SNS COLLEGE OF TECHNOLOGY

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DEPARTMENT OF INFORMATION TECHNOLOGY

AI IN WEB TECHNOLOGY

III YEAR - VI SEM

UNIT 1 – Web Site Basics And HTML

TOPIC 1 – Web Basics

UNIT – 1
WEB SITE BASICS AND HTML

Web Essentials: Clients, Servers, and Communication. The Internet-Basic Internet Protocols –The World Wide Web-HTTP request message-response message-Web Clients Web Servers. Markup Languages: XHTML. An Introduction to HTML History-Versions-Basic XHTML Syntax and Semantics-Some Fundamental HTML Elements-Relative URLs-Lists-tables-Frames-Forms-HTML 5.0.

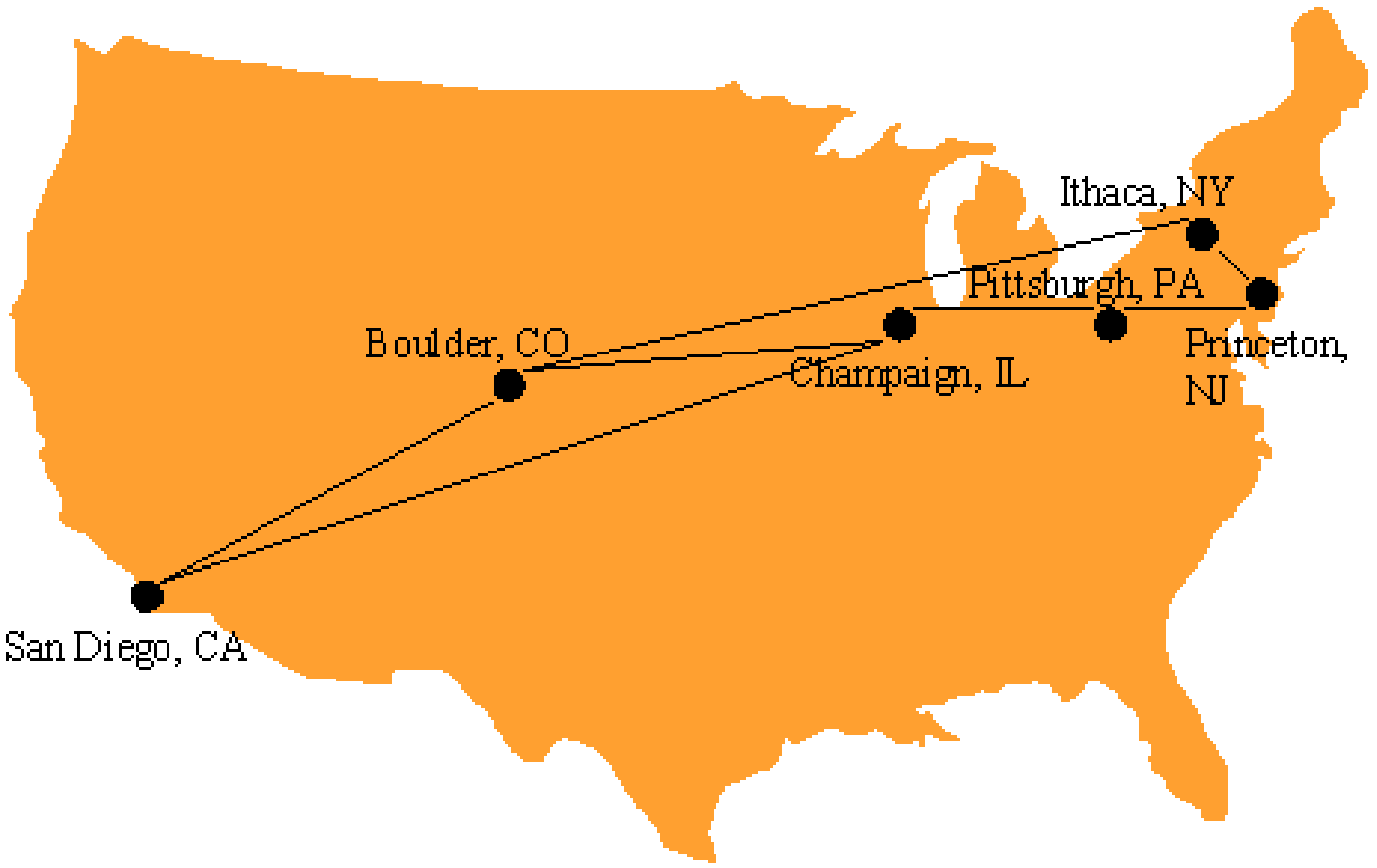
The Internet

- Technical origin: ARPANET (late 1960’s)
  - One of earliest attempts to network heterogeneous, geographically dispersed computers
  - Email first available on ARPANET in 1972 (and quickly very popular!)
- ARPANET access was limited to select DoD-funded organizations

The Internet

- Open-access networks
