MSIcode Scripting Technology

for Windows Installer

An InstallAware Whitepaper

August 2007

INSTALLAWARE STUDIO
INSTALLAWARE STUDIO
Copyright © InstallAware 2003-2006 (www.installaware.com) All Rights Reserved.

Contents

Introduction

In addition to the visual setup editors found in most setup authoring tools, InstallAware provides a human readable, branching setup script called MSIcode. Available only with InstallAware, MSIcode offers a drag-drop scripting environment that introduces branching, script-driven execution logic into Windows Installer. Yet, InstallAware does this without requiring any external scripting engine that needs to be installed as a scripting runtime before-hand. InstallAware automatically compiles the MSIcode setup script into a pure, independent, 100% logo compliant MSI file at build time. This shifts the burden of properly populating MSI database tables and creating custom actions (the latter an especially error prone process) from the developer to the setup IDE, providing developers with unprecedented levels of flexibility in coding their setup logic. Such flexibility was unavailable since the initial launch of Windows Installer in 1999.

MSIcode

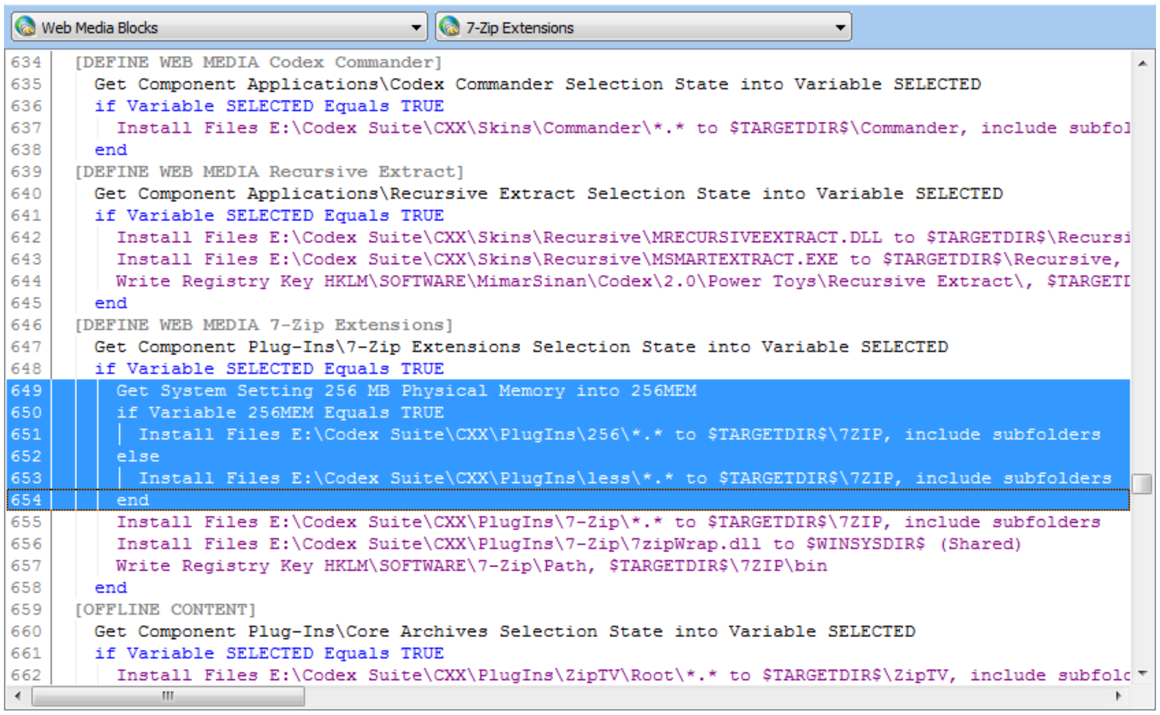
One of the key strengths of InstallAware 7 is the unique architecture it employs for creating Windows Installer packages.

While all other setup tools for Windows Installer provide high level visual editors for creating Windows Installer packages, none of them offer a native scripting capability for Windows Installer. Any scripting that is offered either requires an external scripting engine, which needs to be pre-installed and thus adds an extra layer of complexity to setups; or executes directly through another scripting technology which does not require to be pre-installed before use.

