

A web server extension for M/Caché/IRIS and YottaDB

mg_web

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1 Introduction

mg_web provides a high-performance minimalistic interface between three popular web servers (Microsoft IIS, Apache and Nginx) and M-like DB Servers (YottaDB, InterSystems IRIS and Cache).

HTTP requests passed to the DB Server via **mg_web** are processed by a simple function of the form:

```
Response = DBServerFunction(CGI, Content, System)
```

Where ***CGI*** represents an array of CGI Environment Variables, ***Content*** represents the request payload and ***System*** is reserved for **mg_web** use.

A simple ‘Hello World’ function would look something like the following pseudo-code:

```
DBServerFunction(CGI, Content, System)
{
    // Create HTTP response headers
    Response = "HTTP/1.1 200 OK" + crlf
    Response = Response + "Content-type: text/html" + crlf
    Response = Response + crlf
    //
    // Add the HTML content
    Response = Response + "<html>" + crlf
    Response = Response + "<head><title>" + crlf
    Response = Response + "Hello World" + crlf
    Response = Response + "</title></head>" + crlf
    Response = Response + "<h1>Hello World</h1>" + crlf
    return Response
}
```

In production, the above function would, of course, be crafted in the scripting language provided by the DB Server.

2 Web Server Components

In this section we discuss the process for building and configuring the **mg_web** component for all supported web servers.

2.1 *mg_web* for Microsoft IIS

mg_web for IIS is implemented as an *IIS Native Module*.

2.1.1 Building from source

It is assumed that you have Visual C++ installed.

Copy the contents of **/src/** and **/src/iis/** to a directory of your choice. You should now have the following files in that directory.

```
Makefile.win  
mg_web.c  
mg_web.h  
mg_websys.h  
mg_web_iis.cpp
```

To build **mg_web** for IIS (**mg_web_iis.dll**):

```
nmake -f Makefile.win
```

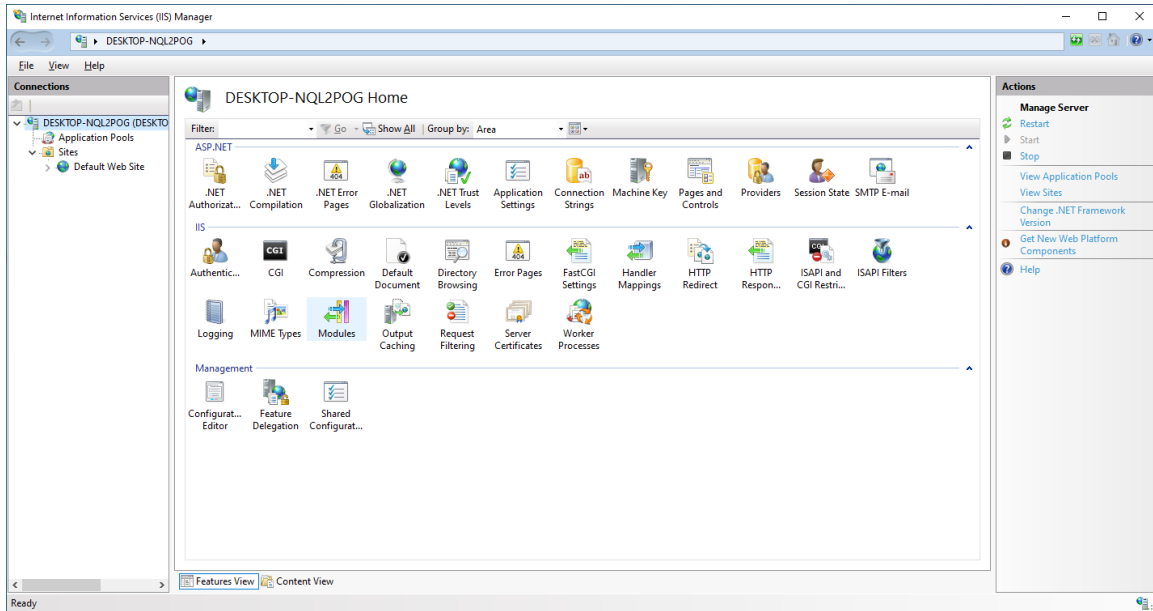
The following command will simply copy the module (**mg_web_iis.dll**) to the **c:\inetpub\mgweb** directory. You will need to create this directory first.

```
nmake -f Makefile.win install
```

