CS 580 Client-Server Programming
Spring Semester, 2007
Doc 10 Protocol, HTTP, POP
Mar 6, 2007

References

Hypertext Transfer Protocol - HTTP/1.0, Berners-Lee, Fielding, Nielson, rfc1945, http://www.w3.org/Protocols/rfc1945/rfc1945

Hypertext Transfer Protocol -- HTTP/1.1, Fielding, Gettys, Mogul, Masinter, Leach, Berners-Lee, rfc2616, http://www.w3.org/Protocols/rfc2616/rfc2616.html

Uniform Resource Identifiers (URI): Generic Syntax, Berners-Lee, Fielding, Masinter, rfc2396 http://www.ietf.org/rfc/rfc2396.txt

RFC 1939, http://www.ietf.org/rfc/rfc1939.txt

Reading

HTTP/1.0 rfc1945, http://ftp.ics.uci.edu/pub/ietf/http/rfc1945.html

Post Office Protocol RFC 1939,http://www.ietf.org/rfc/rfc1939.txt

Protocol

Requirements for a "good protocol"

Well defined

Complete

Parsable

Extendable

Available protocol document

Assignment 2 Protocol

Client Request	Server Response
add cat;	success;
result cat;	name:cat;yes:0;no:0;
vote cat;yes;	success;
result cat;	name:cat;yes:1;no:0;
list;	cat;dog;rat;mat;

Well defined

Every bit of data sent in either direction has to have its place in the protocol description.

Protocol is a Language

Common formal description:

- BNF and Augmented BNF

Format of the description language needs to be part of the protocol document.

Examples are important

Complete

The protocol must cover all possible situations.

Garbage data
Old client or server (different protocol versions)
Illegal requests
Boundary conditions
Etc.

Parsable

Both clients and servers are computer programs.

A computer program's IQ is generally 0.

Design goals

Distinct information packets or messages

Allow parsing independent of semantics

Consistency

Allow for code reuse

Flexibility

Allow parsing independent of semantics

Client Request	Server Response
add cat;	success;
result cat;	name:cat;yes:0;no:0;
vote cat;yes;	success;
result cat;	name:cat;yes:1;no:0;
list;	cat;dog;rat;mat;

How does

the server parse each set of commands?

The client parse each response

Available

Different groups may write clients and servers at different times.

Central registry for Internet protocols

Self regulating:

- RFC - Request For Comment
- IETF - Internet Engineering Task Force

Official:

- ISO
- ANSI

Protocol Types

Typical **synchronous**

Client sends request to server
Server responds with a reply

HTTP, POP, SMTP, GOPHER, XMODEM

Typical **asynchronous**

Client and server both send information to each other concurrently.

TELNET, RLOGIN, ZMODEM

A hybrid protocol is also possible

Protocol Design Issues

Protocol design is difficult!
Learn from examples

Some issues

Protocol extendibility and versioning

Byte order used for sending values

ASCII vs. Binary protocol

Synchronous vs. Asynchronous

State

Timeouts

HTTP

Stateless (http 1.0)

Assigned port 80

Basic Server-Client Interaction (http 1.0)

Client: Open connection

Server: Accept/Reject connection

Client: Send request

Server: Send response to request

Connection closed

HTTP Message Format

HTTP-message = Simple-Request (HTTP/0.9 messages)
| Simple-Response
| Full-Request (HTTP/1.0 messages)
| Full-Response

Full-Request = Request-Line
*(General-Header | Request-Header | Entity-Header)
CRLF
[Entity-Body]

Full-Response = Status-Line
*(General-Header | Request-Header | Entity-Header)
CRLF
[Entity-Body]

HTTP-header = field-name ":" [field-value] CRLF

Entity-Body = *OCTET

HTTP Full Request

Request-Line = Method SP URI SP HTTP-Version CRLF

rohan 13-> **telnet www.eli.sdsu.edu 80**
Trying 130.191.226.80...
Connected to www.eli.sdsu.edu.
Escape character is '^]'.
GET /courses/fall00/cs580/index.html HTTP/1.0

2 CRLF's end the full request

HTTP/1.1 200 OK
Date: Tue, 05 Sep 2000 19:31:14 GMT
Server: Apache/1.3.9 (Unix) PHP/3.0.12
Last-Modified: Mon, 04 Sep 2000 21:03:56 GMT
ETag: "14c199-7e8-39b40e3c"
Accept-Ranges: bytes
Content-Length: 2024
Connection: close
Content-Type: text/html
X-Pad: avoid browser bug

<HTML>
<HEAD>
<TITLE>CS 580: Course Web Site</TITLE>
… stuff removed here…
Connection closed by foreign host.