  - Regional university networks (e.g., SURAnet)
  - CSNET for CS departments not on ARPANET
- NSFNET (1985-1995)
  - Primary purpose: connect supercomputer centers
  - Secondary purpose: provide backbone to connect regional networks

The Internet



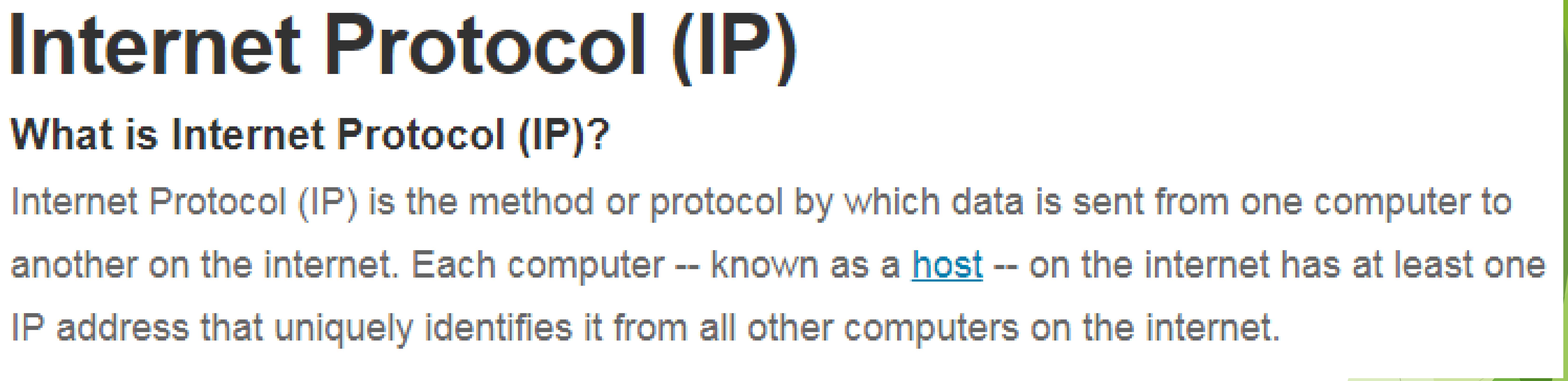
The 6 supercomputer centers connected by the early NSFNET backbone

The Internet

- Original NSFNET backbone speed: 56 kbit/s
- Upgraded to 1.5 Mbit/s (T1) in 1988
- Upgraded to 45 Mbit/s (T3) in 1991

- In 1988, networks in Canada and France connected to NSFNET
- In 1990, ARPANET is decommissioned, NSFNET the center of the internet

The Internet



Internet Protocol (IP)

What is Internet Protocol (IP)?

Internet Protocol (IP) is the method or protocol by which data is sent from one computer to another on the internet. Each computer -- known as a host -- on the internet has at least one IP address that uniquely identifies it from all other computers on the internet.