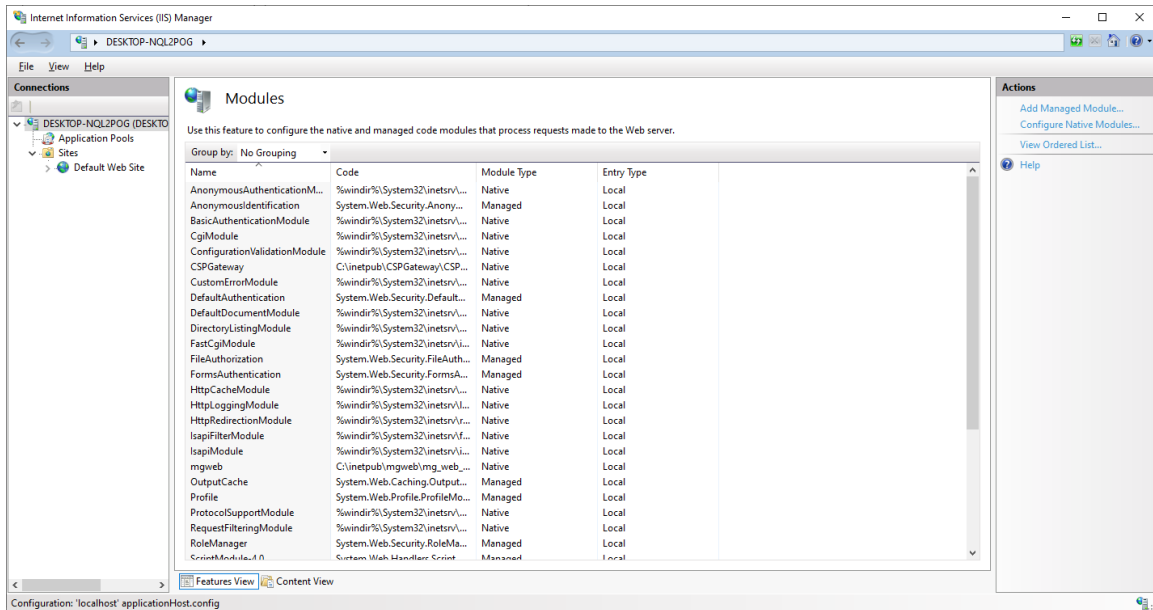
2.1.2 Web Server configuration

The **mg_web** module must be registered as an IIS '*Native Module*'.

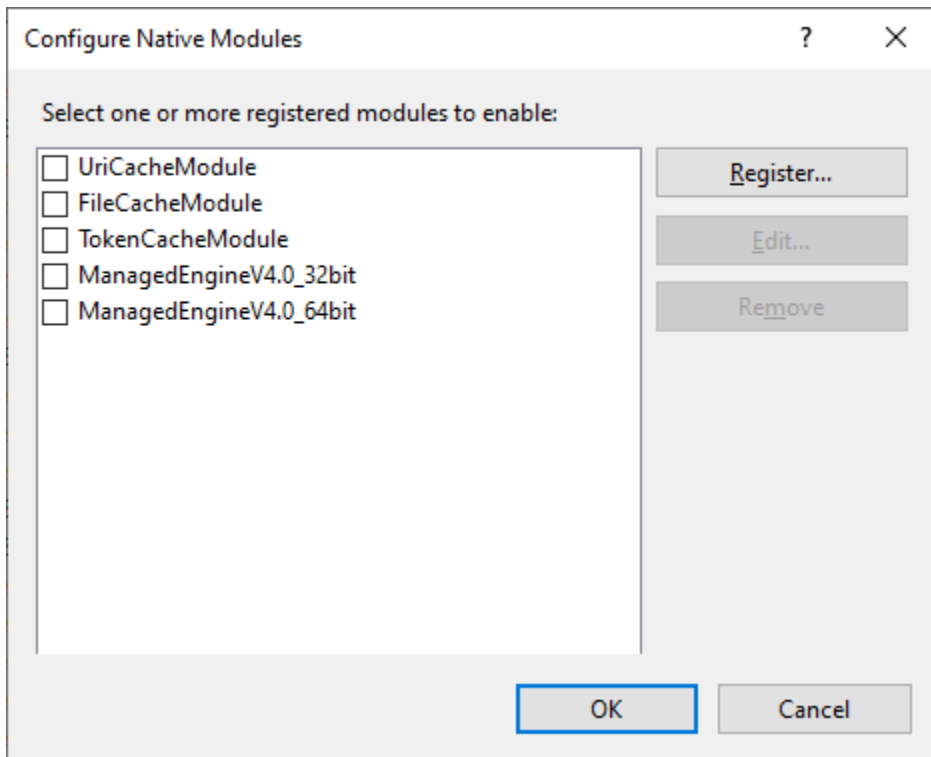
Open the **IIS Control Panel** with focus on the root of the IIS installation in the left-hand panel. Open the **Modules** Control Panel.



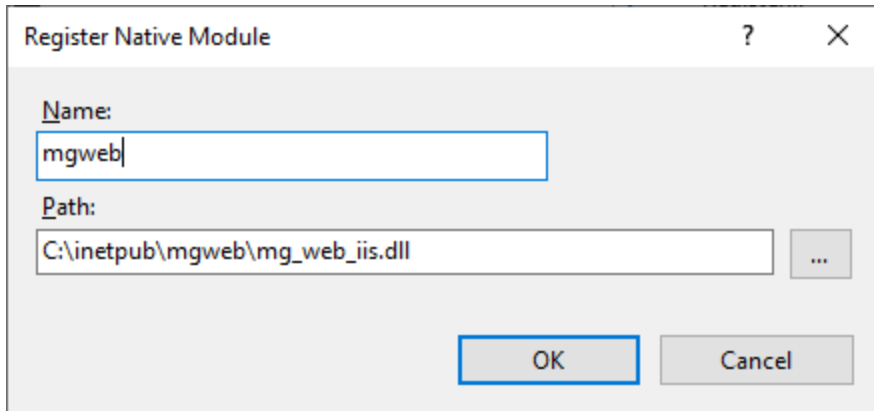
The **Modules** Control Panel. Choose the ‘**Configure Native Modules**’ option in the right-hand panel.



The ‘**Configure Native Modules**’ Control Panel. Note the **Register** button.

