4D

4th Dimension: The new dimension of Internet database access and publishing

TODAY, most databases ensure Internet/Intranet access directly or indirectly. However, most users still wonder:

- How easy is it?

- How time-consuming is it?

- How much is it?

With 4th Dimension Version 6 (4D V6), familiarity with HTML is not required to create and operate a Web site. 4D Visual Form Builder and Automatic HTML Converter do the job for you. Running your application on the Web is a matter of minutes. If, however, you are already a Web expert, you will benefit from saving time and be valued for your efficiency and creativity.

4th Dimension Version 6 is an integrated database system and Web server. 4D Server Version 6 is a combined client/server architecture and Web server. No CGI or additional software is required to serve your data via the Web. Web handling is treated as a standard database task within the 4D architecture.

With 4D and 4D Server our goals are to:

- Enable users to deploy their database effortlessly on the Web. Ensuring Web access to an application is as easy as clicking a check box. No code changes are necessary. 4D and 4D Server view any available Web browser as a 4D client.

- Automatically manage specific, heavy-duty database tasks such as referential integrity, transaction management, user-interface feedback messaging system, and transparent administration for any application running on the Web. 4D does not require any extraneous programming for Web applications.

- Guarantee transparent compatibility and scalability paths between Macintosh and Windows 4D applications, individual systems and client-server architectures, and with Web services.

- Provide extensibility to professional developers. 4D supports external products and HTML formats, allowing the addition of external products or Java applications to the 4D built-in features.

This white paper includes:

- A step-by-step guide for implementing a basic 4D Web application. Creating an application for the Web should not be intimidating. As all businesses can start small and grow large, so too can 4D applications.

- A general survey on 4D and 4D Server built-in Web capabilities. This chapter describes the main 4D capabilities for creating and publishing databases on the Web.

- The competitive advantages of creating 4D Web database application solutions. Creating Web database application solutions often requires myriad tools to ensure connection to a database development environment, to provide actual database capabilities over the Web, and to handle consistent data management within client/server architectures. The 4D coherent, versatile, and integrated database development system eliminates the chore of dealing with multiple tools, and the headaches of reinventing the wheel concerning data management.

- A description of key 4D database architecture features which facilitate and automate 4D Web services.

- An overview of 4D extensibility. The 4D V6 implementation of Internet capabilities is based on industry standards. Therefore, third parties can take advantage of the 4D open architecture to add new capabilities to the 4D Web server engine.
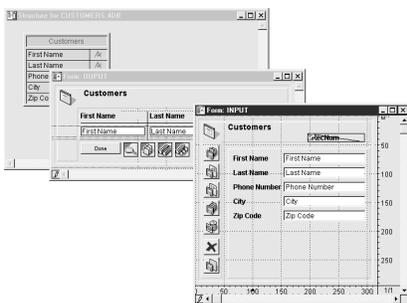
Create a simple application and serve it to the Web in five minutes

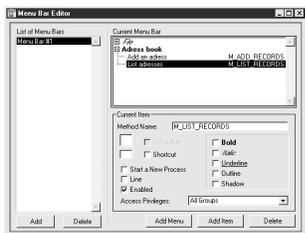The following steps describe how to create and publish a simple application on the Web.

❶ Create your table:

❷ 4D automatically generates Input and Output forms, or you can create your own.

❸ Create a menu bar indicating actions the Web browser will perform.

❹ Write two methods to activate step 3.

❺ Connect to the application from a second machine running a Web browser.

If your Web site has a registered name (i.e., "Flowers International"), indicate that name in the Open, Address, or Location area of your browser.

If your Web site does not have a registered name, indicate your computer IP address in the Open, Address, or Location area of your browser.

4D automatically generates a default front page displaying your action items.
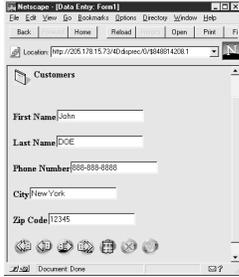

❻ Select "Add records" and enter records.

❼ Do you want to list the records you just entered? Click the Cancel button (with the red cross) to return to the front page, then click on "List Records."
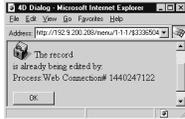
❽ Do you want to modify a record from this list?

