands including extended ones.

\Flash Disk>
```

4. You may then use any of the standard remote commands, or any of the extended commands.

Extended commands implemented by this SLL include:

HELP	-	Displays both the old and new commands.
GET	-	Retrieves and displays log data
LOGFILE	-	Switches log files for the get command (default is ssp.log)
LOGTIME	-	Specifies the retrieval time for the get command
LOGDATE	-	Specifies the retrieval date for the get command

LIST	-	Displays the last value logged for a sensor or sensor(s)
READ	-	Measures and displays readings for a sensor or sensor(s)

6.1.1 TerminalServer.cpp

This is the DLL's main source file containing the definition of DllMain().

Primarily we install the .SLL in this file, we create our new custom group here. We use CUSTOM_GROUP1, different .SLL's can be made that support different groups by simply changing this to CUSTOM_GROUP2-10. We also specify that this custom group has a custom command parser.

```
// TerminalServer.cpp : Defines the initialization routines for the DLL.
//

#include "stdafx.h"
#include <afxdllx.h>

#include "../Utils/Users.h"
#include "TerminalServerMgr.h"

#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif


//////////////////////////////////////////////////////////////////////////
// GetFileVersion()

extern "C" _declspec(dllexport) LPCTSTR GetFileVersion()
{
   // Note: when we upgrade to WCE 3.0, change this to retrieve FileVersion
   // entry of VS_VERSION_INFO.
   return _T("1.2.0.4");
}


bool TerminalServerFunction(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName)
{
   return TerminalServerMgr.TerminalServerFunction(Group, ComPort, UserName);
};

bool TerminalServerParser(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName, LPCTSTR Command)
{
   return TerminalServerMgr.TerminalServerParser(Group, ComPort, UserName, Command);
};

//////////////////////////////////////////////////////////////////////////
// DllMain()

AFX_EXTENSION_MODULE TerminalServerSLL = { NULL, NULL };

extern "C" int APIENTRY
DllMain(HANDLE hInstance, DWORD dwReason, LPVOID lpReserved)
{
    if (dwReason == DLL_PROCESS_ATTACH)
    {
           TRACE0("TerminalServer.SLL Initializing!\n");

           // Extension DLL one-time initialization
           if (!AfxInitExtensionModule(TerminalServerSLL, (HINSTANCE)hInstance))
                  return 0;

           // Insert this DLL into the resource chain
```

```
            // NOTE: If this Extension DLL is being implicitly linked to by
            //  an MFC Regular DLL (such as an ActiveX Control)
            //  instead of an MFC application, then you will want to
            //  remove this line from DllMain and put it in a separate
            //  function exported from this Extension DLL.  The Regular DLL
            //  that uses this Extension DLL should then explicitly call that
            //  function to initialize this Extension DLL.  Otherwise,
            //  the CDynLinkLibrary object will not be attached to the
            //  Regular DLL's resource chain, and serious problems will
            //  result.

            new CDynLinkLibrary(TerminalServerSLL);

        if (!AddCustomGroup(CUSTOM_GROUP1, _T("TerminalServer"), TerminalServerFunction))
           return 0;
        AddCustomCommandParser(CUSTOM_GROUP1, TerminalServerParser);

    }
    else if (dwReason == DLL_PROCESS_DETACH)
    {
            TRACE0("TerminalServer.SLL Terminating!\n");
            // Terminate the library before destructors are called
            AfxTermExtensionModule(TerminalServerSLL);
    }
    return 1;   // ok
}
```

6.1.2 TerminalServerMgr.cpp

This is where most of the work of the application occurs.

There are two methods for creating custom reports or custom commands. If a response can be generated quickly (in under a minute) then the processing can be done in the TerminalServerFunction or TerminalServerParser methods directly. This is in fact how this demo works. If more time is needed, then these functions should create a thread for doing the processing, and return true immediately.

While it may appear at first glance that we are accessing the com ports directly we are in fact using a special class called CSocketCommClass which let's us share any serial port which Remote.exe has open using Interprocess Communication via Windows Sockets.

Methods defined:

void Start(); - Skeleton code not used, but intended for thread processing.

void Stop(); - Skeleton code not used, but intended for thread processing.

bool ReadSetup(CXMLSetup& XMLSetup); - Example code for allowing the module to read it's properties from the setup.

bool WriteSetup(CXMLSetup& XMLSetup); - Example code for allowing the module to read it's properties from the setup.

bool TerminalServerFunction(TUserGroup Group, LPCTSTR ComPort, LPCTSTR serName); - This function is called whenever the custom user logs in on one of remote's ports.

bool TerminalServerParser(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName, LPCTSTR Command); - This function is called whenever the user attempts to use a custom command.

```
// TerminalServerMgr.cpp: implementation of the CTerminalServerMgr class.
//
//////////////////////////////////////////////////////////////////////
```

```
//
// Other SLL's should copy how Setups are handled in this SLL

#include "stdafx.h"

#include "TerminalServerMgr.h"
#include "../Engine/Engine.h"
#include "../Utils/Report.h"
#include "../Utils/SocketCommClass.h"
#include "../LogMgr/LogDesc.h"

#include <math.h>

#ifdef _DEBUG
#define new DEBUG_NEW
#undef THIS_FILE
static char THIS_FILE[] = __FILE__;
#endif


//////////////////////////////////////////////////////////////////////
// CTerminalServerMgr - Interface

CTerminalServerMgr::CTerminalServerMgr()
{
#ifdef SAMPLECODE
   m_hStopEvent = CreateEvent(NULL, TRUE, TRUE, NULL);
   PropertyList.Add(_T("SampleProperty"), SampleProperty);
#endif
   for (int i=0; i<NUM_PORTS; i++)
   {
      pCursor[i] = NULL;
      LogFile[i] = _T("\\FLASH DISK\\SSP.LOG");
      LogTime[i] = CTime::GetCurrentTime();
   };
}

CTerminalServerMgr::~CTerminalServerMgr()
{
#ifdef SAMPLECODE
   CloseHandle(m_hStopEvent);
#endif
   for (int i=0; i<NUM_PORTS; i++)
   {
      if (pCursor[i])
         delete pCursor[i];
   };
}


void CTerminalServerMgr::Start()
{
#ifdef SAMPLECODE
   ResetEvent(m_hStopEvent);
#endif
}


void CTerminalServerMgr::Stop()
{
#ifdef SAMPLECODE
   // Stop child thread.
   SetEvent(m_hStopEvent);
#endif
}


bool CTerminalServerMgr::ReadSetup(CXMLSetup& XMLSetup)
{
#ifdef SAMPLECODE
   CXMLToken XMLToken;
```

```
   XMLSetup.ReadNextToken(XMLToken);
   CString Property = XMLToken.GetText();
   while (XMLToken.nType == CXMLToken::START_TAG)
   {
      TProperty* pValue;
      CString Tag = XMLToken.GetText();
      if (Tag == _T("General"))
      {
         XMLSetup.ReadNextToken(XMLToken);

         while (XMLToken.nType == CXMLToken::ATTR_NAME)
         {
            Property = XMLToken.GetText();
            XMLSetup.ReadNextToken(XMLToken);
            CString str = XMLToken.GetText();
            if ((Index >= 0) && PropertyList.Lookup(Property, pValue))
            {
               int idx = str.ReverseFind(TCHAR('#'));
               if (idx != -1)
               {
                  int iType = _ttoi(str.Right(str.GetLength() - idx - 1));
                  str = str.Left(idx);
                  pValue->SetType(iType);
                  if (pValue->IsInteger())
                     *pValue = _ttoi(str);
                  else if (pValue->IsDouble())
                     *pValue = _tcstod(str, NULL);
                  else
                     *pValue = str;
               }
               else
                  *pValue = str;
            }
            else
            {
               // The attribute is unrecognized and the module does not support dynamic
               // property creation, so discard the property.
               CString out;
               out.Format(_T("CTerminalServerMgr::ReadSetup eating unknown token: %s."),
                     Property);
               Report.Warning(out);
               XMLSetup.ReadNextToken(XMLToken);
            }
            //read the next
            XMLSetup.ReadNextToken(XMLToken);
         };
      };
      XMLSetup.ReadNextToken(XMLToken);
   }
#endif
   return true;
}


bool CTerminalServerMgr::WriteSetup(CXMLSetup& XMLSetup)
{
#ifdef SAMPLECODE
   // Open TerminalServerMgr entry.
   XMLSetup.WriteStartTag(_T("<TerminalServerMgr>"));