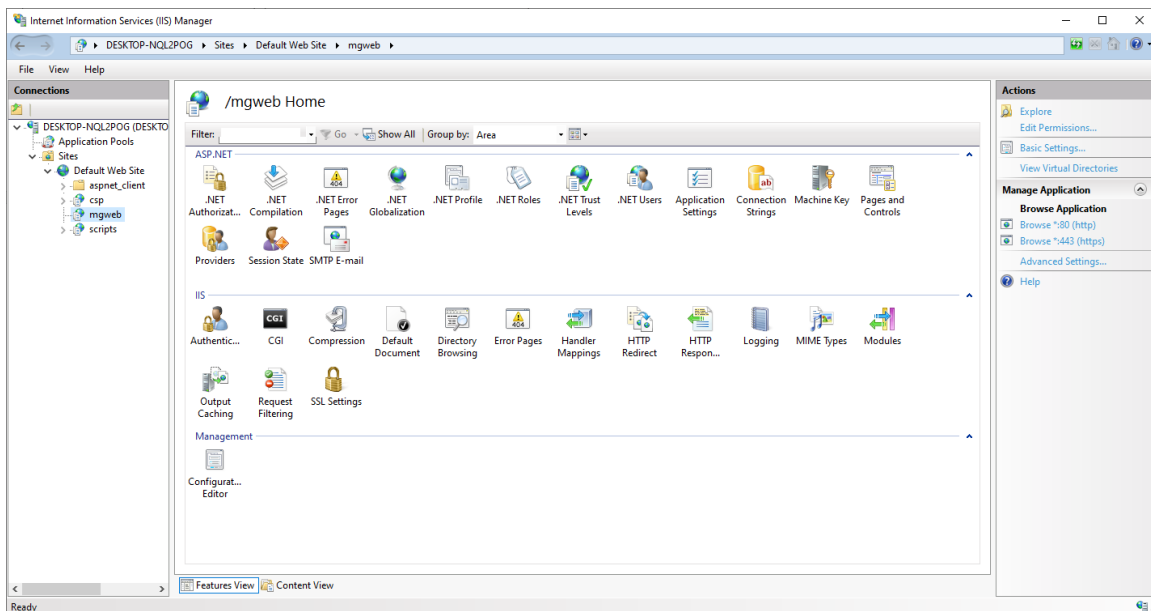


Press the **Register** button to add the **mg_web** module for IIS (**mg_web_iis**).



You can assign a name of your choice to the registration – **mgweb** is used in the above example. When the **mg_web** module is registered it can be associated with a particular (virtual) application path and/or specific file types.

To create a new virtual path for applications, right-click on the appropriate web site in the left-hand panel and choose the '**Add Application**' option. In the example below, virtual application path **mgweb** was added beneath the **Default Web Site**.



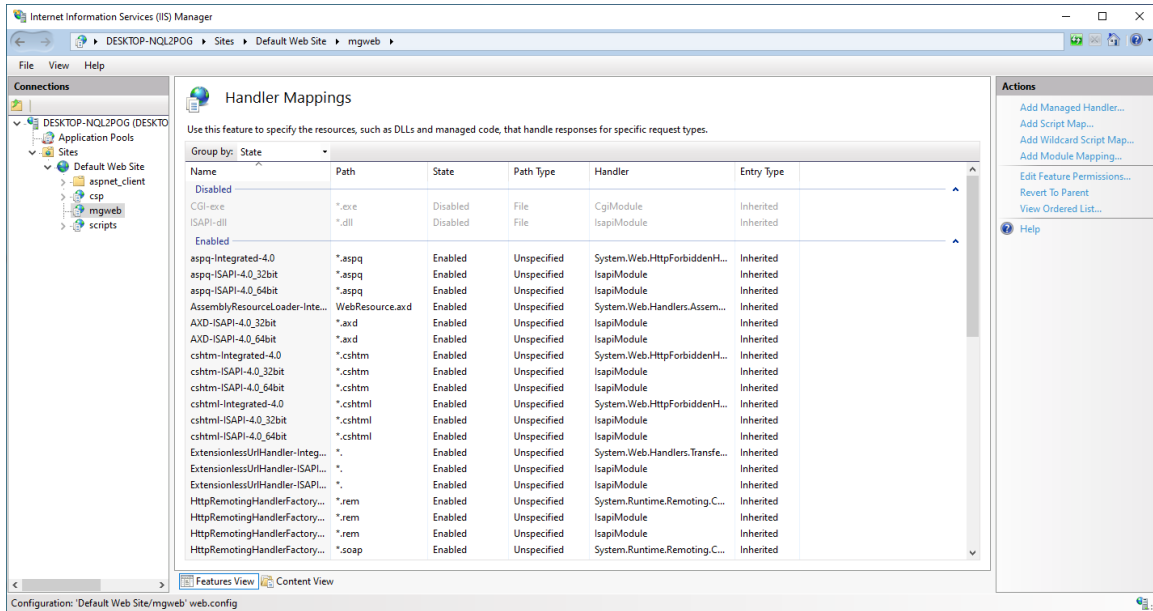
The properties for the virtual application path are shown in the following example. You have to assign an alias (e.g. *mgweb*) and choose an *application pool* to process *mg_web* requests (again named *mgweb* in this example).

The screenshot shows the 'Edit Application' dialog box with the following fields and controls:

- Site name:** Default Web Site
- Path:** /
- Alias:** mgweb
- Application pool:** mgweb
- Select...** button next to the application pool field.
- Example:** sales
- Physical path:** C:\inetpub\mgweb
- Pass-through authentication:** Connect as... Test Settings...
- Enable Preload:** ☐
- OK** and **Cancel** buttons at the bottom right.

Having created a virtual application path for hosting **mg_web** requests, the next task is to map specific file types to the **mg_web** extension. In the following example, we will configure IIS to pass all requests for files of type **.mgw** to **mg_web** for processing.

With the focus on the virtual application path previously created (**mgweb**) in the left-hand panel, open the '**Handler Mappings**' Control Panel and choose '**Add Module Mapping**' in the right-hand panel.



The module name is **mgweb** and we wish to process all files of type **.mgw** with **mg_web**. This is defined in the ***Request Path*** text box. You can name the Module Mapping with a name of your choice – **mgweb** is used in the example below.