Double-click on a row handle. The output form is available for record modification.

❾ The 4D integrated user-interface messaging system informs you if this record was previously modified.

This record will be available to you as soon as the other person is finished.

A 4D application can include dozens of tables and hundreds of forms, menus, and methods. Servicing that application on the Web is structurally identical to servicing an application containing one table, two forms, two menus, and two methods. Whether your application is in single-user or client/server mode, running on one or several platforms, using one or more network protocols, the complete, cross-platform, scalable 4D architecture simplifies Web application deployment.

General survey of built-in 4D Web capabilities

4th Dimension and 4D Server include a Web Server engine, enabling you to publish 4D databases on the Web. The 4D Web Server engine delivers the following benefits.

DIRECT WEB SERVICES

Your applications are published directly on the Web, without requiring you to develop a database system, a Web site, or a CGI interface between them. Your database is your Web site.

ON-LINE, TRANSPARENT HTML TRANSLATION

On-line, 4D transparently and dynamically translates your forms and design components into HTML pages. These new HTML pages become instantaneously available to Web browsers. Today, most Web database systems are either CGI-based systems or static HTML-based systems.

Most CGI systems require you to develop a database, a Web site, and a CGI. A static HTML-based system requires utility programs that re-translate your modifications into HTML every time you modify a design component in your database. In both cases, the Web components are created off-line and require manual intervention from the database and/or Web developer. With 4th Dimension, you can modify your design components as many times as you want, whenever you want. Once you save the changes in the Design environment, your modifications are transparently and dynamically available to the Web browsers. Consequently, while developing and testing your application, you can immediately test the result in a currently connected Web browser.

DYNAMIC ACCESS TO RECORDS AND DATA

4D handles Web browsers as standard clients of the 4D database engine. For example, if you modify records on the local 4D database or a 4D Server client workstation, those records become available instantaneously to the Web browsers. You do not need to re-process the records for HTML publishing.

Using 4D Connectivity Plug-ins created by ACI or ACI Partners, you can select, insert, update, and delete data from SQL databases or legacy systems. The Web browser benefits from the powerful 4D features.

SESSION MAINTENANCE AND DATABASE CONTEXT

Web browsers enable you to browse Web pages randomly— jumping from one page to another, from one Web site to another, and so on. In the context of using Web browsers for Client/Server databases, the browser must comply with the logic of the database transactions. For example, if you are adding a record, the record data entry must be validated or canceled. The user must not exit the record via the browser navigation control or leave it in an uncertain state. The 4D Web Server engine includes built-in session and database context maintenance. Throughout the Web page URLs, 4D maintains unique context and sub context ID numbers, ensuring complete synchronization between the current Web page displayed in the browser and the context of the 4D database connection. No more clumsy attempts to use complex URLs, hidden form fields, or "cookies" to track your Web users from connection to connection!

TRANSPARENT MULTI-USER MAINTENANCE AND TRANSACTION MANAGEMENT

Web browsers are treated as complete database clients when they become 4D clients. For example, if you start modifying a record in a Web browser, 4D automatically locks the record, preventing modification from any other concurrent client. After you validate or cancel the data entry, 4D automatically unlocks the record. In addition, 4D allows you to perform data entry under transaction, as you are entitled to do using 4th Dimension or 4D Client. Web users benefit from the 4D built-in transaction management capabilities. If errors are encountered during data manipulation, changes are canceled automatically by the 4D rollback-management system.

WEB PROCESS MAINTENANCE

4D includes several processes for handling its Web Client/Server architecture. The main, built-in Web Server process handles Web connection attempts. After a Web browser is granted access to the database, the Web connection runs on a separate process 4D automatically creates. As a result of the 4D fully integrated, multi-tasking architecture, regular

or 4D Web clients can perform simultaneous database requests, such as queries. Queries will process in parallel by the database engine. Clients are also guaranteed a request posted by a particular Web client will not intervene with the context of other processes.