   CString Str;
   TProperty* Property;

   XMLSetup.WriteStartTag(_T("<General"));
   POSITION Pos = PropertyList.GetStartPosition();
   while (PropertyList.GetNext(Pos, Str, Property))
      if ((Property->Attributes & TProperty::NOSAVE) == 0)
      {
         CString out;
         out.Format(_T("%s = \"%s#%d\""), Str, Property->AsLPCTSTR(), Property->GetType());
         XMLSetup.WriteText(out);
```

```
      };
   XMLSetup.WriteEndTag(_T("/>"));

   // Close outermost entry.
   XMLSetup.WriteEndTag(_T("</TerminalServerMgr>"));
#endif

   return true;
}


/*
   Here's where we do the work of generating a custom report.
   In this case we are just setting things up for a custom command line.

   For anything that might take more then a minute, we'd want to create a seperate thread
   for each report that needs to be generated, and immediately return true from this function.
*/
bool CTerminalServerMgr::TerminalServerFunction(TUserGroup Group, LPCTSTR ComPort,
      LPCTSTR UserName)
{
   CSocketComm Port;

   Port.SetCommPort(ComPort);

   // Open port.
   if (Port.OpenComm())
   {
      // Here we tell remote which commands we are going to support.
      // We can intercept all commands including the builtin ones by placing an asterisk
      // _T("*,get,...") at the begging of the command list.
      Port.SetExtendedCommands(_T(",get,read,list,logfile,logtime,logdate,help,"));
      CString Txt;
      // Let the user know the terminal server is active.
      Txt.Format(_T("Hello %s, Terminal Server is Active. Use Help for a list of ")
            _T("commands including extended ones.\r\n"), UserName);
      Port.PutStr(Txt);
      // Force a command prompt to be displayed
      Port.SetComOptions(ENABLECOMMANDPROMPT, ENABLECOMMANDPROMPT);
      Port.CloseComm();
      return true; // This will cause Remote to keep the command line running
   }
   else
   {
      Report.Warning(_T("TerminalServerFunction(): Failed to open communications port."));
   }
   return false; // this will cause Remote to hangup and get ready for a new user.
};

/*
   Here's the function which is called whenever a custom command is entered at Remote.exe's
   command line by the user. Basically we open the com port (via sockets), parse the command,
   and output any response we wish the user to see.
*/

bool CTerminalServerMgr::TerminalServerParser(TUserGroup Group, LPCTSTR ComPort,
      LPCTSTR UserName, LPCTSTR Command)
{
   int PortIndex = ComPort[3] - '1';
   if ((PortIndex < 0) || (PortIndex >= NUM_PORTS))
      return true;

   CSocketComm Port;

   Port.SetCommPort(ComPort);

   // Open port.
   if (Port.OpenComm())
   {

      // Parse the Command, in to the Lower case root of the command, and the Parameters
```

```
CString Cmd = Command;
CString CmdRoot;
CString Parm;
int SpacePos;
SpacePos = Cmd.Find(' ');
if (SpacePos <= 0)
   CmdRoot = Cmd;
else
{
   CmdRoot = Cmd.Left(SpacePos);
   Parm = Cmd.Mid(SpacePos+1);
};

CString LowerCmdRoot = CmdRoot;
LowerCmdRoot.MakeLower();

// Parse each of the commands we support
if (Cmd.CompareNoCase(_T("get")) == 0) // GET COMMAND
{
   // We need a cursor to walk thru the log, do we have one already?
   if (pCursor[PortIndex] == NULL)
   {
      // No, let's see if we can find a match for the requested logfile and make a cursor
      CLogDesc* pLog = LogList.GetByName(LogFile[PortIndex]);
      if (pLog)
      {
         pCursor[PortIndex] = new LOGCURSOR(pLog->log);
         // If we have don't have a valid time just go to the top of the log,
         // otherwise search for the specified date and time
         if (LogTime[PortIndex].GetTime() == 0)
            pCursor[PortIndex]->GotoTop();
         else
            pCursor[PortIndex]->Search(LogTime[PortIndex].GetTime());
      };
   };
   if (pCursor[PortIndex])
   {
      INT64 Time64;
      UINT8 Quality;
      TCHAR Sensor[128];
      TCHAR Units[128];
      TCHAR Number[128];
      TCHAR Qual;
      CString Txt;

      // Retrieve and display 20 lines from the log file
      for(int Lines=1; Lines<=20; Lines++)
      {
         if (pCursor[PortIndex]->IsNote())
         {
            // Log notes need to be handled differently from sensor data
            if (pCursor[PortIndex]->ReadNote(Time64, Sensor))
            {
               CTime Time((time_t) Time64);
               Txt.Format(_T("%02d-%02d-%4d %02d:%02d:%02d %s\r\n"), Time.GetMonth(),
                     Time.GetDay(), Time.GetYear(), Time.GetHour(), Time.GetMinute(),
                     Time.GetSecond(), Sensor);

               // Send the log note out the com port to the user
               Port.PutStr(Txt);
            }
         }
         else if (pCursor[PortIndex]->ReadSensor(Time64, Sensor, Units, Quality, Number))
         {
            // Process sensor data and the quality information
            CTime Time((time_t) Time64);
            switch (Quality)
            {
               case CSensorData::GOOD:
                  Qual = 'G';
                  break;
```

```
               case CSensorData::BAD:
                  Qual = 'B';
                  break;
               case CSensorData::UNDEFINED:
               default:
                  Qual = 'U';
                  break;
            }
            Txt.Format(_T("%02d-%02d-%4d %02d:%02d:%02d %-12s %10s %s (%c)\r\n"),
                  Time.GetMonth(), Time.GetDay(), Time.GetYear(), Time.GetHour(),
                  Time.GetMinute(), Time.GetSecond(), Sensor, Number, Units, Qual);

            // Send the sensor data out the com port to the user
            Port.PutStr(Txt);
         };
         if (!pCursor[PortIndex]->MoveNext())
            break;
      };
      // If we've hit the end of the log, let the user know
      if (pCursor[PortIndex]->AtBottom())
         Port.PutStr("[END OF LOG]\r\n");
   }
   else
   {
      // User specified a log file that isn't in the system
      Port.PutStr("Could not find logfile.\r\n");
   };
}
else if (LowerCmdRoot.Compare(_T("logfile")) == 0) // LOGFILE COMMAND
{
   // If the user didn't specify a path or extension, tack them on
   if (Parm.Find('\\') < 0)
      Parm = _T("\\Flash Disk\\") + Parm;
   if (Parm.Find('.') < 0)
      Parm += _T(".LOG");

   // Just remember which file was selected
   LogFile[PortIndex] = Parm;

