

Remote Process Control over the Internet

Mark Smith

Purdue University North Central

Abstract

This paper presents remote process control over the Internet using remote-control computing software. Remote-control computing software allows you to connect to remote computers from your computer and control those systems. You can monitor and control attached system processes, provide problem solving assistance, upload and download files, and even change system parameters. This paper describes what remote-control computing is, who the major players in the industry are, and how it can be used to monitor and control remote processes. A case study of remote-control computing software in operation is also presented, describing how one off-the-shelf package was setup to monitor and control a plant floor production system.

Introduction

Networking technologies, and especially the Internet, have become a major component of application systems. As we teach the design and implementation of process control systems in the Engineering curriculum, we must recognize that these systems will require capabilities for control and support from remote locations. For example, the need for remote control may be driven by the high cost of a particular process. The Oak Ridge National Laboratory uses remote process control at its High Temperature Materials Laboratory to allow researches from across the country to use a million-dollar electron microscope¹.

Even when control of the process is not required across the country, there are times when it is helpful (or even critical) to monitor another node on a LAN. For example, Conquergood describes in his research the ability to monitor and control potentially high voltages from one location by gathering voltage information from PCs doing data acquisition from various plant processes².

While some research in this area has focused on custom solutions to provide remote control over the Internet³, this paper will examine the issues involved in implementing remote process control using off-the-shelf remote-control computing software. This approach separates the process control system from the remote-control software, resulting in several advantages. The process control system can be developed without worrying about the complexities involved in remote-process control. The remote-control system can be developed independently of the process involved, making it useful for many applications. Educators need not worry about integrating remote-control computing into process design and development curriculum, as remote-control computing can be taught as a computer literacy subject, like word processing or spread sheet computing.

Remote-control computing

Remote-control computing refers to the ability of one computer system to control another computer system from a remote location. It is implemented over a network using software that

resides on both computers. One system acts as the Host (or server) and the other system as the Guest (or remote controller). The guest system takes control of the host system.

There are many software packages that provide some level of remote-control processing capability. Generally, they are categorized into two groups: consumer-oriented remote control and enterprise system remote control⁴. The marketplace is very active, with new features and functionality for these products appearing quarterly⁵. Enterprise remote-control products have the highest level of functionality and are the focus of this paper.

Remote Process Control refers to the ability to monitor and control a business process from a remote location. The business process may include a plant PC connected to other plant devices like PLCs, data collection equipment, or other computer systems. The remote and host computer systems are often running different operating systems. Connectivity from the remote to the host computer may also take various forms, with the Internet often the connection of choice.

The role of remote-control computing for Process Control

1. Monitoring & Control

As stated earlier, remote-control computing software allows you to connect to remote computers from your computer, and control those systems as if you were right there in front of them. This allows you to access applications on the host system and any other equipment attached to it, including other systems on the same LAN or WAN. You can monitor and control the processes controlled by the host, and run applications on network servers and other operating system platforms.

2. Maintenance & Support

Many problems with process control systems can be resolved remotely when they occur, by taking over control of the host computer. You can run the software, confirm input requirements, check output, etc., and in fact, try anything you would do if you were sitting at their keyboard. You can even transfer files - interactively sending and receiving data or programs that may assist with your problem resolution activities or to update the host system software.

Remote-control computing software

There are many players in the remote-control software marketplace. Many of the consumer-oriented products are available as Freeware or Shareware. These products provide some level of remote-control and/or file transfer capability, but generally do not contain all of the features and functions required by the enterprise system user. Information identifying many of these programs and their capabilities can be downloaded from the Internet⁶.

The following table consists of a number of the more robust enterprise system remote-control software packages.

