

Web Servers & Dynamic Web Documents

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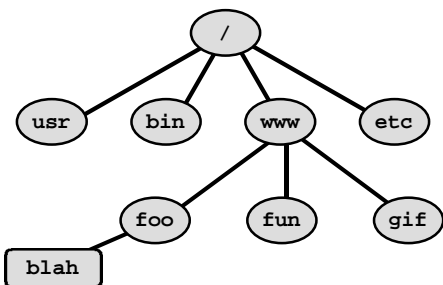
Web Server

- Talks HTTP
- Looks at METHOD, URI to determine what the client wants.
- For GET, URI often is just the path of a file (relative to some directory on the web server).

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GET /foo/blah



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In the good old days...

- Years ago... the WWW was made up of (mostly) static documents.
 - Each URL corresponded to a single file stored on some hard disk.
- Today - many of the documents on the WWW are built at request time.
 - URL doesn't correspond to a single file.

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Dynamic Documents

- Dynamic Documents can provide:
 - automation of web site maintenance
 - customized advertising
 - database access
 - shopping carts
 - date and time service
 - high paying jobs for netprog students.

Cool idea!

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Web Programming

- Writing programs that create dynamic documents has become very important.
- There are a number of general approaches:
 - Create custom server for each service desired.
 - Each is available on different port.
 - Have web server run external programs.
 - Develop a real smart web server
 - SSI, scripting, server APIs.

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Custom Server

- Write a TCP server that watches a “well known” port for requests.
- Develop a *mapping* from http requests to service requests.
- Send back HTML (or whatever) that is created/selected by the server process.
- Have to handle http errors, headers, etc.

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An Example Custom Server

- We want to provide a time and date service.
- Anyone in the world can find out the date and time (according to our computer)!!!

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Custom Server request

- We don't care what is in the http request, our reply doesn't depend on it.
- We assume the request comes from a browser that wants the content formatted as an HTML document.

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WWW based time and date server

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- Listen on a well known TCP port.
- Accept a connection.
- Find out the current time and date
- Convert time and date to a string
- Send back some http headers (Content-Type)
- Send the string wrapped in HTML formatting.
- Close the connection.

loop forever

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Accessing our custom server.

- We can publish the URL to our server, or embed links to the server in other HTML documents.
- We need to make sure the server is always running (on the published host and port).
- Once we are famous we can include advertisements and make money!

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Important Note

- These slides say "we" and "our" a lot.
- I don't really mean that.
- This is all mine - get your hands off my future dot com.

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Another Money Making Scheme Example

- Keep track of how many times our server is hit each day.
- Report on the number of hits our server got on any day in the past!

The Request and Reply

- The reply now *does* depend on the request.
- We have to remember that the request comes from a HTTP client, so we need to accept HTTP requests.

Time & Date Hit Server

- Each request comes as a string (URI) specifying a resource.
- Our requests will look like this:
/mm/dd/yyyy  Y2K Compliant!
- An example URL for our service:
`http://www.timedate.com:4567/02/10/2000`
- We will get a request like:
`GET /02/10/2000 HTTP/1.1`

Fancy means \$\$\$

- We want to provide a table that lists the number of hits received each hour of the day in question

timedate.com hit report for 01/17/1999

<u>hour</u>	<u>number of hits</u>
12-1AM	4,320
1-2AM	18,986
2-3AM	246

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HTML Basics

- I assume everyone knows something about HTML.
 - If not: check the home page for some links.
- HTML Tables:
 - `<TABLE>` , `</TABLE>` start/end a table
 - `<TR>` , `</TR>` start/end a table row
 - `<TD>` , `</TD>` start/end a table cell
 - `<TH>` , `</TH>` start/end table header cell

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timedate.com Hit Table

```
<TABLE>
<TR>
  <TH>hour</TH>
  <TH>number of hits</TH>
</TR>
<TR>
  <TD>12-1AM</TD>
  <TD>4,320</TD>
</TR>
<TR>
  <TD>1-2AM</TD>
  <TD>18,986</TD>
</TR>
```

<u>hour</u>	<u>number of hits</u>
12-1AM	4,320
1-2AM	18,986
2-3AM	246

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New code

- Record the "hit" in database.
- Read request - parse request to month,day,year
- Lookup hits for month,day,year in database.
- Send back some http headers (Content-Type)
- Create HTML table and send back to client.
- Close the connection.
- *Collect millions in advertising revenues.*

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Drawbacks to Custom Server Approach

- We might have lots of ~~ideas~~ custom services.
 - Each requires dedicated address (port)
 - Each needs to include:
 - basic TCP server code
 - parsing HTTP requests
 - error handling
 - headers
 - access control (might want users to pay each time they check the time and date!)