Even though this approach is suitable, it bifurcates installation projects into two disparate sets – one that goes through Windows Installer, and another that goes through the third party scripting engine (which may or may not need to be pre-installed). Separate editors and environments must be mastered for these two independent aspects of setup projects, and this increases the burden on the developer. It also complicates the development process as the two separate parts can interact with each other in unexpected ways and have unexpected dependencies. InstallAware has addressed this problem since its very first release in a conceptually clean, technically sound manner.

Types of MSIcode Commands

InstallAware 7 presents a single, unified MSIcode script which effectively deals with the bifurcation problem. The MSIcode script is the heart of the installation and has complete control over what happens – and when.



```
[DEFINE WEB MEDIA Codex Commander]
  Get Component Applications\Codex Commander Selection State into Variable SELECTED
  if Variable SELECTED Equals TRUE
    Install Files E:\Codex Suite\CXX\Skins\Commander\*.* to $TARGETDIR$\Commander, include subfol
  end
[DEFINE WEB MEDIA Recursive Extract]
  Get Component Applications\Recursive Extract Selection State into Variable SELECTED
  if Variable SELECTED Equals TRUE
    Install Files E:\Codex Suite\CXX\Skins\Recursive\MRECURSIVEEXTRACT.DLL to $TARGETDIR$\Recursi
    Install Files E:\Codex Suite\CXX\Skins\Recursive\MSMARTEXTRACT.EXE to $TARGETDIR$\Recursive,
    Write Registry Key HKLM\SOFTWARE\MimarSinan\Codex\2.0\Power Toys\Recursive Extract\, $TARGETI
  end
[DEFINE WEB MEDIA 7-Zip Extensions]
  Get Component Plug-Ins\7-Zip Extensions Selection State into Variable SELECTED
  if Variable SELECTED Equals TRUE
    Get System Setting 256 MB Physical Memory into 256MEM
    if Variable 256MEM Equals TRUE
      Install Files E:\Codex Suite\CXX\PlugIns\256\*.* to $TARGETDIR$\7ZIP, include subfolders
    else
      Install Files E:\Codex Suite\CXX\PlugIns\less\*.* to $TARGETDIR$\7ZIP, include subfolders
    end
    Install Files E:\Codex Suite\CXX\PlugIns\7-Zip\*.* to $TARGETDIR$\7ZIP, include subfolders
    Install Files E:\Codex Suite\CXX\PlugIns\7-Zip\7zipWrap.dll to $WINSYSDIR$ (Shared)
    Write Registry Key HKLM\SOFTWARE\7-Zip\Path, $TARGETDIR$\7ZIP\bin
  end
[OFFLINE CONTENT]
  Get Component Plug-Ins\Core Archives Selection State into Variable SELECTED
  if Variable SELECTED Equals TRUE
    Install Files E:\Codex Suite\CXX\PlugIns\ZipTV\Root\*.* to $TARGETDIR$\ZipTV, include subfolc
```

The MSIcode script contains several different classes of commands:

- Comments: As found in all programming environments, comments are hints for the developer.
- Flow Control: Commands that direct program flow into alternate branches based on the evaluation of conditions.
- Plug-In: Custom plug-in provided commands.
- Directive: Directives to the MSIcode compiler, such as compiler variables, conditionally including/excluding certain types of code, and web media block declarations.
- Windows Installer: Commands that have direct correlates in the MSI database that is created at build time. Most commands that actually install the application (as opposed to, for instance, displaying dialogs and controlling program flow) fall in this category.

- Modify System: Commands that apply the pending changes to the system (an installation, advertising, patching, or an uninstallation).
- Label: Labels for use in directing program flow control.
- Statement: Any scripting command that either obtains system information, or makes direct, immediate changes to the system without going through the Windows Installer engine.

If you are a developer familiar with other Windows Installer authoring tools, you may find it easy to think of every command type, except Windows Installer commands, as custom actions. In effect, they are custom actions that are executed by the InstallAware engine. And, InstallAware also achieves conditional flow for your Windows Installer commands. The two combined together in a single setup script effectively eliminates the bifurcation problem with zero technical/conceptual overhead. Plus, the need to author and schedule custom actions – a very error prone, innately complex task – is eliminated, thanks to the richness of the MSIcode commands, and the wide range of pre-built installation behavior they cover.