OPTIMIZED WEB SERVER ARCHITECTURE

The 4D Web Server engine has the same capabilities as the 4D database engine. For example, if you load a series of record values to arrays, the operation is performed locally on the Web server machine. The result is sent, as one entity, to the requesting Web client.

In addition, because a Web connection is a plain and full-featured 4D process on the Web server side, you can run any 4D algorithms. They are executed locally on the Web server side and only the result, if any, goes to the Web browser. For example, you can perform a query that involving relations, sets, and the computation of statistical results with only the result returning to the Web browser. You can build a complex Web database system like a Web expert, and compile your 4D applications.

HTML AND JAVASCRIPT ENCAPSULATION

Although 4D performs almost everything you need to publish databases on the Web, you can encapsulate HTML and JavaScript code to customize your 4D development. For example, you may want to enhance the Home page of your Database/Web site with an eye-catching HTML page.

You can build an entire custom HTML page and put it on the Web using the SEND HTML FILE command. You can also encapsulate HTML within a 4D form. From the browser, 4D and HTML objects blend together seamlessly. Within the encapsulated HTML, you can implement JavaScript code that performs actions and data control on the client Web browser side without requiring that a request be sent back to the server.

BINDING BETWEEN HTML AND 4D OBJECTS

If you use encapsulated HTML code within your 4D development, you want, on the 4D side, to retrieve the values and data that were entered into the HTML objects. Instead of obligating you to write complicated HTML parsing routines, 4D provides a simple, built-in scheme for binding HTML objects to your 4D variables—your objects only need to have the same name. As a result, analysis for and response to HTML requests are simple to implement. You only need to write 4D code related to the 4D variables filled out automatically by the data that returned from the Web browser.

The compelling 4D environment for development and deployment of Web solutions

The 4D environment provides exceptional conditions for implementing, testing, and deploying Web solutions.

PLUG AND PLAY

4D includes an integrated virtual manager, allowing simultaneous use of several protocols and easy installation. To serve a 4D application, install TCP/IP on your machine and 4D TCP/IP Network component. If you try to start the 4D Web Services when TCP/IP is not available, the 4D integrated user-interface messaging system delivers a reminder.


By default, 4D publishes a Web database on the regular Web TCP Port (port 80). If the port is already in use by another Web service, you can change the TCP Port used by the 4D application simply by specifying an appropriate value in the Database Properties Window.

CLICK AND SELECT: STARTING 4D WEB SERVICES

You can initiate 4D Web Services in the following three ways.

Automatic publishing

If you want Web Services to become one of your application properties, check Publish Database at Startup in the Database Properties Window. Your application will publish automatically on the Web every time you open it.
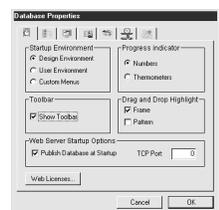
At-will publishing

A Web Server menu allows you to enable and disable Web Services at your convenience.

### Programmatic control of application publishing

You can use the command START WEB SERVER. You are not required to quit 4D and reopen your database to start or stop publishing a database on the Web. Rather, you can interrupt and restart the Web services according to your needs.

INTERACTIVE MULTI-USER AND MULTI-PLATFORM RAD ENVIRONMENT FOR THE WEB

Since creating an application for the Web is identical to creating any 4D application, power users benefit from the main concepts of the 4D development environment—simplicity, transparency, and clarity.

Here are a few examples:

▶ The 4D object- and event-based programming model drastically reduces code.

▶ Cross-platform development tools allow platform customization at the object level. Point-and-click and drag-and-drop control for each object in a form enable visual graphical design for Web forms.

▶ Automated global modifications: Form and object style sheets allow designers to implement changes to the application interface with minimal effort.
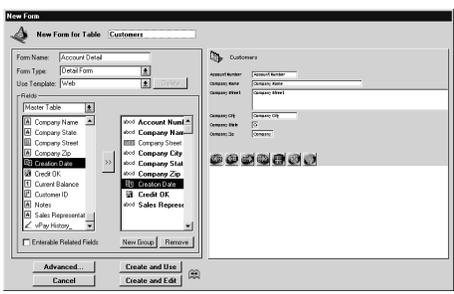
Any 4D Form can convert into an HTML form. For creation of Web-specific forms, users benefit from the general 4D Wizard and Form Editor.