   // Delete any existing Cursor, so the Get command will search for new data
   if (pCursor[PortIndex])
   {
      delete pCursor[PortIndex];
      pCursor[PortIndex] = NULL;
   };
}
else if (LowerCmdRoot.Compare(_T("logtime")) == 0) // LOGTIME COMMAND
{
   // Parse out the time and store it
   int Hours=0, Minutes=0, Seconds=0;
   if (_stscanf((LPCTSTR) Parm, _T("%d:%d:%d"), &Hours, &Minutes, &Seconds) == 3)
      LogTime[PortIndex] = CTime(LogTime[PortIndex].GetYear(),
            LogTime[PortIndex].GetMonth(), LogTime[PortIndex].GetDay(), Hours,
            Minutes, Seconds);
   else
      LogTime[PortIndex] = 0;
   if (pCursor[PortIndex])
   {
      delete pCursor[PortIndex];
      pCursor[PortIndex] = NULL;
   };
}
else if (LowerCmdRoot.Compare(_T("logdate")) == 0) // LOGDATE COMMAND
{
   // Parse out the date and store it
   int Month=1, Day=1, Year=2000;
   if (_stscanf((LPCTSTR) Parm, _T("%d-%d-%d"), &Month, &Day, &Year) == 3)
   {
      if (Year < 99)
         Year += 2000;
      LogTime[PortIndex] = CTime(Year, Month, Day, LogTime[PortIndex].GetHour(),
```

```
            LogTime[PortIndex].GetMinute(), LogTime[PortIndex].GetSecond());
      }
      else
         LogTime[PortIndex] = 0;
      if (pCursor[PortIndex])
      {
         delete pCursor[PortIndex];
         pCursor[PortIndex] = NULL;
      };
   }
   else if (LowerCmdRoot.Compare(_T("list")) == 0) // LIST COMMAND
   {
      // Go thru the list of every module in the system
      for (int i = 0; i<Engine.ModuleList.GetSize(); i++)
      {
         TModule& m = Engine.ModuleList.GetAt(i);
         TProperty* p;
         // We're looking for Log Modules
         if ((m.GetModuleType() == TModule::LOGGING) && m.GetProperty(_T("SensorName"), p))
         {
            // If the user wanted only a certain sensor, then check the SensorName
            // property and skip if this isn't the one requested.
            if (!Parm.IsEmpty() && (Parm.CompareNoCase(p->AsCString()) != 0))
               continue; // Skip this sensor, it wasn't requested
            TCHAR Qual;
            CSensorData Data;
            // Retrieve the last data stored in to this log module
            m.Get(2, Data);
            switch (Data.Quality)
            {
               case CSensorData::GOOD:
                  Qual = 'G';
                  break;
               case CSensorData::BAD:
                  Qual = 'B';
                  break;
               case CSensorData::UNDEFINED:
               default:
                  Qual = 'U';
                  break;
            }
            CString Txt;
            // Format up the data and display to the user
            Txt.Format(_T("%-12s %10s %s (%c)\r\n"), p->AsLPCTSTR(),
                  Data.Data.AsLPCTSTR(), Data.Units, Qual);
            Port.PutStr(Txt);
         }
      }
   }
   else if (LowerCmdRoot.Compare(_T("read")) == 0) // READ COMMAND
   {
      // Go thru the list of every module in the system
      for (int i = 0; i<Engine.ModuleList.GetSize(); i++)
      {
         TModule* m = &Engine.ModuleList.GetAt(i);
         TProperty* p;
         // We're looking for Log Modules
         if ((m->GetModuleType() == TModule::LOGGING) && m->GetProperty(_T("SensorName"), p))
         {
            // If the user wanted only a certain sensor, then check the SensorName
            // property and skip if this isn't the one requested.
            if (!Parm.IsEmpty() && (Parm.CompareNoCase(p->AsCString()) != 0))
               continue; // Skip this sensor, it wasn't requested
            // Take a peek at the module just to the left of this log module in the setup
            TNode& Node = m->Inputs[2];
            // Is it a Measure or Average module? (Note: some other types of processing
            // can't be handled like VectAvg)
            while ((Node.Module->Name == _T("Measure")) ||
                  (Node.Module->Name == _T("Average")))
            {
               // Yes it is, so instead of trying to measure this, move on to module to left
```

```
                  m = Node.Module;
                  Node = Node.Module->Inputs[2];
               };
               // Now we can pull data from the module to cause a reading to be taken
               Node.Module->Pull(CTime::GetCurrentTime(), true);
               TCHAR Qual;
               CSensorData Data;
               // Now retrieve the data measured and display it
               m->GetInputData(2, Data);
               switch (Data.Quality)
               {
                  case CSensorData::GOOD:
                     Qual = 'G';
                     break;
                  case CSensorData::BAD:
                     Qual = 'B';
                     break;
                  case CSensorData::UNDEFINED:
                  default:
                     Qual = 'U';
                     break;
               }
               CString Txt;
               Txt.Format(_T("%-12s %10s %s (%c)\r\n"), p->AsLPCTSTR(),
                     Data.Data.AsLPCTSTR(), Data.Units, Qual);
               Port.PutStr(Txt);
            }
         }
      }
      else if (LowerCmdRoot.Compare(_T("help")) == 0) // HELP COMMAND
      {
         Port.PutStr("[[[ STANDARD COMMANDS ]]]\r\n");
         // Here we use RunCommand to have remote display it's standard help screen.
         Port.RunCommand(_T("\rhelp")); // the \r at the beginning prevents recursion here
         Port.PutStr("[[[ EXTENDED COMMANDS ]]]\r\n");
         Port.PutStr("GET\t\t\tRetrieves a screen full of log data\r\n");
         Port.PutStr("LOGFILE file\t\tSets the log file to use for Get\r\n");
         Port.PutStr("LOGTIME hh:mm:ss\tSets the start time for Get\r\n");
         Port.PutStr("LOGDATE mm-dd-yyyy\tSets the start date for Get\r\n");
         Port.PutStr("LIST [sensor]\t\tShows the last value logged for a sensor\r\n");
         Port.PutStr("READ [sensor]\t\tMeasures and displays current sensor reading\r\n");
      }
      else // Program error. An unimplemented command was ran.
      {
         CString Txt;
         Txt.Format(_T("Hello %s! Unimplemented custom command: %s.\r\n"), UserName, Command);
         Port.PutStr(Txt);
      };
      // When we're all done, we close the port.
      Port.CloseComm();
   }
   else
   {
      Report.Warning(_T("TerminalServerParser(): Failed to open communications port."));
   }
   return true; // this will cause Remote to emit a command prompt
};

// The global alarm manager object.
CTerminalServerMgr TerminalServerMgr;


////////////////////////////////////////////////////////////////////////
// App Init and Exit Callbacks

extern "C" _declspec(dllexport) void AppInit()
{
   TerminalServerMgr.Start();
}
```

```
extern "C" _declspec(dllexport) void AppExit()
{
   TerminalServerMgr.Stop();
}


//////////////////////////////////////////////////////////////////////
// Setup Callbacks

extern "C" _declspec(dllexport) bool ReadSetup(CXMLSetup& XMLSetup)
{
   if (!TerminalServerMgr.ReadSetup(XMLSetup))
   {
      Report.Warning(_T("Error interpreting TerminalServer configuration from setup."));
      return false;
   }
   else
      return true;
}


extern "C" _declspec(dllexport) bool WriteSetup(CXMLSetup& XMLSetup)
{
   if (!TerminalServerMgr.WriteSetup(XMLSetup))
   {
      Report.Warning(_T("Error writing TerminalServer configuration to setup."));
      return false;
   }
   else
      return true;
}


extern "C" _declspec(dllexport) LPCTSTR GetSetupTag()
{
   return _T("TerminalServerMgr");
}
```

6.1.3 TerminalServerMgr.h

Header file for TerminalServerMgr.cpp.