Achieving Conditional Program Flow with Windows Installer

Windows Installer does not permit conditional program flow – that is, the developer may not create setups with execution logic like the following:

```
If Variable X is True then
  Install File Set A
Else
  Install File Set B
End
```

Windows Installer does permit attaching conditions to each component that installs, however this is a very inconvenient and counter-intuitive way of achieving conditional program flow, and in most cases is not a functional equivalent of conditional program flow either.

InstallAware, with its unique MSIcode technology, makes conditional program flow possible. Inside your MSIcode script, you are free to use as many Windows Installer commands as you like, and you may enclose those commands inside as many nested conditional commands as you want, directing program flow according to your installation requirements. This flexibility lets you focus on the actual logic of your setup, and gets your application installed correctly on a diverse array of hardware and software platforms, without having to worry about the implementation details on the Windows Installer side.

When you build your setup, InstallAware does several things behind the scenes:

- It parses your MSIcode for Windows Installer commands, and populates the necessary MSI table structures for them, and
- It attaches a unique condition to each Windows Installer command.

At runtime, as the InstallAware setup driver runs your MSIcode, when it comes across Windows Installer commands, it sets their unique condition to "execute". And when the InstallAware setup driver encounters a Modify System command, it applies all pending installation (or uninstallation) changes to the system. This mechanism constitutes the heart of MSIcode, and very effectively creates the effect of conditional program flow on the Windows Installer platform, embracing and extending MSI technology to do what could not be done before. MSIcode will save you countless hours of development and testing time when building setups that require complex installation logic.

A Single Script for Installs, Maintenance, and Uninstalls

Another time saving feature offered by MSIcode technology is having a unified script for the entire install/maintain/uninstall cycle. If parts of an application are to be removed during a maintenance operation, and other parts added, absolutely no additional scripting code is required to install the new parts, or remove the old parts. And of course, no scripting code is required to remove all installed parts during an uninstallation.

A script with manual coding for the install/maintain/uninstall cycles could look like the following:

```
If Installing or Maintaining
  If Feature A is Selected
    Install File Set A
  If Feature B is Selected
    Install File Set B
End

If Maintaining
  If Feature A is Not Selected
    Remove File Set A
  If Feature B is Not Selected
    Remove File Set B
End
```

```
If Uninstalling
  Remove File Set A
  Remove File Set B
End
```

With InstallAware, you have a much simpler script that does everything in one place. If parts of your application are no longer needed, InstallAware automatically removes them (during either a maintenance operation, or an uninstallation) – no manual coding is necessary. If new parts of your application must be installed, InstallAware automatically adds them. All powered by the same block of code – including the first time install:

```
If Uninstalling
  Modify System: Apply Uninstall

If Installing or Maintaining
  If Feature A is Selected
    Install File Set A
  If Feature B is Selected
    Install File Set B
  Modify System: Apply Install
End
```

When you compare the two code listings above, you immediately see that MSIcode, through its unified scripting model, saves you many lines of manual coding for the maintenance and uninstallation cycles of your application, while still operating on a highly customizable scripting model.

Limitations of MSIcode

Because each InstallAware setup is still based on Windows Installer technology, there are some unavoidable restrictions. Fortunately these are very few, and will not impact most setups. Moreover, these restrictions would apply to any setup based on Windows Installer technology – regardless of whether InstallAware or another Windows Installer tool was used.

The first limitation is that loops are not supported. While the InstallAware script contains constructs that allow you to code loops, if you execute a Windows Installer statement multiple times within a loop, only the last iteration of that command will actually run on the target system. Because InstallAware cannot determine at compile time the number of times a command located inside a loop may execute, it can populate only a single set of Windows Installer table structures for that command. At runtime, even though the command may execute multiple times, only its last iteration will have any effect. This is because only the last execution's setting of internal Windows Installer conditions will survive – the previous internal conditions will all have overridden one another.

The second limitation is that no changes are actually made to the target system when a Windows Installer command executes. You may think of this as InstallAware caching and queuing the command for deferred execution. The deferred commands are all executed at once when one of the Modify System commands are called (Apply Install, Apply Advertised, Apply Patch, Apply Uninstall). Apply Install installs the application, Apply Advertised installs the application in advertised mode, Apply Patch patches a previously installed application, and Apply Uninstall removes an application. Because Windows Installer does not permit conditional program flow, the only alternative to this approach would be immediately applying changes to the system any time a Windows Installer command was called. While the InstallAware development team investigated this option early during development, it caused extremely severe drawbacks in execution time and was abandoned.