The Internet

- Internet: the network of networks connected via the public backbone and communicating using TCP/IP communication protocol
  - Backbone initially supplied by NSFNET(**National Science Foundation Network**), privately funded (ISP fees) beginning in 1995

Internet Protocols

- Communication protocol: how computers talk
  - Cf. telephone “protocol”: how you answer and end call, what language you speak, etc.
- Internet protocols developed as part of ARPANET research
  - ARPANET began using TCP/IP in 1982
- Designed for use both within local area networks (LAN’s) and between networks

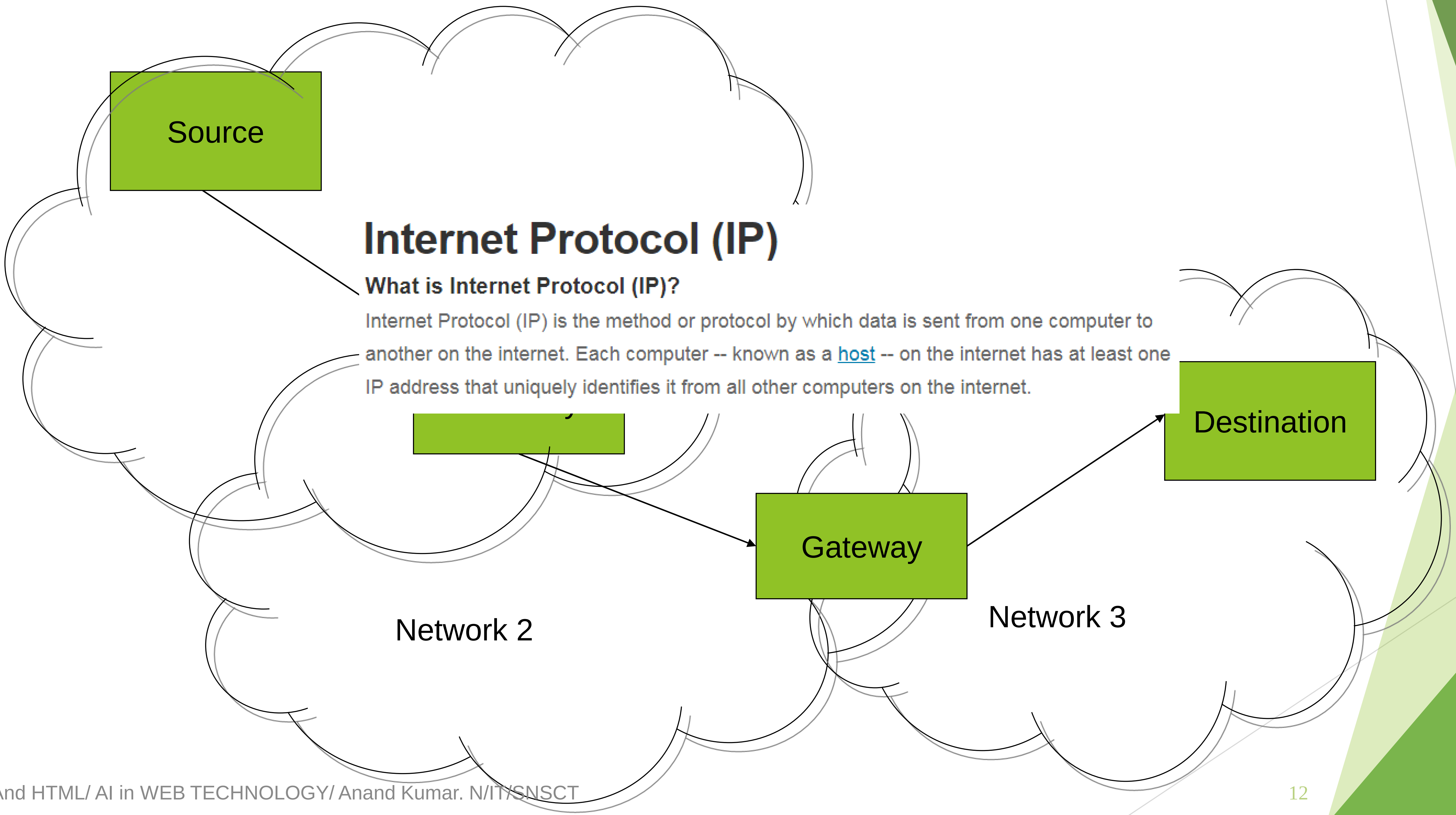
Internet Protocol (IP)