```
// TerminalServerMgr.h : header file for TerminalServerMgr of Alarm.dll
//

#if !defined(_TerminalServer_MGR_INCLUDED_)
#define _TerminalServer_MGR_INCLUDED_

#if _MSC_VER >= 1000
#pragma once
#endif // _MSC_VER >= 1000

#ifndef __AFXWIN_H__
    #error include 'stdafx.h' before including this file for PCH
#endif

#include "../Engine/XMLSetup.h"
#include "../Engine/Engine.h"
#include "../Logger/Logger.h"

const NUM_PORTS = 4;

//////////////////////////////////////////////////////////////////////
// CTerminalServerMgr
//
class CTerminalServerMgr
```

```
{
   ////////////////////////////////
   // Interface
   ////////////////////////////////
public:

   // Constructors and destructor.
   CTerminalServerMgr();
   virtual ~CTerminalServerMgr();

   // Start alarm processing.
   void Start();

   // Stop alarm processing.
   void Stop();

   // Read configuration data from setup.
   bool ReadSetup(CXMLSetup& XMLSetup);

   // Write configuration data to setup.
   bool WriteSetup(CXMLSetup& XMLSetup);

   bool TerminalServerFunction(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName);
   bool TerminalServerParser(TUserGroup Group, LPCTSTR ComPort, LPCTSTR UserName, LPCTSTR
Command);

   ////////////////////////////////
   // Implementation
   ////////////////////////////////
protected:
   friend class CTerminalServerControlPanelEntry;
   TPropertyList PropertyList;
   LOGCURSOR* pCursor[NUM_PORTS];
   CString LogFile[NUM_PORTS];
   CTime LogTime[NUM_PORTS];

#ifdef SAMPLECODE
   TProperty SampleProperty;
#endif

#ifdef SAMPLECODE
   // Event handles used to coordinate thread termination.
   HANDLE m_hStopEvent;
#endif
};


//The global alarm mgr object
extern CTerminalServerMgr TerminalServerMgr;


#endif // !defined(_TerminalServer_MGR_INCLUDED_)
```

6.1.4 TerminalServerControlPanelEntry.cpp

This demo only includes the skeleton of how to implement a control panel entry for an SLL. It could be enhanced to enable/disable various features or options of the Terminal Server.

```
// TerminalServerControlPanelEntry.cpp : Defines control panel entry class.
//

#include "stdafx.h"

#include "TerminalServerMgr.h"
#include "TerminalServer.h"
#include "TerminalServerControlPanelEntry.h"
#include "Resource.h"
#include "../Engine/Engine.h"
#include "../Utils/Report.h"
```

```
#include "../Utils/ResourceKey.h"

#ifdef _DEBUG
#undef THIS_FILE
static char THIS_FILE[]=__FILE__;
#define new DEBUG_NEW
#endif


//////////////////////////////////////////////////////////////////////
// CTerminalServerControlPanelEntry

CTerminalServerControlPanelEntry::CTerminalServerControlPanelEntry()
{
   m_pTree = NULL;
   m_hRootItem = NULL;
}


bool CTerminalServerControlPanelEntry::EditItem(CWnd* pParent, HTREEITEM hItem, CTreeCtrl*
pTree)
{
   // This method is called when the user selects edit with a node of the
   // tree selected. Return true only when the tree should be rebuilt as a
   // result of handling the incoming item (e.g., when the text of an item
   // changes, or a new sub-item is added/deletec, etc.).
   // Set member variable m_bSaveNeeded to true when changes are made that
   // need to be saved to the setup file.
   TResourceKey key(TerminalServerSLL);

   // Prompt the user with a dialog of configuration parameters if the handle passed
   // in belongs to TerminalServer.
   if (hItem == m_hRootItem)
   {
      #ifdef SAMPLECODE
      // Show dialog with configuration information
      CTerminalServerDlg Dlg(pParent);

      if (IDOK == Dlg.DoModal())
      {
         if (PromptEngineStop())
         {
            // Incorporate changes.

         }

         // Set flag to cause automatic setup save.
         m_bSaveNeeded = true;
      }
      #endif
   }
   else
   {
      // Handle sub items if used.

   }

   return false;
}


void CTerminalServerControlPanelEntry::InsertItems(CTreeCtrl* pTree)
{
   // Insert the TerminalServer branch into the control panel tree.
   if (Engine.LockGUI())
   {
      m_pTree = pTree;
      m_hRootItem = pTree->InsertItem(_T("TerminalServer"));
      // Insert sub-items if they exist
      // m_hSubItem = pTree->InsertItem(_T("TerminalServer SubItem"), m_hRootItem);
```

```
      Engine.UnlockGUI();
   }
}


extern "C" _declspec(dllexport) void CreateControlPanelEntry(CControlPanelEntry** ppEntry)
{
   CTerminalServerControlPanelEntry* pEntry = new CTerminalServerControlPanelEntry();
   *ppEntry = dynamic_cast<CControlPanelEntry *>(pEntry);
}
```

6.1.5 TerminalServerControlPanelEntry.h

The Header file for TerminalServerControlPanelEntry.h.

```
#ifndef _TerminalServerControlPanelEntry_H_
#define _TerminalServerControlPanelEntry_H_


#include "../engine/module.h"          // For CControlPanelEntry

/*////////////////////////////////////////////////////////////////////////

1. An instance of the class CTerminalServerControlPanelEntry is used to manage
   TerminalServer configuration parameters from the control panel.

////////////////////////////////////////////////////////////////////////*/



////////////////////////////////////////////////////////////////////////
// CTerminalServerControlPanelEntry

class CTerminalServerControlPanelEntry : public CControlPanelEntry
{
   // Constructors and destructor.
public:
   CTerminalServerControlPanelEntry();
   virtual ~CTerminalServerControlPanelEntry() {};

   // Attributes
private:

   // Overrides
public:
   virtual void EditItem(CWnd* pParent, HTREEITEM hItem, CTreeCtrl* pTree);
   virtual void InsertItems(CTreeCtrl* pTree);

   // Methods
public:
private:
//   HTREEITEM m_hSubItem;
};


////////////////////////////////////////////////////////////////////////
#endif // _TerminalServerControlPanelEntry_H_
```

6.2 Threads Example

This example demonstrates the correct way to start and stop threads created by a DLL.

```
HANDLE g_hStopEvent = NULL;
HANDLE g_hThread = NULL;
```

```
////////////////////////////////////////////////////////////////////////
// Thread function

UINT Thread(LPVOID pParam)
{
   // Continue work loop until signaled to stop.
   while (PowerMgr.WaitForSingleObject(g_hStopEvent, 0) == WAIT_TIMEOUT)
   {
      // Typically, sleep until time to do work. Sleep is required
      // at some point in order to give other threads time to run.
      // Sleep may be interrupted by an event (engine start or some
      // other signal) by using either WaitForSingleObject() or
      // WaitForMultipleObjects().
      DWORD dwSleep = 1000;
      PowerMgr.Sleep(dwSleep);

      // Do work...