Edit Module Mapping ? X

Request path:
*.mgw
Example: *.bas, wsvc.axd

Module:
mgweb

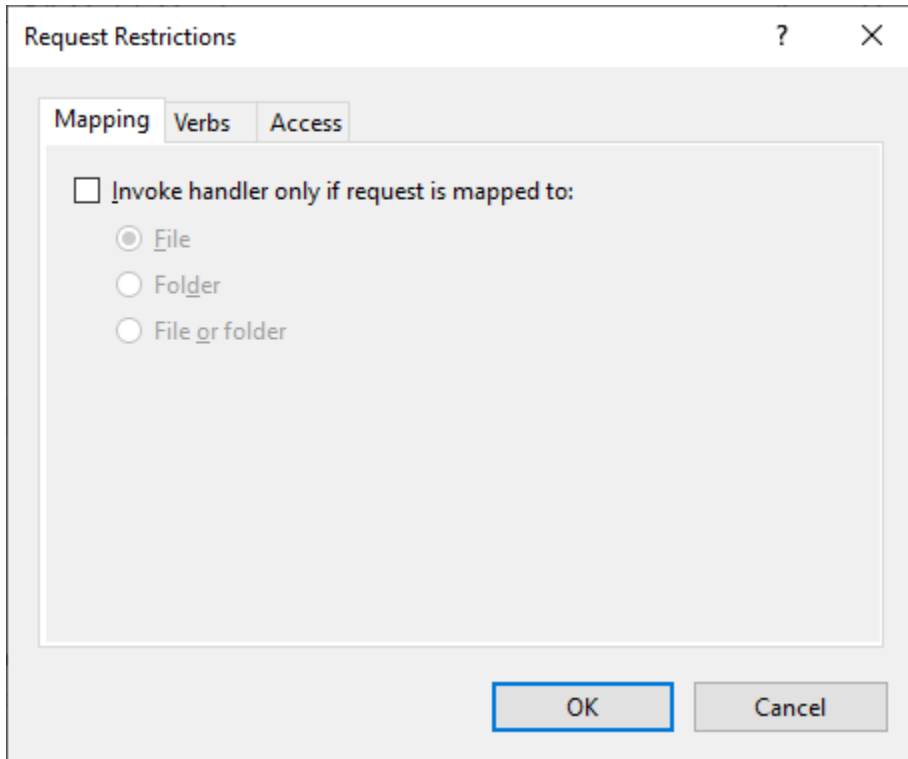
Executable (optional):
...

Name:
mgweb

Request Restrictions...

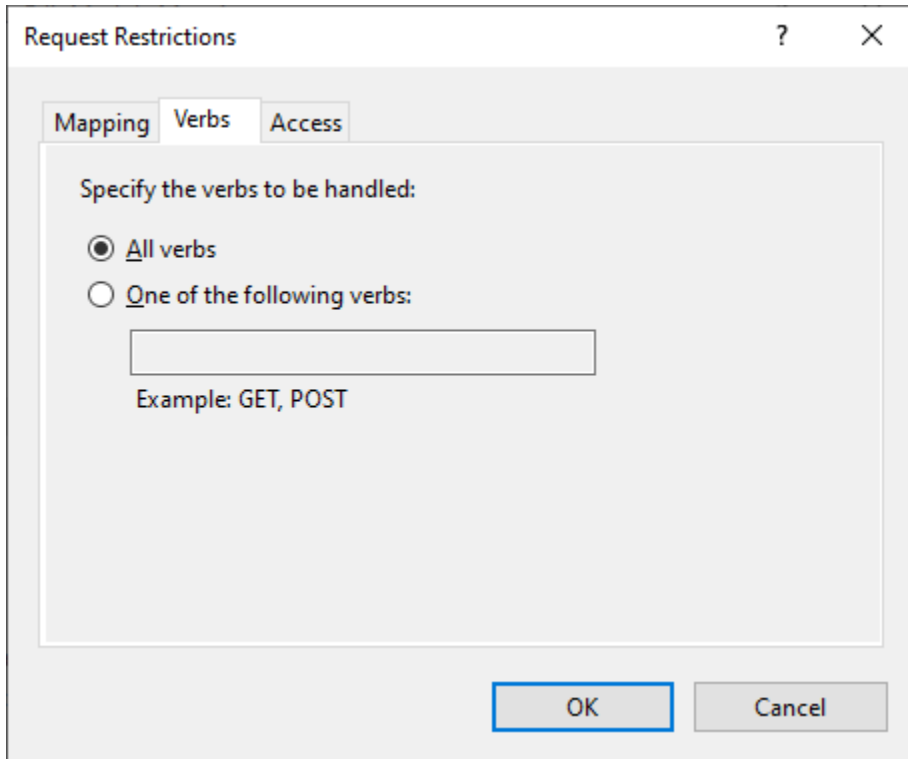
OK Cancel

Press the ***Request Restrictions*** button and make sure that '***Invoke handler only if request is mapped to***' is unchecked. Web resources served my **mg_web** do not physically exist on the web server.



The image shows a 'Request Restrictions' dialog box with a title bar containing a question mark and a close button. Inside the dialog, there are three tabs: 'Mapping', 'Verbs', and 'Access'. The 'Mapping' tab is selected. Within this tab, there is a checkbox labeled 'Invoke handler only if request is mapped to:'. This checkbox is currently unchecked. Below the checkbox are three radio button options: 'File' (which is selected), 'Folder', and 'File or folder'. At the bottom right of the dialog, there are two buttons: 'OK' and 'Cancel'.

Check that all verbs (i.e. HTTP methods) can be served by **mg_web**.