Software Package Name	Developer
Carbon Copy	Compaq Computer Corporation
ControllIT	Computer Associates International

CoSession Remote	Artisoft
Laplink	Traveling Software
NetOP Remote Control for Windows	Cross Tec Corporation
PcAnywhere	Symantec Corporation
PCDuo	Vector Networks
Proxy	Funk Software
ReachOut Enterprise	Stac Software
Timbuktu Pro	Netopia
VNC	Oracle Research Laboratory

Table 1: Enterprise System Remote-Control Software

Features & Functions

The features and functions of these software packages fall into the following categories:

1. Remote control capabilities: what you can do/control on the host machine. This describes the extent to which the remote-control system can recognize and utilize the hardware and software components on the host⁷. This might range from limited capabilities on the host computer all the way to being able to run programs on any network server attached to the host.
2. Connectivity: the options for connecting the guest system to the host system. Most remote-control software products offer multiple connectivity options that may include: direct connect (cabled serial or parallel ports), modem to modem, LAN, WAN, Internet, and wireless infrared. Most systems utilize TCP/IP communications.
3. Supported operating systems: the operating environments supported by the software. Most of the packages support only the Microsoft Windows environments, although VNC and Timbuktu support Apple MacIntosh, and VNC also supports Unix.
4. File Transfer: the ability to transfer files and programs between the guest and host systems. Features of this capability include the ability to handle long file names, drag and drop transfer functions, the ability to synchronize files so that they are the same on both systems, and the ability to continue interrupted file transfers.
5. Security: this includes password protection of the guest and host systems, encryption of data transmissions, virus protection, and host system screen blanking and keyboard locking to prevent onlookers from observing confidential processing⁸.
6. Printer redirection: the ability to print at both the guest and host locations.
7. Chat: the ability to conduct a PC chat with a user at the host site during the remote-control session.
8. Drive mapping: the ability to map the disk drives from the host system to the remote system so that the remote system may use the files and programs located on them as if they were local disk drives.

Product Ranking

In my research, I was able to find three different organizations that have tested and ranked some, though not all, of the remote-control software packages listed in the table above. The test criteria was similar in all three organizations; focusing on performance in terms of screen refresh and file transfer speeds, security features, remote-control functionality, and ease of use.

The comparison done by Network Computing concentrated on solutions that offered operating system and network integration, advanced security options, and enhanced network installation capabilities⁹. The News-Times Computer News focused on security and connectivity, as well as remote-control functionality¹⁰. Smart Computing looked at file transfer features, security, and chat capability in addition to remote-control ability¹¹. All three organizations were unanimous in selecting Symantec's pcAnywhere product as their remote-control product of choice.

pcAnywhere

1. Supported hardware & software platforms

Designed for the PC architecture, Symantec's pcAnywhere was one of the first remote-control software products available. While the current product level (pcAnywhere 32) was developed for Windows/9X, Windows NT, Windows 2000 and Windows ME environments, it is backwards compatible to Windows 3.1 and DOS¹².

2. Connection options

pcAnywhere can be configured to connect via modem, serial port, parallel port, infrared connection, ISDN connection, and several network protocols including TCP/IP, Novell and netBIOS. Access over the Internet is achieved by using the TCP/IP protocol over a dial-up or dedicated connection to an Internet Service Provider.

3. Security features

Security is a primary consideration when you run a remote-control host on a critical system, especially if it is networked to other systems. You can setup passwords at both the host and guest system to protect the configuration data from being viewed or modified by unauthorized people¹³. Several levels of data encryption can be invoked to protect data transferred between the systems. You can even blank the host screen and lock the keyboard and mouse so that people present at the host site cannot observe confidential information.

4. File transfer

pcAnywhere provides a File Manager window of files and directories for both the guest and host systems. You can drag and drop, select a group of files or directories to transfer, and synchronize (or clone) files between systems. Files are compressed for transmission and transfers can be restarted from where they left off if the connection temporarily drops.

5. Miscellaneous functions

Drive mapping, virus checking, and interactive chat between the guest and host systems are also supported by pcAnywhere.