4D form objects are translated automatically to HTML objects. Because some objects are not supported by HTML, the 4D point-and-click control at the object level enables easy cosmetic decisions. In some cases, 4D provides an automatic mapping scheme. For example, if overlapped by a picture, 4D manages Invisible Buttons, Highlight Buttons, 3D Buttons or Button Grids. 4D recalculates the click position and generates an On Clicked event automatically for the appropriate button. Likewise, 4D internal translation schemes maintain Radio Button grouping or transform grouped, scrollable areas (not supported in HTML) automatically into independent, synchronized, scrollable lists placed on the same line.

Since you can set Web awareness as a database property, you can connect to a Web browser while developing and testing an application. Modifications are available transparently and dynamically to the Web browser.
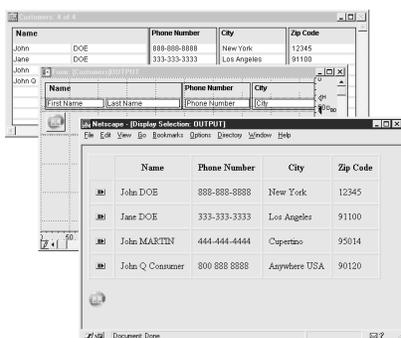
Web database application developers benefit from all 4D tools, such as 4D Compiler and 4D Insider.

4D Compiler is a true machine-language compiler optimized to support a wide range of processors:

▶ 80386, 80486, and Pentium

▶ Macintosh 68020, 68030, 68LC040, 68040, and 68881/68882 math co-processors

▶ Power PC 601, 603, 603e, and 604

4D Insider is a point-and-click, drag-and-drop code-servicing system enabling component builders and users to modularize or merge existing applications and to examine database objects and dependencies.

4D Insider provides:

▶ a complete dictionary of your applications and a display of the application objects and their interdependencies

▶ a global search and replace

▶ a cross referencing and documentation tool

▶ the ability to move table definitions, forms, and methods across applications while retaining object properties and relationships

▶ easy localization of your applications into a different language

BENEFITING FROM 4D DATA MANAGEMENT CAPABILITIES

4D data management capabilities eliminate the burdens generally associated with Web database, thanks to the 4D built-in management of selections of records.

When a query is processed, 4D automatically maintains the resulting selection of records and treats it as a database object with no data duplication. Because 4D maintains current selections, a single query result is usable in a variety of operations without query re-execution. Since current selections are randomly accessible, users can create and conveniently manipulate thousands of records within one or many simultaneously active windows.

4D automatically manages each clients' query environment and maintains several concurrent selections, automatically and transparently acting as an application server. In multi-user situations like the Web, 4D maintains the current selections for each user process and automatically handles record locking inside the selection. Once the record is released, it is available for modification in any other current selection containing that record. Database replication and change synchronization are avoided with 4D current selection management.

In the event a query retrieves a large number of records, 4D includes an automatic paging scheme to avoid speed problems over the Internet and memory overflow on the browser. By default, 4D displays the first 20 records of the selection, including

links to the first 20 pages at the end of each page. You can browse the first 400 records of the selection by clicking on page links that 4D generates automatically at the end of each selection page.


Any power user can modify this display limit with one line of code SET WEB DISPLAY LIMIT—thus providing browsing capabilities through thousands of records.

These Web data management capabilities also apply to data hosted on SQL database systems when passing through 4D via 4D ODBC, 4D for ORACLE, or 4D SQL Server.

EASE OF MAINTENANCE, SCALABILITY, AND COST-EFFECTIVENESS

Because the same tool can be utilized in many situations, companies using 4D save the time and cost associated with maintaining multiple products and multiple development environments.

▸ A 4D Web application created for one platform can be deployed immediately on another. 4D provides native support for Windows 95, Windows NT, Macintosh, and Power Macintosh.

▸ Any 4D Web application scales easily to a workgroup client/server solution using 4D Server.