The impact of either limitation on installation development is very small.

For the first limitation, very rarely would commands that change the target system reside inside a loop. In fact, in the entire range of setup scripts developed by InstallAware Software Corporation, including internal development and external consulting projects, none of the setups had this requirement.

As for the second limitation, conditions that require setup commands to be applied immediately are also rare – they only occur under circumstances in which the setup flow branches based on the outcome of a preliminary setup command. If you do have a need for such branching, you will be relieved to learn that InstallAware allows you to call the Apply Install command more than once in your script, effectively sidestepping this limitation. The only drawback is that each time Apply Install is called, the Windows Installer engine is invoked – which performs a complete installation routine every time. Therefore calling Apply Install multiple times may degrade your installation speed, especially if the calls come after large blocks of file copy operations.

"Non-Windows Installer" MSIcode Commands

As extensive a setup engine Windows Installer is, it does not provide the total set of installation commands – and conveniences – that one expects to find in a complete, self-contained installation authoring environment. InstallAware 7 provides an extended, user customizable set of MSIcode commands which save you both time and effort in developing application installations.

Get System Information

Built-in MSIcode commands, which fall under the generic Statement category, offer ways to obtain extensive system information, including hardware properties (physical memory, display resolution), software properties (the running operating system, third party applications), user properties (privilege level, logged on user/domain/computer name), and more.

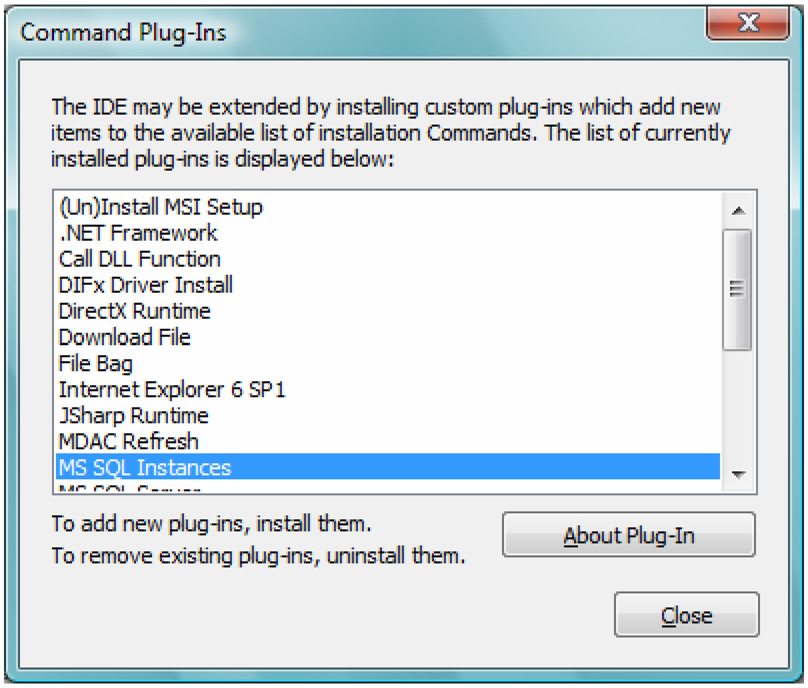
Advanced Install Actions

Statements are also available which perform advanced installation actions. For instance, you may create and update IIS websites and virtual folders. You can share folders or remove existing shares. You may set permissions on file system, registry, or other types of system objects. You may connect to a wide variety of database platforms and execute SQL scripts, including MS SQL, My SQL, and Oracle database servers (no client software is required on the target machine to connect to remote servers).

Run Programs, Call Dynamic Link Libraries

A very convenient way to extend the behavior of your MSIcode scripts is to call outside code – especially if you’ve already encapsulated such code into stand alone executable files or dynamic link libraries. InstallAware lets you run any external program, or call any arbitrary dynamic link library function with a variable list of parameters, all directly from your MSIcode script. The InstallAware 7 IDE also makes it even easier to run programs in your setup finish dialog, or before/after the main installation/uninstallation.

Plug-In Extensibility



The IDE may be extended by installing custom plug-ins which add new items to the available list of installation Commands. The list of currently installed plug-ins is displayed below:

(Un)Install MSI Setup
.NET Framework
Call DLL Function
DIFx Driver Install
DirectX Runtime
Download File
File Bag
Internet Explorer 6 SP1
JSharp Runtime
MDAC Refresh
MS SQL Instances

To add new plug-ins, install them.
To remove existing plug-ins, uninstall them.