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Another Approach

- Take a general purpose Web server (that can handle static documents) and have it *process* requested documents as it sends them to the client.
- The documents could contain commands that the server understands (the server includes some kind of interpreter).

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Example Smart Server

- Have the server read each HTML file as it sends it to the client.
- The server could look for this:
`<SERVERCODE> some command </SERVERCODE>`
- The server doesn't send this part to the client, instead it interprets the command and sends the result to the client.
- Everything else is sent normally.

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Example Commands

```
<SERVERCODE> Time </SERVERCODE>
<SERVERCODE> Date </SERVERCODE>
<SERVERCODE> Hitlist </SERVERCODE>
```

```
<SERVERCODE> Include file </SERVERCODE>
<SERVERCODE> randomfile directory </SERVERCODE>
```

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Example Document

```
<TITLE>timedate.com Home Page</TITLE>
<H1 ALIGN=CENTER>Welcome to timedate.com</H1>
<SERVERCODE> include fancygraphic
</SERVERCODE>
```

```
The current time is
<SERVERCODE> time </SERVERCODE>.<P>
```

```
Today is <SERVERCODE> date </SERVERCODE>.
```

```
Visit our sponsor:
<SERVERCODE> random sponsor </SERVERCODE>
```

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Real Life - Server Side Includes

- Many real web servers support this idea (but not the syntax I've shown).
- Server Side Includes (SSI) provides a set of commands that a server will interpret.

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SSI Configuration

- Typically the server is configured to look for commands only in specially marked documents (so normal documents aren't slowed down).

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SSI Directives

- SSI commands are called *directives*
- Directives are embedded in HTML comments. A comment looks like this:

```
<!-- this is an HTML comment -->
```
- A directive looks like this:

```
<!--#command parameter="arg"-->
```

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Some SSI Directives

echo: inserts the value of an environment variable into the page.
SSI servers keep a number of useful things in environment variables:

`DOCUMENT_NAME, DOCUMENT_URL`

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SSI echo example

This page is located at
`<!--#echo var="DOCUMENT_URL"-->.`

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SSI Directives

include: inserts the contents of a text file.
`<!--#include file="banner.html">`

lastmod: inserts the time and date that a file was last modified.
Last modified:
`<!--#lastmod file="foo.html">`

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SSI Directives (cont.)

exec: runs an external program and inserts the output of the program.

Current users:

```
<!--#exec cmd="/usr/bin/who">
```

Danger! Danger! Danger!

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SSI Example - exec

```
<H1>Directory listing using the  
<CODE>#exec</CODE> SSI directive</H1>
```

```
<PRE>  
<!--#exec cmd="ls -al"-->  
</PRE>
```

```
<HR>
```

```
<H3> Here I forgot to use the HTML  
<CODE><PRE></CODE> tag:</H3>
```

```
<!--#exec cmd="ls -al"-->
```

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Another SSI Example

```
<!--#INCLUDE FILE="header"-->  
It is now:  
<!--#config timefmt="%I:%M %p (%Z)"-->  
<!--#echo var="DATE_LOCAL"-->  
<BR>  
Today is:  
<!--#config timefmt="%A, %B %e, %Y"-->  
<!--#echo var="DATE_LOCAL"--><BR>
```

```
<!--#INCLUDE FILE="footer"-->
```

```
<!--#config timefmt="%D"-->  
This file last modified  
<!--#echo var="LAST_MODIFIED"-->  
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```

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More Power

- Some servers support elaborate scripting languages.
- Scripts are embedded in HTML documents, the server interprets the script:
 - Microsoft *Active Server Pages* (ASP)
 - JScript, VBScript, PerlScript
 - Netscape *LiveWire*
 - JavaScript, SQL connection library.
 - There are others...

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Server Mapping and APIs

- Some servers include a programming interface that allows us to extend the capabilities of the server by writing modules.
- Specific URLs are mapped to specific modules instead of to files.
- We could write our `timedate.com` server as a module and merge it with the web server.

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External Programs

- Another approach is to provide a standard interface between external programs and web servers.
 - We can run the same program from any web server.
 - The web server handles all the http, we focus on the special service only.
 - It doesn't matter what language we use to write the external program.

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Common Gateway Interface

- CGI is a standard interface to external programs supported by most (if not all) web servers.
- The interface that is defined by CGI includes:
 - Identification of the service (external program).
 - Mechanism for passing the request to the external program.

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CGI Programming

- We will focus on CGI programming.
- CGI programs are often written in scripting languages (perl, tcl, etc.), we will concentrate on C

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