Positional Data verses Name-Value Pairs

```
1.0; CERN/3.0; Thursday, 21-Mar-96 17:00:45 GMT; text/html; 2686; Tuesday, 27-Feb-96 05:34:12 GMT
```

```
MIME-Version: 1.0
Server: CERN/3.0
Date: Thursday, 21-Mar-96 17:00:45 GMT
Content-Type: text/html
Content-Length: 2686
Last-Modified: Tuesday, 27-Feb-96 05:34:12 GMT
```

Which is more error prone?

Name-Value Pairs & Orderer

MIME-Version: 1.0
Server: CERN/3.0
Date: Thursday, 21-Mar-96 17:00:45 GMT
Content-Type: text/html
Content-Length: 2686
Last-Modified: Tuesday, 27-Feb-96 05:34:12 GMT

Server: CERN/3.0
Content-Type: text/html
MIME-Version: 1.0
Content-Length: 2686
Last-Modified: Tuesday, 27-Feb-96 05:34:12 GMT
Date: Thursday, 21-Mar-96 17:00:45 GMT

Adding new Fields

MIME-Version: 1.0

Server: CERN/3.0

Date: Thursday, 21-Mar-96 17:00:45 GMT

Content-Type: text/html

Forwarded: by http://rohan.sdsu.edu/ for cs.sdsu.edu

Content-Length: 2686

WhitneyInfo: Hi Mom

Last-Modified: Tuesday, 27-Feb-96 05:34:12 GMT

Name-Value Pairs are your Friends

Don't Program without them

How to Indicate the End of a Message

Use termination sequence

Make the length of the message known

HTTP uses both

Header ends in CRLFCRLF
Header contains length in bytes of message body

HTTP/1.0 200 Document follows
MIME-Version: 1.0
Server: CERN/3.0
Date: Thursday, 21-Mar-96 17:00:45 GMT
Content-Type: text/html
Content-Length: 2686
Last-Modified: Tuesday, 27-Feb-96 05:34:12 GMT

Detecting End of a Message

What if the terminating sequence is part of the message?

What if a HTTP header contains CRLFCRLF

POP3

Post Office Protocol

Purpose: Allow PC's, Macs, etc. to download mail from server

Port number 110

Protocol uses ASCII only

Stateful protocol

Multiple requests & responses on same connection

Format of commands to server

keyword blank argument1 [blank argumentk] CRLF

| keyword | = 3, 4 characters, no spaces

| argument | <= 40 characters, no spaces

keyword and arguments are separated by single space character

Server Response

Status keyword additionalInfo

Status is either "+OK" or "-ERR0.3."

A single line response ends in CRLF

If response requires more than one line:

Each line ends in a CRLF

The response ends in CRLF.CRLF

If a line starts with a "." prepend a "." to it

When Client reads the first CRLF how does it know it is at the end of message?