Software Installation

The minimum system requirements to run pcAnywhere are:

- 486sx 25MHz processor or higher
- 16 MB of RAM (20 recommended)
- 32 MB of hard disk space
- VGA video minimum
- Windows 95/98, Windows NT Workstation and Server 4.0
- CD-ROM drive

Installation is very simple and can be accomplished in just a few minutes. Just load the distribution CD into your drive and select “Install Software”. An installation wizard is loaded that guides you through the process. Documentation and technical manuals are also included on the distribution CD.

Host Setup & Operation

Host systems can be easily setup to allow remote control over the Internet. To create a host environment, start the pcAnywhere program, and then click on the “Be a Host PC” tool bar icon. Next double-click on the “Add Be a Host PC Item” icon to start a wizard to guide you through the process. The first thing you must enter is a name for this host session. Next, select the connection option you want to use. Since this is for an Internet connection, you select TCP/IP. That’s all there is to it. The wizard will ask if you want to start the session immediately. It will also add an icon to the “Be a Host PC” folder and you can select it whenever you want to start the session.

In order to link to this session for remote control, the guest computer will need to know the TCP/IP address of the host computer. To get the TCP/IP address, connect to the Internet through your Internet Service Provider (ISP), and then start your pcAnywhere host session. The TCP/IP address will be displayed on the pcAnywhere window.

Remote Setup & Operation

To create a guest environment to control a host session over the Internet, start the pcAnywhere program, and then click on the “Remote Control” tool bar icon. Next double-click on the “Add Remote Control Item” to start a wizard to guide you through this process. The first thing you must enter is a name for the remote-control session. Next, select the connection option you want to use. Again, since this is for an Internet connection, you select TCP/IP. This window also asks you for the name of the computer running the host session. Leave it blank and end the wizard without starting the session.

Next right-click on the remote-control icon you just created and select “Properties” from the menu list. Click on the settings tab and enter the TCP/IP address of the host computer into the

“Network Host PC to control or IP address” field provided. Click on “OK” and you’re ready to start your remote-control session. To start it up, connect to the Internet through your ISP, then start pcAnywhere. The systems should connect in just a few seconds.

Security

Passwords can be entered for the guest and host sessions that will restrict the ability to view or modify the configuration of the sessions and to prevent unauthorized people from starting the sessions. This is done by selecting the “Protect Item” tab from the session properties dialog window. Simply enter the password and select the level of security wanted.

The keyboard and mouse of the host or remote system can be disabled from the settings tab, and data encryption levels are selected from the security options tab. You can also blank the host screen from the security options tab.

The host session also allows you to set up a folder of authorized callers and the passwords required for them to gain access to the host system. This is done from the callers tab. This is where you also configure what resources a given user has access to on the host.

Remote-Control

Once the guest and host systems are communicating, you can begin remote control operations immediately. You can literally do anything a local user could do (provided it isn’t restricted by the security options), including linking to networks and other equipment connected to the computer.

File transfer

While you’re in remote-control mode, you can begin file transfer activities by clicking on the “Load file transfer” icon in the pcAnywhere tool list. This starts the pcAnywhere File Manager window that allows you to navigate through the files on both systems, including network drives. To send a file, select it from one of the navigation windows and press the Send button. You can also select groups of files and folders to transfer. Other feature will be demonstrated as time permits.

Case Study

Champion Laboratories, Inc. (manufacturer of automotive and truck filters) uses remote process control to provide support for an automated plant floor system that applies barcodes and customer part information to completed cases of products on their packaging assembly lines. The Champion “Print&Apply” system runs under Windows NT on a data collection server that links plant data collection terminals, printers, and alarm systems to an AS/400 host system where production planning and inventory management data is maintained. The data collection servers are located at two plants in southern Illinois, one plant in South Carolina, and one plant in Mexico. The plants are all connected over a WAN supported by the Champion IT organization. The data collection server software and “Print&Apply” application are supported by a consulting organization located in southwest Michigan.

Support for these processes is handled remotely using pcAnywhere remote-control software. System support includes activities such as monitoring data flow between the plant data collection

terminals and the AS/400 system, activating/deactivating terminals and communication links, updating system and application software, troubleshooting problems, and even re-booting the systems.