▸ Any 4D or 4D Server application interfaces smoothly with existing enterprise databases using 4D Connectivity Plug-ins such as 4D for ORACLE, 4D SQL Server, 4D ODBC, or third-party plug-ins. 4D applications can query data from various servers simultaneously, merge and display the result with a unified interface, either directly inside 4D or inside any Web browser accessing 4D.
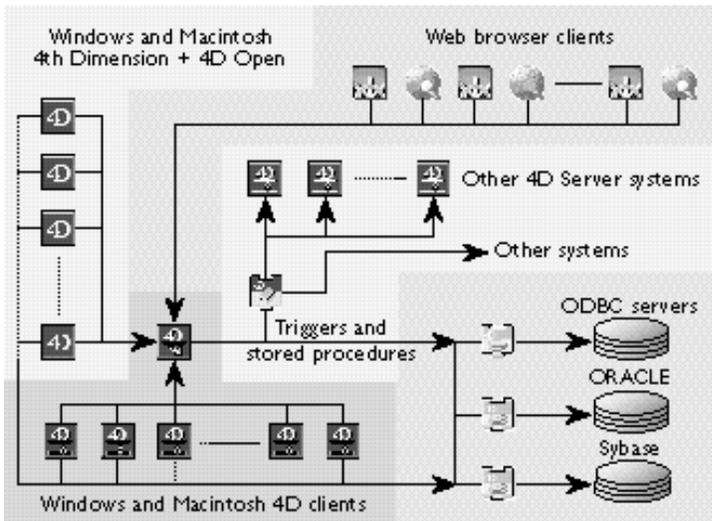
Inside 4D Web service mechanisms

While implementing 4D Web services, we focused on managing all essential database mechanisms to simplify the tasks of users, Web developers, and Web masters. Here are some key decisions we made:

▶ Automate and enforce database management controls by embedding, within the 4D architecture, user-interface messaging schemes

▶ Eliminate specific Web administration tasks to provide database administrators the opportunity to handle business-oriented activities such as site-visit analysis or prospect follow-ups

▶ Extend 4D Web server capabilities in sync with database and client/server requirements, and ensure the basis for upward compatibility with future enhancements

This section describes the technology underlying the unique transparency of 4D Web capabilities.

HANDLING WEB CONNECTIONS

A Web connection to 4D or 4D Server is structurally identical to a client/server connection and benefits from built-in 4D capabilities. 4D maintains state between browser requests transparently to the developer.

In a 4D client/server architecture, you connect, work in a session, then disconnect from the server. With HTTP, every time you perform an action requiring attention or action from the Web server, a request is sent to the server. In short, an HTTP request can perceive the sequence as "Connect+Request+Wait for reply+Disconnect." The HTTP protocol is not a "session-based" protocol—it is more a "request-based" protocol, as in SQL.

In order to run a client/server session above HTTP, 4D maintains, through transparent encoding of URLs, a context uniquely identifying your Web connection and associates the connection to the 4D process handling it. The 4D process handling the Web connection terminates after no activity is detected for a delay time equal to the database Web timeout settings.

You can control Web Connection Timeout. A Web connection process either executes 4D code or waits for the submission of the Web page currently displayed on the browser side. In the latter case, a Web connection process will wait for a delay greater than or equal to the Web Server Connections Timeout set in the Database Properties window or set programmatically using the SET WEB TIMEOUT command.
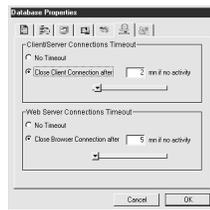
At your convenience, you can increase or decrease this timeout. If you specify "No Timeout," the Web connection processes will stop only when the database is exited. If there are open Web connection processes when you stop the Web server, each processes continues to execute until the Web user stops querying the database for a delay time greater than or equal to the Web server connections timeout.

WEB CONNECTION PROCESSES

Because of its multi-threaded architecture, 4D and 4D Server automatically open, run, and execute a kernel Web server process when an application is published as a Web site.

This kernel Web process automatically displays user-interface messages, if necessary. For instance, if all authorized site licenses are already in use, 4D sends a message to the browser user.

Once a Web connection is initiated, the Web connection process handles the entire Web session for that connection.