- IP is the fundamental protocol defining the Internet (as the name implies!)
- IP address:
  - 32-bit number (in IPv4)
  - Associated with at most one device at a time (although device may have more than one)
  - Written as four dot-separated bytes, e.g. 192.0.34.166

Internet Protocol (IP)

- IP function: transfer data from source device to destination device
- IP source software creates a packet representing the data
  - Header: source and destination IP addresses, length of data, etc.
  - Data itself
- If destination is on another LAN, packet is sent to a gateway that connects to more than one network

IP



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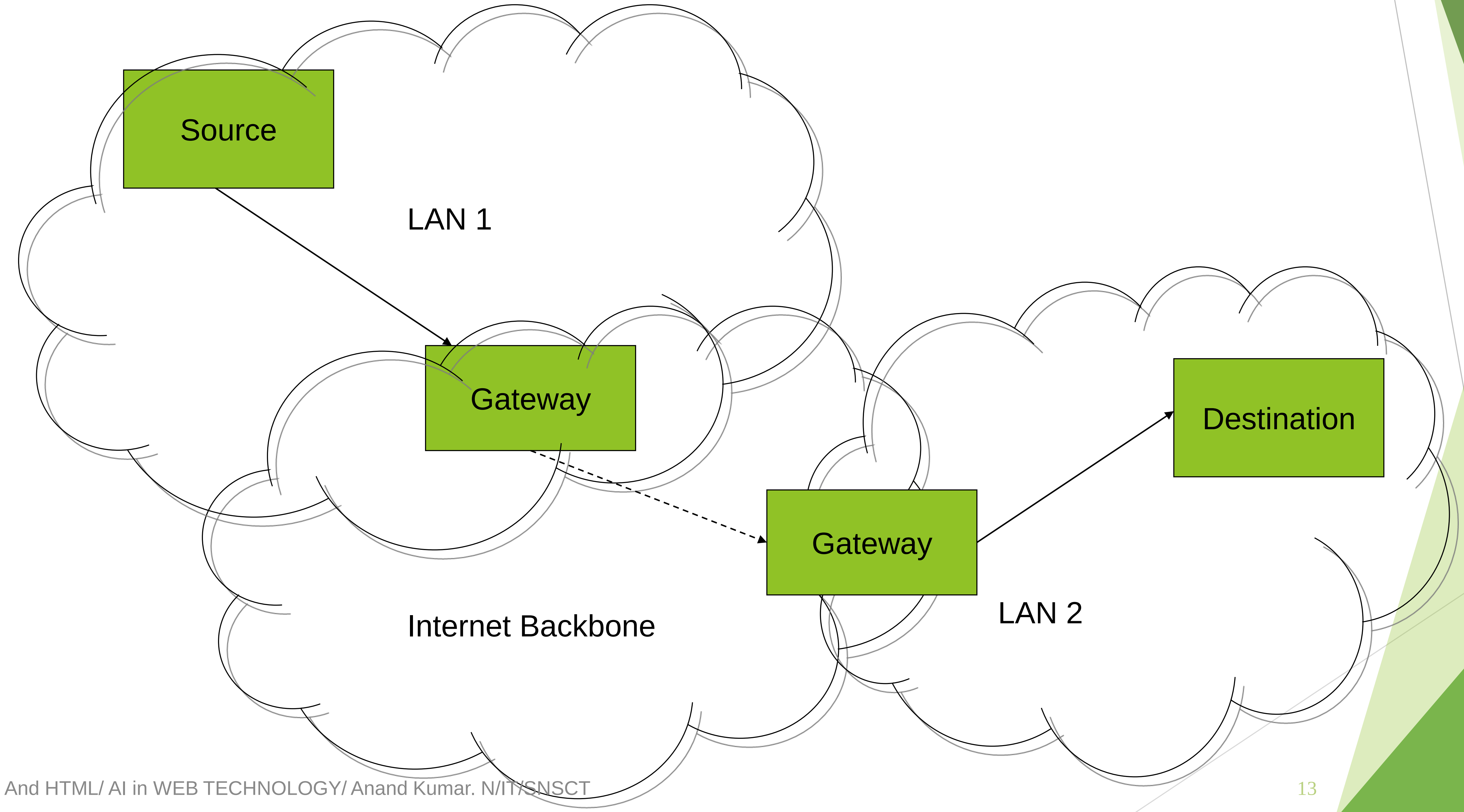
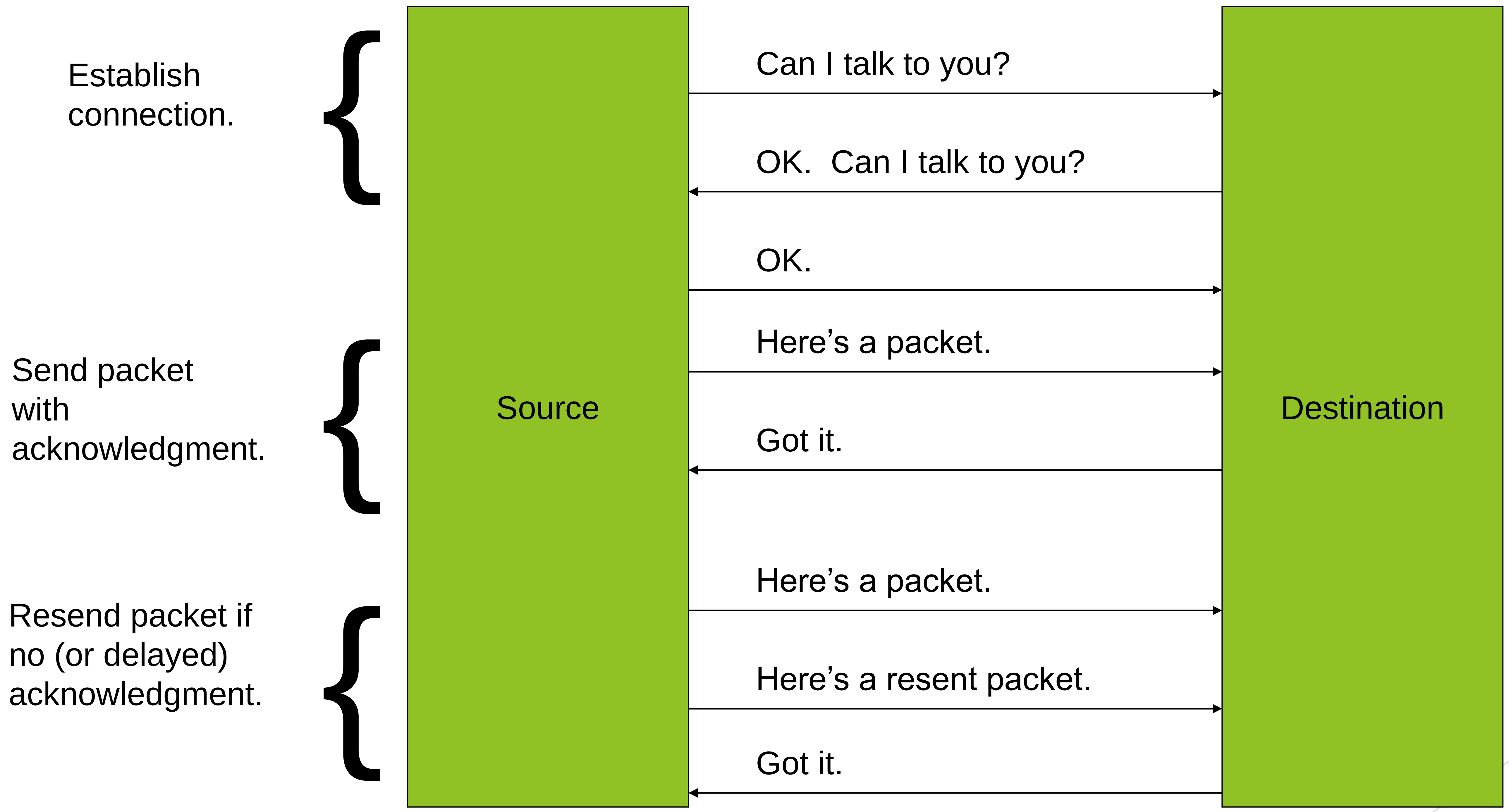
IP