   }

   return 0;
}

////////////////////////////////////////////////////////////////////////
// App Init and Exit Callbacks

extern "C" _declspec(dllexport) void AppInit()
{
   // Called when Xpert boots. Objective is to start thread.
   g_hStopEvent = CreateEvent(NULL, TRUE, FALSE, NULL);

   // Reset event used by thread to know when to stop.
   ResetEvent(g_hStopEvent);

   // Spawn thread.
   CWinThread* pThread = AfxBeginThread(Thread, NULL);
   if (pThread)
      g_hThread = pThread->m_hThread;
}

extern "C" _declspec(dllexport) void AppExit()
{
   // Called when Xpert shuts-down. Objective is to stop thread.
   if (g_hThread)
   {
      // Signal thread to quit.
      SetEvent(g_hStopEvent);

      // Wait for thread to complete.
      PowerMgr.WaitForSingleObject(g_hThread, INFINITE);
      g_hThread = NULL;
   }
   CloseHandle(g_hStopEvent);
}
```

6.3 Engine API Examples

The following examples demonstrate using various Engine API functions.

6.3.1 hStartEvent and hStopEvent

1. Start and stop events can be used to detect engine start and stop, as may be necessary outside scope of a setup block (which uses Initialize() and Stop()).
2. Example of event wait:

```
if (PowerMgr.WaitForSingleObject(Engine.hStopEvent, dwWait) != WAIT_TIMEOUT)
```

```
      // Detected engine stop!
```

6.3.2 ModuleList

1. List of all modules defined by the current setup.
2. Example of access:

```
// The following function searches all setup blocks for a block named
// strBlockName, having a property named strPropName. If such a block is
// found, pProp is set to point to the property, iBlock is set to the
// index of the block within ModuleList, and true is returned. Otherwise,
// false is returned.
bool FindProperty(const CString& strBlockName, const CString& strPropName,
      TProperty* pProp, int& iBlock)
{
   for (int i = 0; i < Engine.ModuleList.GetSize(); i++)
   {
      TModule* pMod = &Engine.ModuleList.GetAt(i);
      if (!pMod->Name.Compare(strBlockName))
      {
         iBlock = i;
         TPropertyEnum penum(*(pMod));
         CString strStoredName;
         TProperty* pStoredProp;
         while (true == penum.Get(strStoredName, pStoredProp))
         {
            if (strStoredName == strPropName)
            {
               pProp = pStoredProp;
               return true;
            }
         }
      }
   }

   // Not found if we reach here.
   return false;
}
```

6.3.3 Exported Engine Functions

1. Interface dialogs provide easy way to get data from user in touchscreen environment.
2. The following example shows how to get an integer from the user, while validating the integer's range. The user is allowed to cancel the edit at any time.

```
   void OnBtnChangeInt()
   {
      UpdateData(TRUE);
      int iNewInt = m_iStoredInt;
      if (IDOK == ChangeNumberDlgInt(this, iNewInt))
      {
         while (1 > iNewInt || iNewInt > 999)
         {
            AfxMessageBox(_T("Please enter an integer between 1 and 999."));
```

```
         if (IDOK != ChangeNumberDlgInt(this, iNewInt))
            return;
      }
      m_iStoredInt = iNewInt;
      UpdateData(FALSE);
   }
}
```

6.4 Analog I/O

1. Initalize device for making required measurement in Initalize(). This ensures manual measurements while recording is on will work as expected.
2. Initalize device again prior to making measurement in Execute(). This ensures any device reconfiguration does not corrupt measurement.
3. Table in Analog I/O section of this document defines what config parameters need to be defined for each type of measurement.
4. Solar Radiation Sensor Example

```
CSolarRad::CSolarRad() : TModule(_T("SolRad"), DefLibSLL.hResource)
{
   AddProperty(_T("AIOModule"), m_propAIOModule = 1);
   AddProperty(_T("AIOChannel"), m_propAIOChannel = 0);
   AddProperty(_T("Units"), m_propUnits = _T("W/m2"));
   AddProperty(_T("Calibration"), m_propCalibration = 1.);

   LastData.Data = 0;
   LastData.TimeScheduled = CTime::GetCurrentTime();
   LastData.TimeActual = CTime::GetCurrentTime();
   LastData.Quality = CSensorData::UNDEFINED;
   LastData.Units = m_propUnits;
   LastData.SensorID = Function;
   LastData.DeviceTime = 0;
}

CSolarRad::~CSolarRad()
{
   // Release channel.
   Engine.IOModList.ClearChannelInUse(ANALOG, m_propAIOModule, m_propAIOChannel);
}

void CSolarRad::ShowProperties(CWnd* pParent)
{
   TResourceKey key(DefLibSLL);
   CSolarRadDlg dlg(pParent);

   // Initialize dialog data.
   dlg.m_iIOMod = m_propAIOModule;
   dlg.m_iChannel = m_propAIOChannel;
   dlg.m_strUnits = m_propUnits;
   dlg.m_rCal = m_propCalibration;
   if (dlg.DoModal() == IDOK)
   {
      // Incorporate data from dialog.
      Engine.IOModList.ClearChannelInUse(ANALOG, m_propAIOModule, m_propAIOChannel);
      m_propAIOModule = dlg.m_iIOMod;
      m_propAIOChannel = dlg.m_iChannel;
      m_propUnits = dlg.m_strUnits;
      m_propCalibration = dlg.m_rCal;
      Engine.IOModList.SetChannelInUse(ANALOG, m_propAIOModule, m_propAIOChannel);
   }
}

void CSolarRad::Execute(TTime tScheduled)
{
```

```
      // Initialize instance of sensor data.
      CSensorData RawData = LastData;
      RawData.Quality = CSensorData::BAD;
      RawData.Data = 0;
      RawData.TimeScheduled = tScheduled;
      RawData.TimeActual = CTime::GetCurrentTime();

      // Get a pointer to the I2C device.
      AnalogIO* pAnalogIO = Engine.IOModList.GetAnalogIO(m_propAIOModule);
      if (!pAnalogIO)
      {
         Report.Error(_T("CSolarRad::Execute: Failed to get analog device."));
      }
      else
      {
         // Measure voltage.
         double rVoltage;
         pAnalogIO->LockConfig();
         pAnalogIO->SetConfigurationGain(m_propAIOChannel, 1);
         pAnalogIO->SetPolyAdjust(m_propAIOChannel, TRUE);
         pAnalogIO->SetConfigurationExcitationHoldOff(m_propAIOChannel);
         pAnalogIO->SetConfigurationSingleEnded(m_propAIOChannel);
         pAnalogIO->SetExcitationVoltage(m_propAIOChannel, 5);
         pAnalogIO->SetExcitationChannel(m_propAIOChannel, 0);
         pAnalogIO->SetExcitationVoltageOff(m_propAIOChannel);
         pAnalogIO->SetPeriod(m_propAIOChannel, 10);
         pAnalogIO->SetSamples(m_propAIOChannel, 1);
         I2CCODE code = pAnalogIO->SingleVoltageReading(m_propAIOChannel, rVoltage);
         pAnalogIO->FreeConfig();
         if (code != I2C_OK)
         {
            Report.Error(_T("CSolarRad::Execute: Failed to get data from IO device."));
         }
         else
         {
            // Compute radiation.
            RawData.Data = rVoltage * 1000.0 / m_propCalibration.AsDouble();
            RawData.Quality = CSensorData::GOOD;
         }
      }

      // Buffer output data.
      LockData();
      LastData = RawData;
      UnlockData();
   }
```

6.5 Digital I/O – Tipping Bucket Example

```
CTippingBucket::CTippingBucket() : TModule(_T("TipBckt"), DefLibSLL.hResource)
{
   AddProperty(_T("Channel"),             Channel = 0);
   AddProperty(_T("IODeviceName"),        ModName = 1);
   AddProperty(_T("FilterValue"),         FilterValue = 3);
   AddProperty(_T("Offset"),              Offset = 0);
}