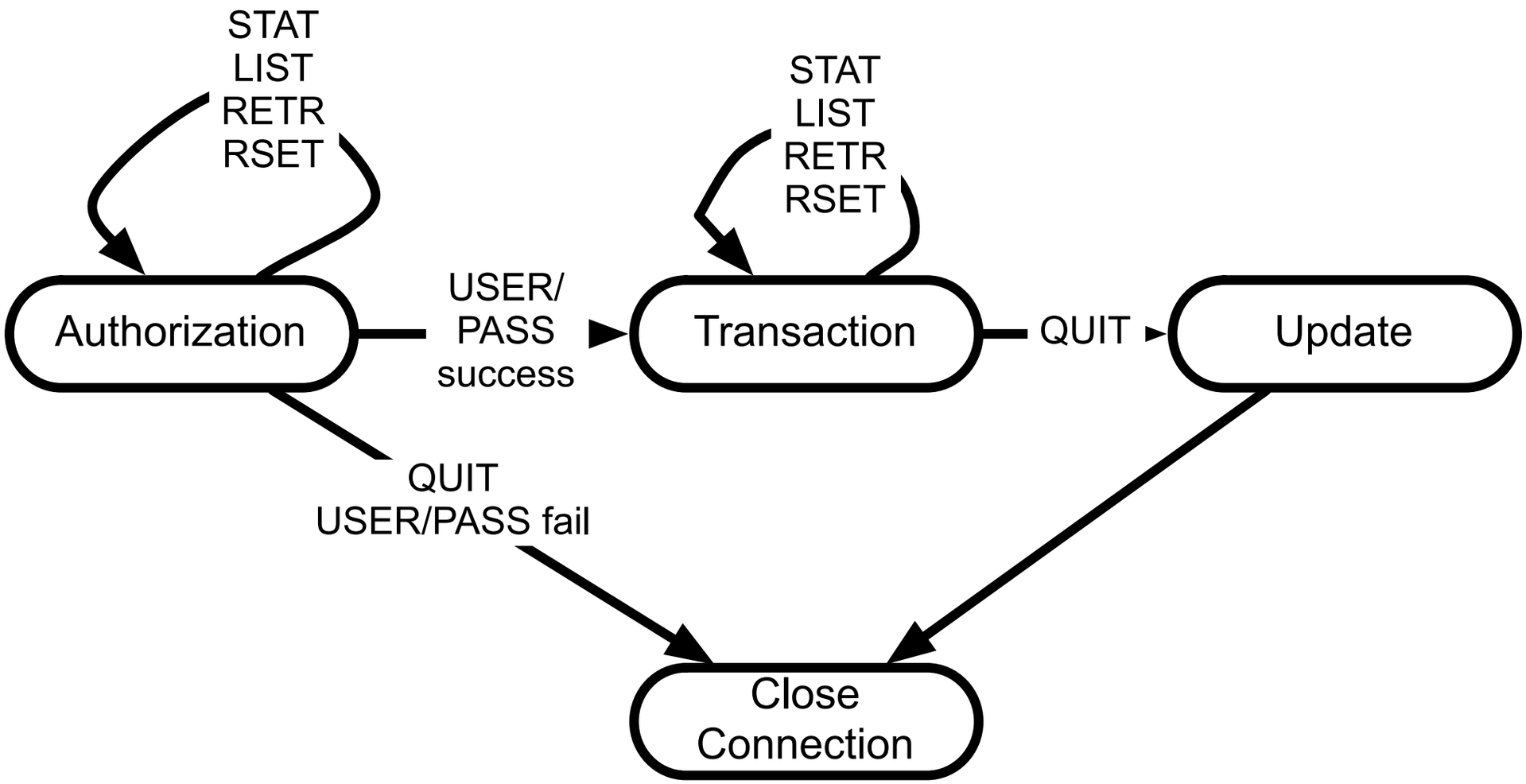
Timeouts

A POP3 server may have an autologout timer

A server must wait at least 10 minutes before timing out an idle client

The POP3 server on cs.sdsu.edu times out in 2 minutes

Client Connect States



Authorization State

Server acknowledges connection from client with

+OK "message"

+OK UCB Pop server (version 2.1.2-R3) at sciences.sdsu.edu starting.

Commands: USER, PASS, APOP, QUIT

USER PASS

Combination is used to progress to transaction state

USER must come first
PASS or QUIT must come after USER

Example
Ti 38->**telnet cs.sdsu.edu 110**
Trying 130.191.226.116...
Connected to cs.sdsu.edu.
Escape character is '^]'.
+OK QPOP (version 3.1.2) at sciences.sdsu.edu starting.
USER whitney
+OK Password required for whitney.
PASS typeYourPasswordHere
+OK whitney has 116 visible messages (0 hidden) in 640516 octets.

Transaction State

Commands: STAT, LIST, RETR, RSET, QUIT

STAT

Arguments: none
Returns "+OK" numberOfMessages SizeOfMail

STAT
+OK 22 45595

LIST

Arguments: a message-number (optional)
Returns: size of message in octets

Examples

LIST 2
+OK 2 3064

LIST
+OK 116 visible messages (640516 octets)
1 2980
2 3064 (message 3 - 116 deleted to save space)
116 1290
.

RETR

Arguments: a message-number

Returns: the message

Transaction State

RETR 21

+OK 825 octets
Received: from [130.191.9.18] (ebb2p9.sdsu.edu [130.191.9.18]) by sciences.sdsu.edu (4.1/8.6.10) with SMTP id UAA29486 for <whitney@saturn.sdsu.edu>; Mon, 11 Mar 1996 20:16:07 -0800 (PST)
X-Sender: whitney@cs.sdsu.edu (Unverified)
Message-Id: <v02110100ad6aaaf097b6@[130.191.9.70]>
Mime-Version: 1.0
Content-Type: text/plain; charset="us-ascii"
Date: Mon, 11 Mar 1996 20:16:50 -0800
To: whitney@saturn.sdsu.edu
From: whitney@saturn.sdsu.edu (Roger Whitney)
Subject: Sample Mail
X-UIDL: 826604201.000

this is a test
..
the end

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Transaction State

DELE

Arguments: a message-number to delete
Returns: a confirmation of deletion
Marks a message to be deleted

NOOP

Arguments: none
Returns: a positive response
Does nothing

Why NOOP?

QUIT

Arguments: none
Returns: a positive response
Send POP3 server to UPDATE state

Update State

Updates mail box to reflect transactions taken during the transaction state, then logs user out

If session ends by any method except the QUIT command during the transaction state, the update state is not entered