Source
LAN 1
Gateway
Internet Backbone
Gateway
LAN 2
Destination

Transmission Control Protocol (TCP)

- Limitations of IP:
  - No guarantee of packet delivery (packets can be dropped)
  - Communication is one-way (source to destination)
- TCP adds concept of a connection on top of IP
  - Provides guarantee that packets delivered
  - Provide two-way (full duplex) communication

TCP

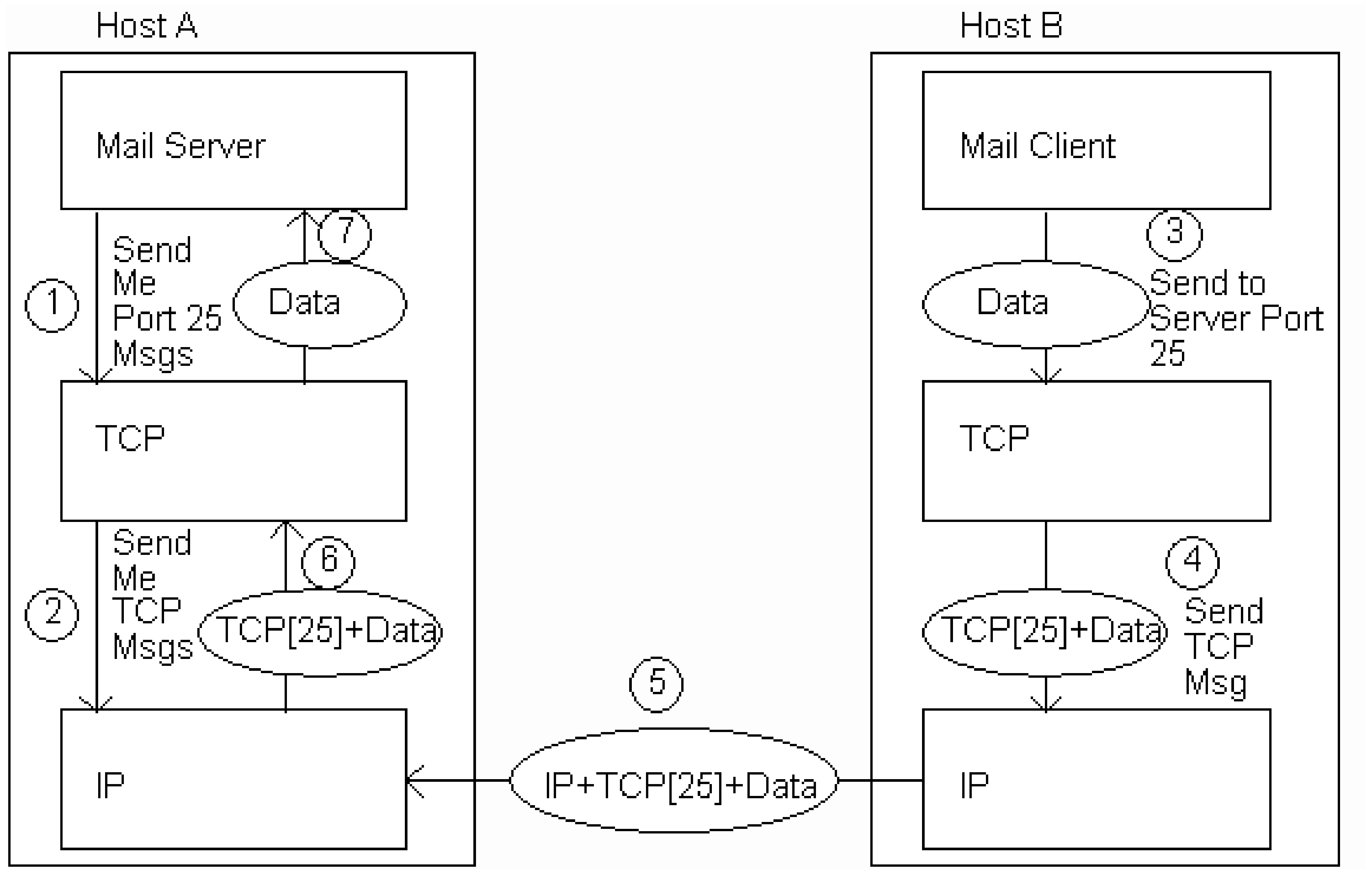


Establish connection.
Send packet with acknowledgment.
Resend packet if no (or delayed) acknowledgment.
Source
Destination
Can I talk to you?
OK. Can I talk to you?
OK.
Here’s a packet.
Got it.
Here’s a packet.
Here’s a resent packet.
Got it.

TCP

- TCP also adds concept of a port
  - TCP header contains port number representing an application program on the destination computer
  - Some port numbers have standard meanings
    - Example: port 25 is normally used for email transmitted using the Simple Mail Transfer Protocol (SMTP)
  - Other port numbers are available first-come-first served to any application

TCP


Host A
Host B
Mail Server
Mail Client
Send Me Port 25 Msgs
1
Data
7
TCP
Send Me TCP Msgs
2
TCP[25]+Data
6
IP
3
Data
Send to Server Port 25
TCP
4
TCP[25]+Data
Send TCP Msg
IP
5
IP+TCP[25]+Data

User Datagram Protocol (UDP)

- Like TCP in that:
  - Builds on IP
  - Provides port concept
- Unlike TCP in that:
  - No connection concept
  - No transmission guarantee
- Advantage of UDP vs. TCP:
  - Lightweight, so faster for one-time messages

Domain Name Service (DNS)

- DNS is the “phone book” for the Internet
  - Map between host names and IP addresses