CTippingBucket::~CTippingBucket()
{
   Engine.IOModList.ClearChannelInUse(DIGITAL, ModName, Channel);
}

void CTippingBucket::ShowProperties(CWnd* pParent)
{
   TResourceKey key(DefLibSLL);
   CTippingBucketDlg dlg(pParent);

   dlg.m_Channel = Channel;
   dlg.m_FilterValue = FilterValue;
```

```
   dlg.m_IOMOD = ModName;
   if (dlg.DoModal() == IDOK)
   {
      // Update engine with regard to what module/channels combo is now in use.
      Engine.IOModList.ClearChannelInUse(DIGITAL, ModName, Channel);
      Channel = dlg.m_Channel;
      FilterValue = dlg.m_FilterValue;
      ModName = dlg.m_IOMOD;
      Engine.IOModList.SetChannelInUse(DIGITAL, ModName, Channel);
   }
}

void CTippingBucket::Initialize()
{
   // Initialize buffered output data.
   LastData.TimeScheduled = CTime::GetCurrentTime();
   LastData.TimeActual = CTime::GetCurrentTime();
   LastData.SensorID = Function;
   LastData.Quality = CSensorData::UNDEFINED;
   LastData.Data = 0;
   LastData.Units = _T("MM");

   DigitalIO* pDigIO = NULL;
   pDigIO = Engine.IOModList.GetDigitalIO(ModName);

   // Configure device channel.
   pDigIO->SetAsCounter(Channel);
   pDigIO->InvertIO(Channel);
   pDigIO->ConfigureFilters(Channel, FilterValue);
   pDigIO->SetSensitivityLow(Channel);
   pDigIO->StartRequest();
}

void CTippingBucket::Execute(TTime tScheduled)
{
   // Initialize sensor data.
   CSensorData Data = LastData;
   sdTips.TimeScheduled = tScheduled;
   sdTips.TimeActual = CTime::GetCurrentTime();
   sdTips.Quality = CSensorData::BAD;
   sdTips.Data = 0.0;

   // Get io module object.
   DigitalIO* pDigIO = Engine.IOModList.GetDigitalIO(ModName);
   if (pDigIO)
   {
      UINT32 nTips;
      if (pDigIO->ReadCount(Channel, nTips) == I2C_OK)
      {
         sdTips.Data = nTips;
         sdTips.Quality = CSensorData::GOOD;
      }
   }

   // Buffer output data.
   LockData();
   LastData = sdTips;
   UnlockData();
}

void CTippingBucket::Stop()
{
   DigitalIO* pIO = Engine.IOModList.GetDigitalIO(ModName);
   if (pIO)
      pIO->StopRequest();
   else
      Report.Error(_T("Failed to get handle to IO module."));
}

bool CTippingBucket::Calibrate()
{
```

```
   // TModule override called when user invokes calibration from View Sensors.
   double dOrigVal, dNewVal;
   dOrigVal = dNewVal = LastData.Data.AsDouble();
   if (IDOK == ChangeNumberDlgReal(NULL, dNewVal, _T("Enter current value")))
   {
      Offset = dNewVal - dOrigVal + Offset.AsDouble();
      return true;
   }
   return false;
}

bool CTippingBucket::I2CCalibrate()
{
   // TModule override called when user invokes calibration from Xlite display.
   DisplayIO::EditStatus Status;
   double OrigVal, NewVal;
   DisplayIO* pDisp = Engine.IOModList.GetDisplayIO(1);
   if (pDisp)
   {
      OrigVal = NewVal = LastData.Data.AsDouble();
      Status = pDisp->EditFloat( NewVal, _T("Cur.Val"),true, -1000, 5000);
      if (Status == DisplayIO::EDIT_OK)
      {
         Offset = NewVal - OrigVal + Offset.AsDouble();
         return true;
      }
   }
   return false;
}
```

6.6 SDI API – Example

```
void CSDI::Execute(TTime tScheduled)
{
   // Initialize raw output data.
   CSensorData sdRawData;
   sdRawData.Data = 0;
   sdRawData.TimeScheduled = tScheduled;
   sdRawData.TimeActual = CTime::GetCurrentTime();
   sdRawData.Quality = CSensorData::BAD;
   sdRawData.Units = m_propUnits;

   // Output command and get return data.
   int iRet;
   double dData[MAX_SDI_MEASUREMENTS];       // Results stored here.
   DWORD dwNumMeasurements;                  // Number of measurements taken.
   DWORD dwSDITimeout;                       // Max time in milliseconds to wait for result.
   iRet = CollectData(_T("0M!"), dData, MAX_SDI_MEASUREMENTS * sizeof(double),
         &dwNumMeasurements, dwSDITimeout, FALSE);
   if (!iRet)
   {
      sdRawData.Data = dData[0];
      sdRawData.TimeActual = CTime::GetCurrentTime();
      sdRawData.Quality = CSensorData::GOOD;
   }


   // Buffer output data.
   LockData();
   LastData = sdRawData[0];
   UnlockData();
}
```

6.7 Report Management API

Example of "hooking" into reporting mechanism.

```
void MyMessageHook(LPVOID pInfo, int iLevel, LPCTSTR szMsg)
{
   // pInfo contains info provided during Hook().
   // iLevel indicates level/type (status, error, debug, etc.) of message.
   // szMsg contains message.
}

void HookUp()
{
   // Tell report manager to give me all non-debug messages.
   Report.Hook(MyMessageHook, NULL);
   Report.SetFilter(MyMessageHook, TReport::msg_All & ~TReport::msg_Debug);
}

void UnHook()
{
   Report.UnHook(MyMessageHook);
}
```

6.8 Serial Communications

Example of using CSerialComm class in a sensor block's execute method. The presumption is the sensor is controlled serially.

```
// Header contains the following:
// CSerialComm m_port;
// TProperty m_propComPort;
```

```
void CMySerialSensor::Execute(TTime tScheduled)
{
   // <raw output data initialization not shown>

   // Make measurement.
   m_port.SetCommPort(_T("COM1:"));
   m_port.SetConfiguration(CBR_4800, 8, NOPARITY, ONESTOPBIT, FALSE);
   m_port.OpenComm();
   m_port.FlushInput();

   COMMTIMEOUTS CommTimeouts;
   CommTimeouts.ReadIntervalTimeout = 0;
   CommTimeouts.ReadTotalTimeoutConstant = 300;
   CommTimeouts.ReadTotalTimeoutMultiplier = 1;
   m_port.SetTimeouts(CommTimeouts);

   // Signal sensor to return measurement data.
   m_port.PutStr("O\r");

   TCHAR strData[BUF_LEN];
   int iNumChars = m_port.GetStr(strData, BUF_LEN - 1);
   {
      // strData now contains measurement, process as required.
   }

   m_port.CloseComm();

   // <Buffer of output data not shown>
}
```

Example of converting multi-byte strings to wide-character strings.

```
// pMBS points to multi-byte string (e.g., char* pMBS = "string")).
// iNumChars contains number of characters pointed to by pMBS.
TCHAR* psz = new TCHAR[iNumChars + 1];
mbstowcs(psz, (const char*)pMBS, iNumChars);
psz[iNumChars] = _T('\0');
// use psz;
delete[] psz;
```

6.9 Remote Communications using SSP

Example of using CSocketComm class and RemoteRequest() in order to dialout to a station over a modem and send an SSP alarm message. This sample can be built-in to and executed from an SLL created with the SDK. It will send an SSP Alarm message once a minute by dialing out the provided phone number once a minute. It will keep doing this until Xpert application is shutdown. The default phone number of 555-5555 and port of COM2: should be checked and/or changed.

The sample program automatically detects how the port was configured in Remote and will only dialout if an actual Modem or Voice modem was specified. If it’s a radio or direct connect port the message is transmitted without taking the extra steps of dialing out and making a connection.

This demo requires v1.4 or later of Remote.exe and the SDK, as RemoteRequest, and ENABLESSPPARSER do not exist in earlier revisions.