The image shows a 'Request Restrictions' dialog box with three tabs: 'Mapping', 'Verbs', and 'Access'. The 'Verbs' tab is selected. Inside the dialog, there is a section titled 'Specify the verbs to be handled:' with two radio button options. The first option, 'All verbs', is selected. The second option, 'One of the following verbs:', is unselected and has an empty text input field below it. Below the input field, there is an example text: 'Example: GET, POST'. At the bottom right of the dialog, there are 'OK' and 'Cancel' buttons.

Request Restrictions

Mapping Verbs Access

Specify the verbs to be handled:

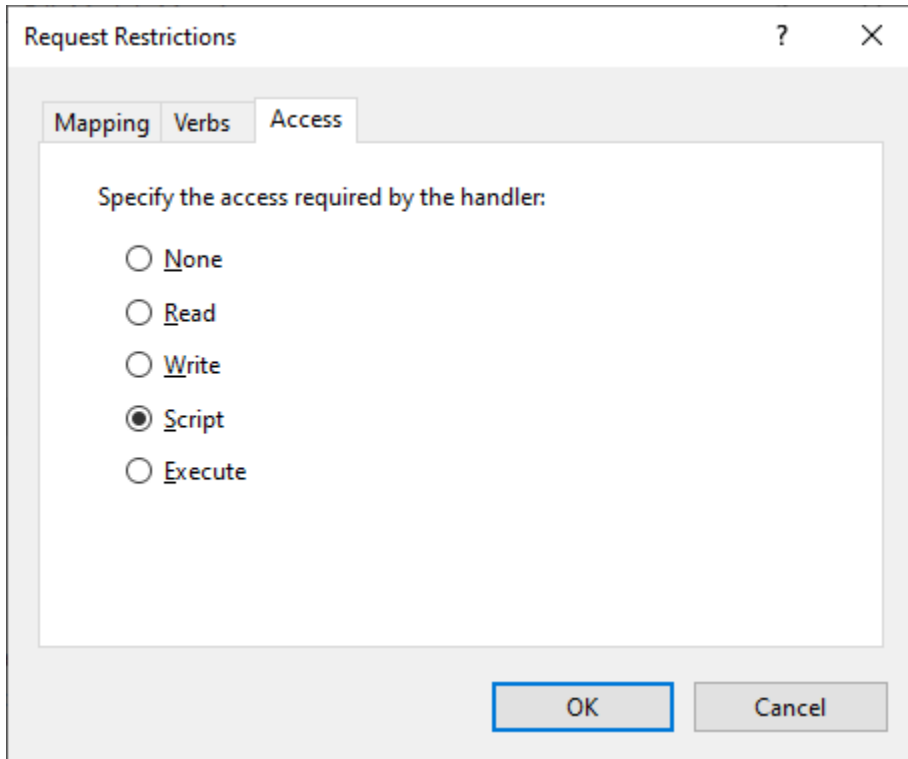
☒ All verbs

☐ One of the following verbs:

Example: GET, POST

OK Cancel

Check that '*Script*' is selected in the *Access* panel.



The image shows a 'Request Restrictions' dialog box with three tabs: 'Mapping', 'Verbs', and 'Access'. The 'Access' tab is selected. Inside the dialog, there is a text prompt 'Specify the access required by the handler:' followed by five radio button options: 'None', 'Read', 'Write', 'Script', and 'Execute'. The 'Script' option is selected, indicated by a filled circle. At the bottom right of the dialog are 'OK' and 'Cancel' buttons.

Request Restrictions

Mapping Verbs Access

Specify the access required by the handler:

- ☐ None
- ☐ Read
- ☐ Write
- ☒ Script
- ☐ Execute

OK Cancel

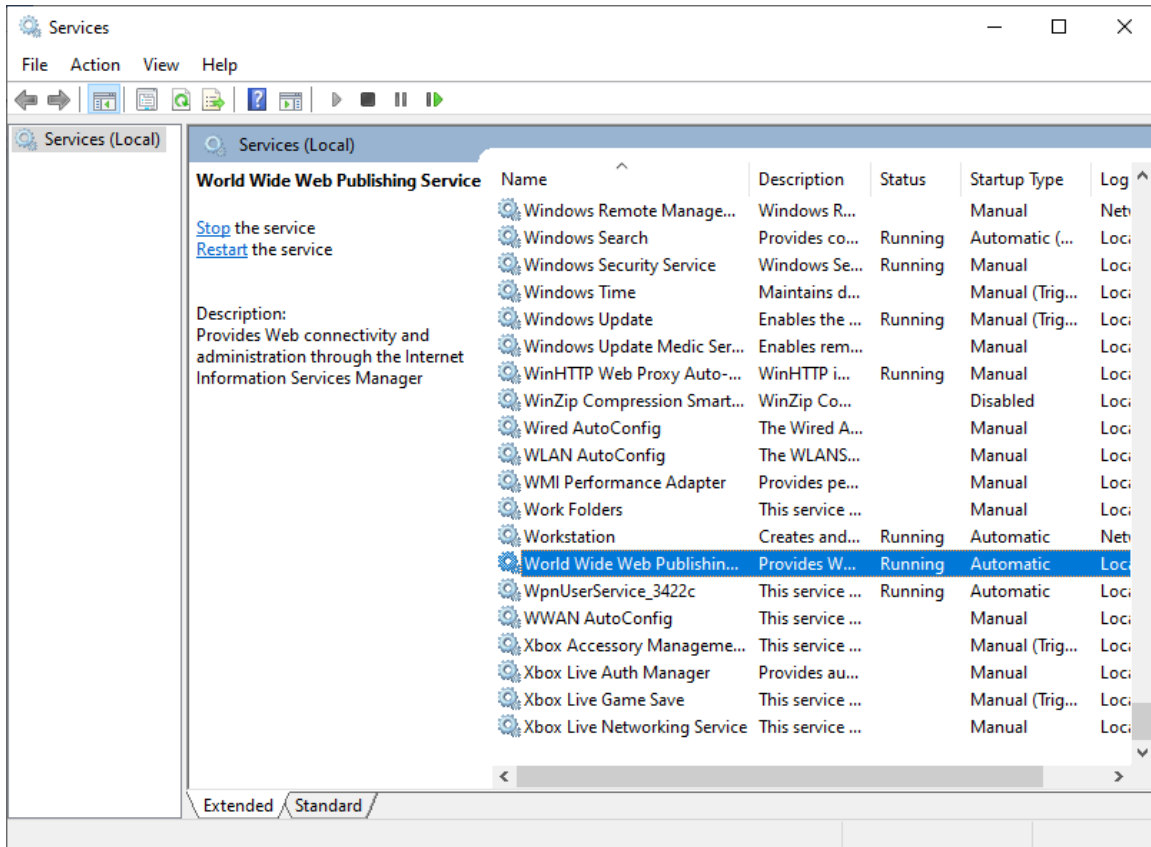
The **mg_web** configuration and log files (**mgweb.conf** and **mgweb.log**) will be expected to exist in the same directory as that hosting the **mg_web** module. The IIS worker processes must have permission to access these files. Create these files and use the following commands to grant full access to IIS.

```
caccls C:\inetpub\mgweb\mgweb.conf /E /G IIS_IUSRS:F  
caccls C:\inetpub\mgweb\mgweb.log /E /G IIS_IUSRS:F
```