Whenever you find that InstallAware MSIcode scripting falls short of meeting your needs (and such cases ought to be rare), you can always tap the power of your favorite programming language and directly code what you want to do in the development environment that you are most comfortable and productive in. InstallAware is plug-in extensible, and what's even better, each plug-in command also looks and works just like a native part of your MSIcode: It is visible in the script editor, can be copied/cut/pasted like any other MSIcode command, and has full access to the state of the installation, including reading from/writing to script variables.

InstallAware ships with several pre-built plug-ins that perform various tasks, and also includes two plug-in templates for plug-ins implemented using the Visual C++ and Delphi programming languages. Of course, you may develop your own plug-ins in any environment capable of creating standard Win32 DLLs.

InstallAware community members have built and donated freeware plug-ins performing a very wide variety of tasks, available for free download and immediate use on the community website.

InstallAware

Two-Way Integrated Design Views

One of the most time-saving features when scripting MSIcode, and one that has been greatly enhanced in the InstallAware 7 release, are the design views that represents the installation actions taken by MSIcode graphically.

Just click the Design tab to access the design views. The design views intelligently parse your MSIcode script and also work with highly customized scripts. 31 separate designers represent different aspects of your installation, from files being installed to your setup dialogs. Whenever you make changes in a designer, it automatically updates the underlying MSIcode for you. It will do so without damaging your existing setup logic and correctly insert/remove MSIcode statements where applicable.

The design views are a great time saver and help you make the best of your MSIcode script – by letting you avoid custom scripting unless absolutely necessary.

Automation Interface

While scripting MSIcode in the InstallAware 7 IDE is a fun and enjoyable process, there may be times in which you need to programmatically emit MSIcode scripts without depending on the IDE. For instance, you may be building a large set of installers with very similar features but different branding/names for your network of resellers. Especially if you have a large number of resellers and installers to customize, this could very quickly escalate into a development nightmare.

With the automation interface in InstallAware 7, you get full programmatic access to MSIcode scripts. Directly from your own external programs, you may:

- Emit a complete MSIcode script, line by line
- Emit a setup project, with its own settings, dialogs, support files, and such
- Build a release, or a patch

This provides unprecedented flexibility in developing installers. Continuing our reseller scenario, you could build a website where each reseller could log on to their account, and upload their custom graphics and text for their brand/version of the product. Then they would click a “Build Installer” button which would immediately invoke the InstallAware automation interface, emit and build their setup, and deliver the download link. Any time you updated your software to a newer version, you wouldn’t have to worry about manually updating the many installers for your resellers either! You’d just let them know that you have a newer version available, and they could all log on to their accounts and generate their personalized installers – all delivered by the InstallAware automation interface.

This is just one example for a case where InstallAware automation takes a major burden off of your shoulders. There are countless other uses for this technology. Some InstallAware licenses even permit you to redistribute the automation libraries, so you can emit and build installers directly on end-user systems! For instance, consider a screen saver creator application – each screen saver it generates would also need an installer. Developing a home made installer for the screen savers produced would be a major undertaking. With a redistributable automation interface, you can simply call the InstallAware library functions and let InstallAware do what its best at – building setups – while you get to focus on your core expertise.

The automation interface is cleanly encapsulated inside Win32 DLLs which can be called from any Windows programming language. The automation interface also provides an ASP object which can be called from an Active Server Pages website.

The InstallAware Customer Site, which vends licenses to developers who have purchased InstallAware, uses the automation interface to create watermarked installers that contain the name of the individual or organization that purchased the license.