```
#include "../Engine/Engine.h"
#include "../Utils/Report.h"
#include "../Utils/Power.h"

// Various parameters used by the program that may be changed for your h/w
CWinThread* ModemThread;
const TCHAR PhoneNumber[] = _T("555-5555");
const TCHAR ComPort[] = _T("COM2:");
const int PortIndex = 2;               // COM2:
```

```
const TCHAR ToPath[] = _T("*");        // Send message to any station listening
const int NumRetries = 3;              // Try a message 3 times
const int AckDelay   = 10000;          // Wait up to 10 seconds for an ACK
const int AlarmInterval = 60000;       // How often to send alarms

// Function to build up an SSP Alarm Message by iterating thru the Tag List
bool BuildAlarmMessage(TSSPData& Data)
{
   CString Name;
   CTag* Tag;
   bool Result = false;

   Data.Clear();
   Data.Write(OpAlarm);

   Engine.LockTags();
   for (POSITION P=Engine.TagList.GetStartPosition(); P != NULL; )
   {
      Engine.TagList.GetNextAssoc(P, Name, Tag);
      if (Tag->IsCurDataTag())
      {
         TValue Value;
         int Type;
         CSensorData::QualityType Quality;
         Data.Write(Name);                        // Name of tag being sent
         Data.Write((UINT8) 2);                   // Always just 2 values for Alarm or CurData
         Tag->GetTag(0, Type, Value);             // Retrieve the data value of the tag
         Data.Write((UINT8) 0);                   // Indicate first value (1 of 2)
         Data.Write((UINT8) dt_real);             // Indicate data type
         Data.Write(Value.AsDouble());            // Add the data value to the packet
         Tag->GetTag(1, Type, Value, Quality);    // Retrieve alarm status of the tag
         Data.Write((UINT8) 1);                   // Indicate second value of the tag (2 of 2)
         Data.Write((UINT8) dt_alarm);            // Indicate data type
         Data.Write((DWORD) Value.AsInteger());   // Add the alarm value to the packet
         Result = true;
      };
   };
   Engine.UnLockTags();
   return Result;
};

// The top-level thread which manages dialing out, formatting, and sending the SSP alarm
UINT RemoteThread(LPVOID pParam)
{
   CSocketComm Port;
   Port.SetCommPort(ComPort);
   Port.SetConfiguration(CBR_9600, 8, NOPARITY, ONESTOPBIT, false);
   COMMTIMEOUTS CommTimeouts;
   CommTimeouts.ReadIntervalTimeout = 0;
   CommTimeouts.ReadTotalTimeoutMultiplier = 0;
   CommTimeouts.ReadTotalTimeoutConstant = 90000; // Allow 90 second timeout
   CommTimeouts.WriteTotalTimeoutMultiplier = 0;
   CommTimeouts.WriteTotalTimeoutConstant = 0;
   Port.SetTimeouts(CommTimeouts);

   TSSPData SendData;
   TSSPData ReplyData;
   CString ReplyTo;
   CString ReplyFrom;
   DWORD ReplySeqNum;
   // Matches is an array of possible messages we expect to be sent back
   OPMATCH Matches[2] = {OPMATCH(0, OpAck, OpAlarm), OPMATCH(0, OpNak, OpAlarm)};

   bool DialupConnect = false;
   bool VoiceConnect  = false;

   // Auto detect if we have a dial-up modem connected
   if (Port.OpenComm()) // Gain access to the port
   {
      int Options = 0;
      Port.GetComOptions(Options);
```

```
   DialupConnect = (Options & ISMODEM) != 0; // Detect Sutron or Hayes type Modem
   VoiceConnect  = (Options & ISVOICE) != 0; // Detect Sutron Voice Modem
   Port.CloseComm();
};

// Dialout once a minute, exit when the application stops
PowerMgr.SetSpeed(TPowerMgr::pwr_Minute); // Allow lowest power consumption mode of one minute
while (PowerMgr.WaitForSingleObject(Engine.GetAbortEvent(), AlarmInterval) == WAIT_TIMEOUT)
{
   PowerMgr.SetSpeed(TPowerMgr::pwr_Fast); // Switch to full speed so we don't drop any bytes
   if (DialupConnect)
   {
      if (Port.OpenComm()) // Gain access to the port
      {
         Report.Debug(_T("DEMO: Modem port %s opened"), ComPort);
         if (Port.LockComm(INFINITE)) // Request exclusive access
         {
            bool Connected     = true;
            Report.Debug(_T("DEMO: Modem port locked"));
            // SSP Processing is off by default after locking a port.
            // We need to turn it on so we can send the alarm.
            Port.EscapeCommFunction(SETDTR); // Enable the modem
            Port.FlushInput();
            if (VoiceConnect)
            {
               Report.Debug(_T("DEMO: Waiting for VOICE modem power up"));
               PowerMgr.Sleep(4000); // Voice modem requires a long power on delay
            }
            else
               PowerMgr.Sleep(250);
            // Enable result codes, disable command echo,
            // enable short form, enable RLSD, enable DTR to hangup,
            // and finally DIAL the Phone Number
            // Short form response codes have no line feed in header
            // and are ASCII numbers as opposed to strings, ("0" instead of "OK")
            Report.Debug(_T("DEMO: Dialing phone number %s"), PhoneNumber);
            Port.PutStr("ATQ0E0V0&D0&C1DT");
            Port.PutStr(PhoneNumber);
            Port.WaitForTxEmpty('\r');
            TCHAR Str[32];
            if (Port.GetStr(Str, 1))
            {
               Sleep(250); // Wait for more characters
               int BytesToRead = Port.NumberBytesInputBuffer();
               if (BytesToRead > (sizeof(Str) - 2))
                  BytesToRead = sizeof(Str) - 2;
               if (BytesToRead)
                  Port.GetStr(Str+1, BytesToRead);
               Report.Debug(_T("DEMO: Modem response: %s"), Str);
               Sleep(1000);
            }
            else
            {
               Report.Debug(_T("DEMO: No response from modem"));
               Connected = false;
            };
            if (Str[0] == '3') // Check for NO CARRIER response from the modem
               Connected = false;
            DWORD Status = 0;
            Port.GetCommModemStatus(&Status);
            // Carrier Detect (ie RLSD) should be high if the modem connected
            if ((Status & MS_RLSD_ON) == 0)
               Connected = false; // no CD so we're obviously not connected
            if (Connected)
            {
               // Build up the Alarm Message to send
               if (BuildAlarmMessage(SendData))
               {
                  // SSP Processing and Parsing is turned off by default when use LockComm()
                  // but we need to enable them so RemoteRequest() can function
                  Port.SetComOptions(ENABLESSP | ENABLESSPPARSER, ENABLESSP | ENABLESSPPARSER);
```