The Design Process List window shown below displays the Web connection process "Web Connection# 1066993139," initiated after a Web browser connection has started:
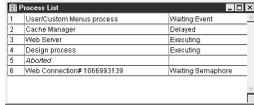
CONTEXT IDS

A context ID is randomly generated and uniquely identifies each Web connection. The context ID is maintained on the 4D and browser side during the entire Web connection. In the example provided here, the context ID is 1066993139. In the Web browser window shown here, you can see this number in the URL displayed in the Location area of the browser:

4D automatically maintains URLs during the Web session. Each time an HTTP request is received by the 4D TCP/IP Network component, 4D extracts the context ID from the URL, thereby redirecting the request to the right Web Connection process.

Context IDs enable 4D to:

▸ Maintain a Web and database session over each Web connection

▸ Handle multiple, concurrent Web connections transparently

▸ Prevent undesirable connections using bookmarks, because a different context ID is generated at each connection

SYNCHRONIZING WEB AND DATABASE SESSIONS

4D automatically manages and increments a sub context ID each time a new 4D-based HTML page is sent to the browser. The sub context ID is crucial in ensuring quality maintenance of the database session.

Web users are, by nature, "Web wanderers." It may happen that a Web user, while adding a record to a table, decides to navigate to other pages before clicking the Cancel or the OK button—thus leaving data entry in an uncertain state. To prevent any incident, or possible frustration by the Web user, 4D uses a sub context ID to synchronize the Web session on the browser side with the database session on the 4D side. If a desynchronization of the Web and database session is detected, 4D automatically sends a message to the browser.

USER INTERFACE MANAGEMENT

From a user viewpoint, actions on the Web browser side pilot a Web session. From a database viewpoint, the Web Connection process pilots a Web session. The Web browser displays pages sent by the Web connection process, which either executes 4D code or waits for the submission, from the browser, of the current Web page. From an administration viewpoint, the Web connection process is a 4D process whose execution domain is 4th Dimension or 4D Server, but with a user interface remotely echoed on the connected browser.

The 4D client/server architecture employs an advanced two-way communication system between the workstation and the host. Unlike most client/server offerings, 4D Server can send messages to the client. As Web servers, 4D and 4D Server ensure communication with browsers. As a result, browser users are never left in the dark and Web server administration is greatly simplified. It becomes a natural task for 4D to identify and "understand" the browser interface logic, especially the free navigation schemes specific to browsers.

STATISTICAL ANALYSIS OF CONNECTIONS

Given that 4D can receive any information from browsers, Web masters easily obtain and compute statistical information on the number and frequency of connections, or determine what information was accessed. Since 4D is a database, possibilities in this area are almost unlimited. Consequently, any Webmaster or IS administrator can be actively involved with business-related questions.

ON WEB CONNECTION

On Web connection is a database method called automatically when a user deploys an application. For specific needs, developers can call any of the project methods or forms defined in the database and HTML pages. The database method can handle the whole session.

USING HTML PAGES
CREATED WITH HTML TOOLS

Your 4D-based Web site is either a complete 4D-based system or a combination of 4D forms and HTML pages. Using an existing HTML document as a home page simply requires you indicate the name of this document into an On Web Connection database method.

The command SET HTML ROOT tells 4D where to look for the HTML documents. The command SEND HTML FILE sends the HTML document as the current Web page to the browser.

Here is a simple HTML document viewed with Microsoft Front Page:
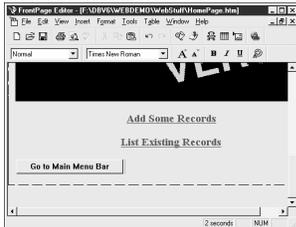
Here is the same document viewed with Claris Home Page:

LINKING URLS

The linked text items, "Add Some Records" and "List Existing Records," trigger execution of the 4D project methods through their URLs. Any HTML object can link to a project method in your database using the URL "/4D METHOD/Name_of_Your_Method".

Here is the URL for the text "Add Some Records" in Claris Home Page:

Here is the same URL in Microsoft Front Page:
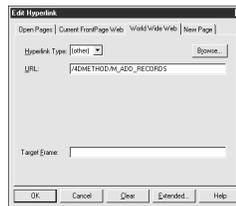
When the Web browser sends back the URL, 4D executes the project method specified after the /4D METHOD/ keyword. When the project method is complete, you return to the HTML page that triggered the execution. The project method can display 4D forms, other HTML pages, and so on.