Final contents of the **mg_web** directory (**C:\inetpub\mgweb**):

```
mg_web_iis.dll  
mgweb.conf  
mgweb.log
```

Finally, restart IIS from the main Windows Services Control Panel (*World Wide Web Publishing Service*).



IIS will now pass all requests for files of type *.mgw* in path *mgweb* to *mg_web* for processing. For example:

<http://localhost/mgweb/myfile.mgw>

2.2 *mg_web* for Apache

mg_web for Apache is implemented as an *Apache Extension Module*.

2.2.1 Building from source

It is assumed that you have a suitable C/C++ compiler installed. For example, GCC for Linux and Visual C++ for Windows.

Copy the contents of `/src/` and `/src/apache/` to a directory of your choice. You should now have the following files in that directory.

```
mg_web.c
mg_web.h
mg_websys.h
mg_web_apache.c
```

To build **mg_web** for Apache (**mg_web_apache.so** or **mg_web_apache.dll**):

Using the Apache extension compiler tool - *APache eXtenSion tool* (**apxs**):

```
apxs -a -i -c mg_web_apache.c mg_web.c
```

This will compile the **mg_web** extension for Apache, install the module in the Apache *modules* directory, and add the following line to the Apache configuration file (*httpd.conf*):

```
LoadModule mg_web_module          modules/mg_web_apache.so
```

2.2.2 Web Server configuration

Check that the **mg_web** module is registered in the Apache configuration file (*httpd.conf*).

```
LoadModule mg_web_module          modules/mg_web_apache.so
```

Add the full path of the **mg_web** configuration file (*mgweb.conf*) and log file (*mgweb.log*) to the Apache configuration file (*httpd.conf*). For example:

```
MGWEBConfigFile c:/Apache2433/conf/mgweb.conf
MGWEBLogFile c:/Apache2433/logs/mgweb.log
```


Create a location through which **mg_web** requests will be processed. For example, **mg_web** can be active for a whole path (*mgweb* in this example):

```
<Location /mgweb>
    MGWEB On
</Location>
```

Alternatively, **mg_web** can be set to configure only specific file types.

```
<Location /mgweb>
    MGWEBFileTypes .mgw .mgweb
</Location>
```

Finally, restart Apache with the new configuration and the web server will now (for example) pass all requests for files of type *.mgw* in path *mgweb* to **mg_web** for processing.

<http://apachehost/mgweb/myfile.mgw>

2.3 *mg_web* for Nginx

mg_web for Nginx is implemented as a *Nginx Addon Module*. Unlike the other web server solutions where **mg_web** is created as a dynamically loaded library, **mg_web** functionality is built directly into the Nginx core executable.

2.3.1 Building from source

It is assumed that you have a suitable C/C++ compiler installed. For example, GCC for Linux and Visual C++ for Windows. Additionally, on Windows Nginx is built using the MSYS toolkit and that should be installed. The Nginx instructions for building this web server under Windows can be found [here](http://nginx.org/en/docs/howto_build_on_win32.html).

http://nginx.org/en/docs/howto_build_on_win32.html

Copy the contents of `/src/` and `/src/nginx/` to a directory of your choice. For example, `/opt/mgweb/`. You should now have the following files in that directory.

```
config
mg_web.c
mg_web.h
mg_websys.h
mg_web_nginx.c
```

To build **mg_web** into Nginx:

For UNIX systems, add the **mg_web** module directory to the pre-build configuration step. For example:

```
./configure --prefix=/opt/nginx1180 \
            --with-threads \
            --add-module=/opt/mgweb
```

Note that the ‘--with-threads’ option must be included if **mg_web** is to take advantage of Nginx thread pooling (recommended).