In one troubleshooting instance, the organization in Michigan linked to one of the plants in southern Illinois using pcAnywhere over a dial-up Internet connection, then invoked a copy of pcAnywhere on the remote data collection server to link to the server in Mexico over Champion's WAN to diagnose and correct a system problem. The cost benefits from this one instance alone more than paid for the investment in the remote process control capability.

Conclusions

Remote-Control computing is developing an important role in the software portfolio of the process control system. As our information systems become more network centric, and we look at using Internet technologies to deliver process control capabilities, we must develop skills at using tools that can help us provide better support and assistance for these systems. Remote-control computing can help us provide this support and be more productive with our process control tasks.

While not much, if any, exposure to remote-control computing is being presented to students today, we as educators need to look for ways to include it in our technology curriculum. It should be introduced in computer literacy courses, and used in more advanced process development classes. Students can then learn to look at it as just another tool to assist them in implementing business process control systems.

Bibliography

1. Krause C. (1998). From a Distance: Remote Operation of Research Equipment. *ORNL Review*, v30n3-4.
2. Conquergood, S. (1997), High Speed Remote Process Control, ISA Tech/Expo Technology Update Proceedings, 1997, v1 n5, p493-499.
3. Fuhr, P. and Mowat, E. (1995), Remote Interrogation and Control of Sensors via the Internet, *Sensors*, December 1995, v12 n12.
4. Fratto, M. (2000). Take Charge Of Enterprise Resources With Eight Remote-Control Solutions [62 paragraphs]. *Network Computing* [On-line]. Available: <http://www.networkcomputing.com> [2000, Nov 26].
5. Doherty, S. (2000). Remote Control Saves Steps [63 paragraphs]. *Network Computing* [On-line]. Available: <http://www.nwc.com/1102/1102f3.html> [2000, Nov 7].
6. Winfiles (1998). Windows 95/98 Remote Computing Tools. [42 paragraphs]. Winfiles.com [On-line]. Available: <http://winfiles.cnet.com/apps/98/remote.html> [2000, Oct 27].
7. Doherty, S. (2000). PC Duo 5.03: Remote Control Takes Hold of the Enterprise [11 paragraphs]. *Network Computing* [On-line]. Available: <http://www.nwc.com/1114/1114sp3.html> [2000, Nov 26].
8. Robinson, P. (1998). Computing by Remote Control [35 paragraphs]. *TheNews-Times Computer News* [On-line]. Available: <http://www.newstimes.com/archive98/apr2998/cph.htm> [2000, Oct 27].

9. Fratto, M. (2000). Take Charge Of Enterprise Resources With Eight Remote-Control Solutions [62 paragraphs]. *Network Computing* [On-line]. Available: <http://www.networkcomputing.com> [2000, Nov 26].
10. Robinson, P. (1998). Computing by Remote Control [35 paragraphs]. *TheNews-Times Computer News* [On-line]. Available: <http://www.newstimes.com/archive98/apr2998/cph.htm> [2000, Oct 27].
11. DePasquale, E. (1996). Remote Control Software: Extending The Boundaries Of Your Office -- Guide Series: *Computing Basics*, September, 1996, Vol. 4, Issue 9
12. DePasquale, E. (1996). Remote Control Software: Extending The Boundaries Of Your Office -- Guide Series: *Computing Basics*, September, 1996, Vol. 4, Issue 9
13. Rocket, W. (1999). Symantec pcAnywhere 9.0 Is Just Right for Control Freaks [17 paragraphs]. *Network Computing* [On-line]. Available: <http://www.nwc.com/1023/1023sp3.html> [2000, Nov 14].

MARK SMITH

Mark Smith is an assistant professor at Purdue University's North Central campus, teaching Computer Technology courses. He joined the university after a career in the information technology industry, working in management and technical positions in the Industrial Sector and as a consultant with IBM. Mark received an A.A.S in Computer Technology and B.S. in Management from Purdue University, and an M.B.A. from the University of Notre Dame.