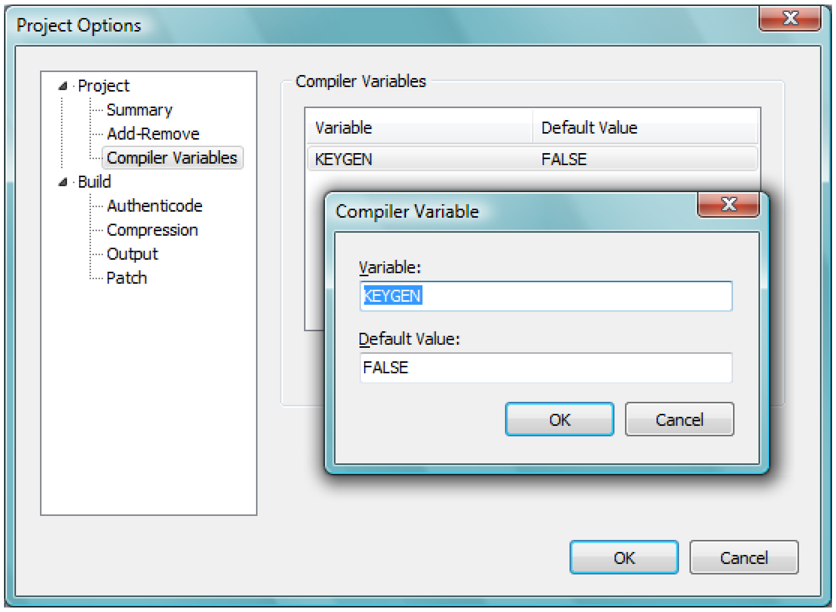
Compiler Variables

There may also be cases in which you need to customize your installers – but not as thoroughly as needing to use the automation interface. For instance, you may have several editions for a product, each with progressively more features and higher prices. When building the installers for these various editions, instead of coding multiple scripts for each, you would rather code and maintain a single script. In this case, using the automation interface would be overkill – another way to quickly customize the script becomes necessary.

Compiler variables are resolved at build time, and let you achieve the following:

- Include or exclude various parts of MSIcode based on compiler variable values
- Substitute compiler variables used in MSIcode commands with their literal values

Continuing our example with the various editions, you could use Compiler Variable If statements to conditionally include/exclude parts of your MSIcode, and hence, application files, based on the product edition. You could also use compiler variables directly in MSIcode commands for build time substitution of their values into the script (such as, the edition name).



Variable	Default Value
KEYGEN	FALSE

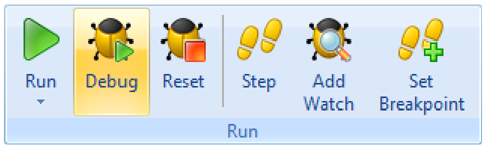
Variable: KEYGEN

Default Value: FALSE

Compiler variables, and their values, are defined in the Project Options window. The values specified in the Project Options window may also be overridden while building from the command line, or via the automation interface. Coupled with the redistributable command line build interface that is provided with higher-end InstallAware editions, compiler variables may also be used to create customized installation packages directly on end-user systems – again without having to use the automation interface to programmatically emit full setup projects from scratch.

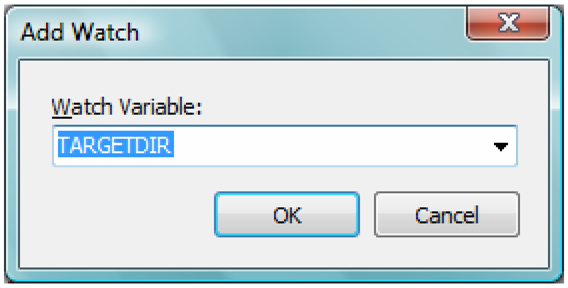
Integrated Debugging

Despite the beauty and power of MSIcode, or perhaps because of it, the need to debug the scripts you have developed in InstallAware will arise sooner or later. Along with the canonical MessageBox command that can be used to output values of variables to the screen, InstallAware 7 provides a visual, integrated debugger right within the main IDE.



The run group on the MSIcode tab contains all the debugging commands you need:

- Start debugging
- Step through MSIcode line by line
- End a debug session
- Add variable watches
- Set breakpoints on MSIcode statements



TARGETDIR

You may also override the values of variables while in a debugging session to test alternate routes of program flow.

Summary

InstallAware achieves what no other installation development environment can, providing you with state-of-the-art tools that save you time and effort while building modern application installations. InstallAware's unique fusion of scripting, web deployment, and Windows Installer technologies makes InstallAware the ultimate setup development solution.

About InstallAware Software Corporation

Focusing solely on the Windows Installer (MSI) platform for Microsoft Windows operating systems, InstallAware is the premier provider of software installation tools for Internet deployment. Founded in 2003, InstallAware is supported by thousands of users worldwide, and is a Borland Integrated Partner. For more information, visit www.installaware.com.