Having run the configuration step, the Nginx web server with **mg_web** included can be built using:

```
make
make install
```

For Windows systems, using the MSYS environment, the process is very similar. Add the **mg_web** module directory to the pre-build configuration step. For example:

```
auto/configure --with-cc=cl --builddir=objs --prefix= \
--conf-path=conf/nginx.conf --pid-path=logs/nginx.pid \
--http-log-path=logs/access.log --error-log-
path=logs/error.log \
--sbin-path=nginx.exe \
--http-client-body-temp-path=temp/client_body_temp \
--http-proxy-temp-path=temp/proxy_temp \
--http-fastcgi-temp-path=temp/fastcgi_temp \
--with-cc-opt=-D_FFD_SETSIZE=1024 \
--without-http_rewrite_module \
--without-http_gzip_module \
--with-select_module \
--add-module=/opt/mgweb
```

Having run the configuration step, the Nginx web server with **mg_web** can be built using:

```
nmake -f objs/Makefile
```

2.3.2 Web Server configuration

Add the full path of the **mg_web** configuration file (**mgweb.conf**) and log file (**mgweb.log**) to the Nginx configuration file (**nginx.conf**). These directives should be added to the **http** section of **nginx.conf**. For example:

```
MGWEBConfigFile /opt/nginx1180/conf/mgweb.conf
MGWEBLogFile /opt/nginx1180/logs/mgweb.log
```

Create a location through which **mg_web** requests will be processed. These directives should be added to the **server** section of **nginx.conf**. For example, **mg_web** can be active for a whole path:

```
location /mgweb {
    MGWEB On;
    MGWEBThreadPool default;
}
```

Alternatively, **mg_web** can be set to configure only specific file types.

```
location /mgweb {
    MGWEBFileTypes .mgw .mgweb;
    MGWEBThreadPool default;
}
```

Note that in both cases **mg_web** is configured to use a Nginx thread pool called *default*.

Finally, restart Nginx with the new configuration and the web server will now (for example) pass all requests for files of type *.mgw* in path *mgweb* to **mg_web** for processing.

<http://nginxhost/mgweb/myfile.mgw>

3 DB Server Components

The installation package contains two DB Server routines (i.e. M routines): **%zmgsi** and **%zmgsis**. In this section we will look at the procedure for installing them.

3.1 Installation for InterSystems Caché or IRIS

Log in to the Manager Namespace (%SYS) and install the **zmgsi** routines held in either **/m/zmgsi_cache.xml** or **/m/zmgsi_iris.xml** as appropriate.

```
do $system.OBJ.Load("/m/zmgsi_cache.xml","ck")
```

Change to your development UCI and check the installation:

```
do ^%zmgsi

M/Gateway Developments Ltd - Service Integration Gateway
Version: 3.3; Revision 10 (7 July 2020)
```

3.2 Installation for YottaDB

The instructions given here assume a standard 'out of the box' installation of **YottaDB** deployed in the following location:

```
/usr/local/lib/yottadb/r122
```

The primary default location for routines:

```
/root/.yottadb/r1.22_x86_64/r
```

Copy all the routines (i.e. all files with an 'm' extension) held in the GitHub **/yottadb** directory to:

```
/root/.yottadb/r1.22_x86_64/r
```

Change directory to the following location and start a **YottaDB** command shell:

```
cd /usr/local/lib/yottadb/r122
./ydb
```

Check the installation:

```
do ^%zmgsi
```

Note that the version of **zmgsi** is successfully displayed.

3.3 *Setting up the DB Server network service*

The default TCP server port on which the DB Server (**%zmgsi**) listens is **7041**. If you wish to use an alternative port then modify the following instructions accordingly. The SIG will, by default, expect the database server to be listening on port **7041** of the local server (localhost).

3.3.1 InterSystems Caché or IRIS

Start the M-hosted concurrent TCP service in the Manager UCI (%SYS):

```
do start^%zmgsi(0)
```

To use a server TCP port other than 7041, specify it in the start-up command (as opposed to using zero to indicate the default port of 7041).

3.3.2 YottaDB

Network connectivity to **YottaDB** is managed via the **xinetd** service. First create the following launch script (called **zmgsi_ydb** here):

```
/usr/local/lib/yottadb/r122/zmgsi_ydb
```

Content:

```
#!/bin/bash
cd /usr/local/lib/yottadb/r122
export ydb_dir=/root/.yottadb
export ydb_dist=/usr/local/lib/yottadb/r122
export
ydb_routines="/root/.yottadb/r1.22_x86_64/o* (/root/.yottadb/r1.22_x86_64/r /root/.yottadb/r) /usr/local/lib/yottadb/r122/libyottadbutil.so"
export ydb_gblidir="/root/.yottadb/r1.22_x86_64/g/yottadb.gld"
$ydb_dist/ydb -r xinetd^%zmgsis
```

Create the **xinetd** script (called **zmgsi_xinetd** here):

```
/etc/xinetd.d/zmgsi_xinetd
```

Content:

```

service zmgsi_xinetd
{
    disable          = no
    type             = UNLISTED
    port             = 7041
    socket_type      = stream
    wait             = no
    user             = root
    server           = /usr/local/lib/yottadb/r122/zmgsi_ydb
}

```

- Note: sample copies of **zmgsi_xinetd** and **zmgsi_ydb** are included in the /unix directory.

Edit the services file:

```
/etc/services
```

Add the following line to this file:

```
zmgsi_xinetd          7041/tcp          # ZMGSI
```

Finally restart the **xinetd** service:

```
/etc/init.d/xinetd restart
```

4 General mg_web configuration (mgweb.conf)

The **mg_web** configuration file (*mgweb.conf*) contains the instructions for connecting to each DB Server and which web paths should be routed to each DB Server.