## USING HTML BUTTONS

There are three types of HTML buttons:

▶ **Normal.** Normal buttons are attributed to a URL referring to a 4D method using the /4D METHOD/ keyword.

▶ **Submit.** Submit buttons submit the form with the values entered by the user (if any) to the Web server. They are useful for handling data entry you prefer to perform via an HTML page rather than a plain 4D form.

▶ **Reset.** Reset buttons are not very useful within a 4D development environment. They clear the form of the values entered by the user (if any) but do not send any request to the server.

To submit the HTML form on the 4D side, you specify the POST action 4D method executed by 4D after the form is submitted.

Specifying the POST action 4D method using Microsoft Front Page:
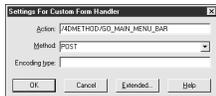
Specifying the POST action 4D method using Claris Home Page:
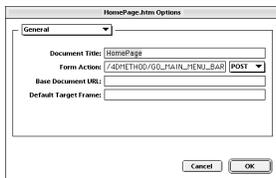
As described in this document, 4D supports HTML. Before implementing HTML and JavaScript code in your 4D application, it is suggested you review what 4th Dimension does automatically for you.

Third-party plug-ins and extensions

The 4D open architecture enables complete interface with other products through extensions and plug-ins created by experienced 4D third-party developers. Although some of these products were created for previous versions of 4D, they are fully compatible with 4th Dimension Version 6. Combined with the new 4D V6 features, these Extensions contribute in making 4D the most complete Web database solution on the market.

This section includes some of the most widely distributed 4D Extensions and Plug-ins.

NETLINK BY FORESIGHT TECHNOLOGY, INC.

Foresight Technology, Inc.
4100 International Plaza, Suite 538
Fort Worth, TX 76109-4818
Tel 800-701-9393 or 817-731-4444
Fax 817-731-9304
http://www.fsti.com/

NetLink is a 4D CGI extension adding over 30 commands to 4D and an optional server plug-in, providing a wide range of additional customization and interface capabilities for publishing a 4D database on the Web.
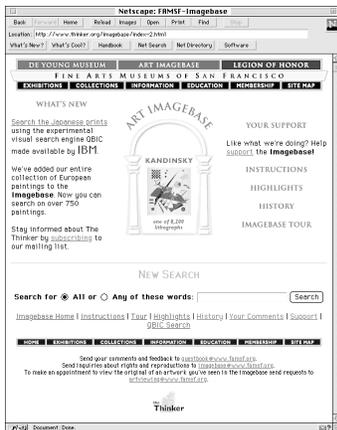
Communicating with existing commercial Web Servers

If you use a commercial Web server like the Internet Information server from Microsoft, the FastTrack server from Netscape, or WebSTAR from StarNine to serve your site, NetLink/4D enables you to use a 4D database when extra relational intelligence is required. NetLink handles all the communication between your Web server and 4D in compliance with CGI, ISAPI (Microsoft's Web Server API), NSAPI (Netscape's Web Server API), and WSAPI (WebSTAR's API) standards, taking full advantage of the 4D multi-tasking architecture to handle multiple, simultaneous connections.

Encrypting HTTP connections

NetLink provides Secure Socket Layer (SSL), a standard for encrypting HTTP connections. Using a CGI, you can take advantage of SSL servers and built-in 4D Web services. The benefit is the ability to easily create secure commerce servers and other applications requiring a high level of security.

Java libraries

NetLink includes Java libraries allowing you to take an existing 4D database back-end and add a Java interface. Using Java as a front-end enables you to create solutions with flexible interfaces and improved performance.

And much more

NetLink can tap into the 4D built-in Web services, while handling the connection directly. NetLink, servicing the CGI connection with a Web server, passes the incoming connection to 4D's Web services, taking advantage of the layout-to-HTML conversion capability, then passing the 4D-generated HTML back to the Web server.

INTERNET TOOLKIT
BY JCA TELEMATIQUE, FRANCE

Internet Toolkit is distributed in North America by Foresight Technology, Inc.