```
                  Port.SetCapture(false); // No need to waste processing power capturing info we
                                          // don't need.
                  // Command Remote to send the SSP Request and wait for the response
                  int Result = RemoteRequest(PortIndex, ToPath, Engine.StationName,
                        GetFlagSeq(), SendData, 2, Matches, ReplyTo, ReplyFrom, ReplySeqNum,
                        ReplyData, NumRetries, AckDelay);
                  if (Result == 0) // See if it was the first match ie OpAck
                  {
                     Report.Status(_T("DEMO: Modem alarm message sent, ack received, and ")
                           _T("alerts cleared."));
                     Engine.ClearAlert();
                  }
                  else if (Result < 0)
                     Report.Warning(_T("DEMO: Timed out sending a Modem alarm ")
                           _T("message (code=%d)."), Result);
                  else
                     Report.Warning(_T("DEMO: Tried to send a Modem alarm message, ")
                           _T("but it was rejected (NAKed)."));
               }
               else
                  Report.Warning(_T("DEMO: No ComTags to send, please add some to the setup."));
            }
            else
               Report.Debug(_T("DEMO: Modem Connect failed"));

            // We might do the following commented out commands if we were intending to
            // communicate directly with the modem some more, but since we're all done, we
            // can just UnLock() and Remote will take care of hanging up and restoring the
            // settings:

            // SetCapture(true);
            // SetComOptions(0, ENABLESSP | ENABLESSPPARSER);
            // Port.EscapeCommFunction(CLRDTR); // Hangup the modem

            Port.UnLockComm();
            Report.Debug(_T("DEMO: Modem port unlocked"));
         };
         Port.CloseComm();
            Report.Debug(_T("DEMO: Modem port closed"));
      }
   }
   else // Radio or Direct Connect - No need to even open the com port for this case
   {
      Report.Debug(_T("DEMO: Sending alarm to %s"), ComPort);
      // Build up the Alarm Message to send
      if (BuildAlarmMessage(SendData))
      {
         // Command Remote to send the SSP Request and wait for the response
         int Result = RemoteRequest(PortIndex, ToPath, Engine.StationName,
               GetFlagSeq(), SendData, 2, Matches, ReplyTo, ReplyFrom, ReplySeqNum,
               ReplyData, NumRetries, AckDelay);
         if (Result == 0) // See if it was the first match ie OpAck
         {
            Report.Status(_T("DEMO: Alarm message sent, ack received, and alerts cleared."));
            Engine.ClearAlert();
         }
         else if (Result < 0)
            Report.Warning(_T("DEMO: Timed out sending an Alarm message (code=%d)."), Result);
         else
            Report.Warning(_T("DEMO: Tried to send an Alarm message, but it was ")
                  _T("rejected (NAKed)."));
      }
      else
         Report.Warning(_T("DEMO: No ComTags to send, please add some to the setup."));
   };
   PowerMgr.SetSpeed(TPowerMgr::pwr_Minute); // Allow lowest power consumption mode of one minute
};
    return 0;
}
```

```
//////////////////////////////////////////////////////////////////////
// App Init and Exit Callbacks
// Modifications to AppInit() necessary to start the thread.
extern "C" _declspec(dllexport) void AppInit()
{
   ModemThread = AfxBeginThread(RemoteThread, NULL);
}

// Modifications to AppExit() necessary to shutdown the thread.
extern "C" _declspec(dllexport) void AppExit()
{
   Report.Debug(_T("DEMO: Stopping Alarm thread"));
   PowerMgr.WaitForSingleObject(ModemThread->m_hThread, INFINITE);
   Report.Debug(_T("DEMO: Finished"));
}
```

6.10 Log API

1. CLogDesc class is used to create, open, name, and write (append) to a log.
2. LOGCURSOR and LOG classes are used to read from a log
3. Example: The following example searches for a log named “MyLog”. If the log is not found, it is created and a note is appended to it. Once the log is either found or created, its contents are printed as status messages.

```
void FindAndDumpLog(const CString& strName)
{
   // Find log named strName
   CLogDesc* pLog = NULL;
   bool bFound = false;
   POSITION pos;
   for (int i = 0; i < LogList.GetCount(); i++)
   {
      pos = LogList.FindIndex(i);
      pLog = LogList.GetAt(pos);
      if (!strName.Compare(pLog->GetName()))
      {
         bFound = true;
         break;
      }
   }

   // Create the log if it did not exist.
   if (!bFound)
   {
      // Create a log named strName 4k size, wrap on, don't ignore bad data.
      // Log is closed and opened after creating to commit to flash.
      pLog = (CLogDesc*)new CLogDesc(strName, 4096, true, false);
      pLog->Create();
      pLog->log.Close();
      pLog->Open();

      // Add log to list maintained by system.
      LogList.AddHead(pLog);
   }

   // Get cursor into log for reading contents.
   LOGCURSOR Cursor(pLog->log);

   // Data used during read.
   CString strLine;
   INT64 Time;
   TCHAR Note[128];
   UINT8 Quality = 0;
```

```
   LVDATAITEM di;
   int nDataLineCount = 0;
   int MaxLines = pLog->log.GetLineCount() + 100;

   // Start reading from top of log (oldest data).
   if (Cursor.GotoTop())
   {
      // Do until number of lines read test exceeds available, or until
      // MoveNext fails (see below).
      for(;;)
      {
         // Function called to read is different for notes versus data.
         if (Cursor.IsNote())
         {
            Cursor.ReadNote(Time, Note);
            if (Time < 0) Time = 0;
            CTime timestamp((time_t)Time);
            wsprintf(di.Time, _T("%02d:%02d:%02d"), timestamp.GetHour(),
                  timestamp.GetMinute(), timestamp.GetSecond());
            wsprintf(di.Date, _T("%02d/%02d/%4d"), timestamp.GetMonth(),
                  timestamp.GetDay(), timestamp.GetYear());
            strLine.Format(_T("%s,%s,%s,,,\r\n"), di.Date, di.Time, Note);
         }
         else if (Cursor.IsRecord())    // Record type of data
         {
            // read data
            Cursor.ReadRecord(Time, di.Sensor, di.Data);

            // format data
            if (Time < 0) Time = 0;
            CTime timestamp((time_t)Time);
            wsprintf(di.Time, _T("%02d:%02d:%02d"), timestamp.GetHour(),
                  timestamp.GetMinute(), timestamp.GetSecond());
            wsprintf(di.Date, _T("%02d/%02d/%4d"), timestamp.GetMonth(),
                  timestamp.GetDay(), timestamp.GetYear());
            strLine.Format(_T("%s,%s,%s,%s\r\n"), di.Date, di.Time, di.Sensor, di.Data);
         }
         else
         {
            Cursor.ReadSensor(Time, di.Sensor, di.Units, Quality, di.Data);
            if (Time < 0) Time = 0;
            CTime timestamp((time_t)Time);
            wsprintf(di.Time, _T("%02d:%02d:%02d"), timestamp.GetHour(),
                  timestamp.GetMinute(), timestamp.GetSecond());
            wsprintf(di.Date, _T("%02d/%02d/%4d"), timestamp.GetMonth(),
                  timestamp.GetDay(), timestamp.GetYear());
            if (Quality == CSensorData::GOOD)
               lstrcpy(di.Quality, _T("G"));
            else if (Quality == CSensorData::BAD)
               lstrcpy(di.Quality, _T("B"));
            else if (Quality == CSensorData::UNDEFINED)
               lstrcpy(di.Quality, _T("U"));

            strLine.Format(_T("%s,%s,%s,%s,%s,%s\r\n"), di.Date, di.Time,
                  di.Sensor, di.Data, di.Units, di.Quality);
            Report.Status(strLine);
         }

         // Do until no more to read.
         if (!Cursor.MoveNext() || nDataLineCount++ > MaxLines)
            break;
      }
   }
}
```