There are general settings such as request timeouts:

```
timeout 30
```

You can also define lists of CGI environment variables to be sent to the DB Server with each request. For example, the following directive will instruct **mg_web** to send to the DB Server all CGI environment variables derived from client HTTP request headers (*HTTP**) and the web server *Server Software* with each request.

```
<cgi>
    HTTP*
    SERVER_SOFTWARE
</cgi>
```

Note that, by default, **mg_web** will only send the following CGI environment variables to the DB Server with each request.

```
REQUEST_METHOD
SCRIPT_NAME
QUERY_STRING
```

4.1 Defining Servers

The following examples will illustrate how DB Server access should be defined for **mg_web**.

Network based access to InterSystems IRIS (or Cache) listening on TCP port 7041:

```
<server local>
    type IRIS
    host localhost
    tcp_port 7041
    username _SYSTEM
    password SYS
    namespace USER
</server>
```


API based access to InterSystems IRIS (or Cache):

```
<server local>
  type Cache
  path /opt/cache20181/mgr
  username _SYSTEM
  password SYS
  namespace USER
</server>
```

Network based access to YottaDB listening on TCP port 7041:

```
<server local>
  type YottaDB
  host localhost
  tcp_port 7041
</server>
```

API based access to YottaDB:

```
<server local>
  type YottaDB
  path /usr/local/lib/yottadb/r122
  <env>
    ydb_dir=/root/.yottadb
    ydb_rel=r1.22_x86_64
    ydb_gblmdir=/root/.yottadb/r1.22_x86_64/g/yottadb.gld
    ydb_routines=/root/.yottadb/r1.22_x86_64/o*(/root/.yottadb/
    r1.22_x86_64/r /root/.yottadb/r)
    /usr/local/lib/yottadb/r122/libyottadbutil.so
    ydb_ci=/usr/local/lib/yottadb/r122/zmgsi.ci
  </env>
</server>
```

4.2 Defining Paths

The following examples will illustrate how web paths should be defined for **mg_web**.

The root path (effectively the default mapping):

```
<location />  
    function web^%zmgweb  
    servers local  
</location>
```

Further examples:

```
<location /mgweb/path1>  
    function web1^%zmgweb  
    servers local1  
</location>
```

```
<location /mgweb/path2>  
    function web2^%zmgweb  
    servers local2  
</location>
```

A hierarchical system of inheritance for the paths is applied. For Example:

<http://webserver/mgweb/path1/file.mgw>

This request will be routed to DB Server **local1**

<http://webserver/mgweb/path2/file.mgw>

This request will be routed to DB Server **local2**

<http://webserver/mgweb/path2/abc/file.mgw>

This request will be routed to DB Server **local2**

<http://webserver/mgweb/file.mgw>

This request will be routed to DB server **local**

<http://webserver/xyz/file.mgw>

This request will be routed to DB server **local** (assuming the web server is configured to pass requests with a path of **/xyz** to **mg_web**).

4.3 Complete example *mgweb.conf*

```
timeout 30

<cgi>
    HTTP*
    SERVER_SOFTWARE
</cgi>

<server local>
    type IRIS
    host localhost
    tcp_port 7041
    username _SYSTEM
    password SYS
    namespace USER
</server>

<location />
    function web^%zmgweb
    servers local
</location>
```

4.4 Reporting configuration errors

It is essential that the **mg_web** event log file is specified correctly and that the web server worker processes are granted full access to it as any configuration errors will be reported in the log.

When a web server worker process successfully links to the **mg_web** library, a message such as that shown below will be written to the **mg_web** event log.

```
>>> Time: Thu Jul 23 16:21:44 2020; Build: 1.0.1 pid=9364;tid=27368;
    mg_web: worker initialization
    configuration: C:/inetpub/mgweb/mgweb.conf
```

If a configuration error is detected it will be reported after the initialization message. For example, if parameter *tcp_port* is not specified correctly, a sequence of messages similar to those shown below will be reported.

```
>>> Time: Thu Jul 23 16:21:44 2020; Build: 1.0.1 pid=9364;tid=27368;  
      mg_web: worker initialization  
      configuration: C:/inetpub/mgweb/mgweb.conf  
>>> Time: Thu Jul 23 16:21:44 2020; Build: 1.0.1 pid=9364;tid=27368;  
      mg_web: configuration error  
      Invalid 'server' parameter 'tcpport' on line 11
```

5 The mg_web DB Server function

The signature of DB Server functions for **mg_web** is as follows:

```
web^%zmgweb(%cgi,%content,%sys)
    ; process request and generate response
    Quit response
```

Where:

```
%cgi:      List of CGI Environment Variables
%content:  The request payload (if any)
%sys:      Reserved for mg_web use.
```

Of course, the function may be named as you wish but must match the corresponding *function* entry in the **mg_web** configuration file (*mgweb.conf*).

There are a number of ‘helper’ functions available to **mg_web** functions. These are described below.

Parse content of type ‘application/x-www-form-urlencoded’ OR a QUERY_STRING to return an array of name/value pairs:

```
Set %status=$$nvpair^%zmgsis(.%nv,%content)
```

Where:

```
%nv:      An array of name/value pairs
%content: The request payload or a QUERY_STRING
```

This function will un-escape all components before placing them in the name/value pair array.

URL decoding function (URL unescaping):

```
Set %decoded=$$urld^%zmgsis(%encoded)
```

Where:

```
%encoded: URL-escaped item.
%decoded: URL-unescaped item.
```

URL encoding function (URL escaping):

```
Set %decoded=$$urle^%zmgsis(%decoded)
```

Where:

%decoded: URL-unescaped item.

%encoded: URL-escaped item.

Determine the maximum string length for this DB Server installation:

```
Set %max=$$getmsl^%zmgsis()
```

Where:

%max: Maximum string length.

6 License

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