Internet ToolKit is a 4D Extension providing the ability to handle any type of TCP/IP connection within your 4D methods. You can implement common Internet protocols, such as SMTP (mail server), POP (mail client), NNTP (news), and more. You can even create your own custom protocols, for example, to connect different database applications.

DATAWAVE BY DATACRAFT, INC.

DataCraft
12600 West Colfax Avenue, Suite C-420
Lakewood, CO 80215
Tel 303-232-4321
Fax 303-233-4343
http://www.datacraft-inc.com/

DataWave is a collection of 4D methods, forms, and wizards by DataCraft, enabling you to publish a 4D database on the Web without programming. Using

the ACI 4D Insider tool, installation takes just seconds. Once installed, DataWave's configuration dialog allows the database administrator to select the files and fields for Web surfers. The form-based search editor can be customized. DataWave uses either NetLink or Internet ToolKit to enable the Web connections, providing the flexibility and integration with commercial Web servers, or the raw speed and simplicity of handling the HTTP connections directly within 4D.

PDM INTERNET TOOLS BY PACIFIC DATA MANAGEMENT, INC.

Pacific Data Management, Inc.
55 South Market Street, Suite 1410
San Jose, CA 95113-2337
Tel 408-283-5900
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PDM INTERNET Tools are 4D extensions providing the means to communicate through the Internet and other TCP/IP networks. PDM INTERNET Tools

support low-level TCP/IP calls, such as sending and receiving raw TCP packets, and higher-level protocols including FTP, SMTP, POP3, NTP, and other commonly used UNIX-based commands.
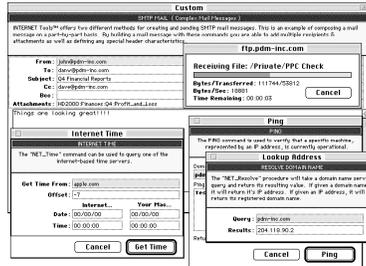
PDM INTERNET Tools have a wide range of usage. Apart from the obvious use of sending and receiving messages and files, other usage includes:

▶ Watch-dog routines remotely reporting database integrity or security

▶ Automated sales report generation and distribution triggered by internal processes or external e-mail requests

▶ Mass electronic mailings using corporate data directly from your database

▶ Remote database update, maintenance and synchronization via direct connection or store-and-forward mail

▶ Automatic fulfillment of product information requests

SMTP (Simple Mail Transfer Protocol)

PDM INTERNET Tools allow users to quickly and easily build and send electronic mail via a SMTP server. Mail composure and delivery can be as simple as a single external call or specifically tailored to affect any message header controlling its delivery behavior. Complete MIME (Multipurpose Internet Mail Extensions) support is included, permitting multiple text or binary attachments to any message. Since Internet mail addressing provides delivery to such services as CompuServe, America Online, AppleLink, etc., you are able to reach anyone with an e-mail account.

POP3 (Post Office Protocol)

In addition to sending mail, the PDM INTERNET Tools package connects and receives mail stored on a POP3 server. The POP3 commands can retrieve mail from any number of mailboxes for storage within a database, re-route, auto-reply, or do remote-search execution. Mail information can download into fields, variables, arrays or files on disk. Multiple-binary attachments are extracted easily and decoded.

FTP (File Transfer Protocol)

Support for the Internet File Transfer Protocol (FTP) is provided through externals connecting to and navigating through directory listings on FTP servers. Provided commands send and receive text and binary files, that optionally displays a progress thermometer.

TCP/IP & Miscellaneous functions

PDM INTERNET Tools contain a full suite of commands providing minute control over TCP/IP communications. Databases can open TCP sessions to remote ports, or passively listen for incoming connections. The TCP commands extend the range of possibilities for database communications with ideas such as:

▶ Building your own telnet interface

▶ Executing shell commands on remote machines

▶ Searching through on-line databases

▶ Retrieving documents from the World Wide Web

Additional utilities are included to Ping (ICMP echo) remote machines, obtain standardized time (NTP), resolve domain names, retrieve 'Finger' information and Encode/Decode files in a variety of formats.