  - DNS often uses UDP for communication
- Host names
  - Labels separated by dots, e.g., `www.example.org`
  - Final label is *top-level domain*
    - Generic: .com, .org, etc.
    - Country-code: .us, .il, etc.

DNS

- Domains are divided into second-level domains, which can be further divided into subdomains, etc.
  - E.g., in `www.example.com`, `example` is a second-level domain
- A host name plus domain name information is called the fully qualified domain name of the computer
  - Above, www is the host name, `www.example.com` is the FQDN

DNS

- `nslookup` program provides command-line access to DNS (on most systems)
- looking up a host name given an IP address is known as a reverse lookup
  - Recall that single host may have multiple IP addresses.
  - Address returned is the canonical IP address specified in the DNS system.

DNS

- `ipconfig` (on windows) can be used to find the IP address (addresses) of your machine
- *`ipconfig /displaydns`* displays the contents of the DNS Resolver Cache (*`ipconfig /flushdns`* to flush it)

Analogy to Telephone Network

- IP ~ the telephone network
- TCP ~ calling someone who answers, having a conversation, and hanging up
- UDP ~ calling someone and leaving a message
- DNS ~ directory assistance

Higher-level Protocols

- Many protocols build on TCP
  - Telephone analogy: TCP specifies how we initiate and terminate the phone call, but some other protocol specifies how we carry on the actual conversation
- Some examples:
  - SMTP (email)
  - FTP (file transfer)
  - HTTP (transfer of Web documents)

World Wide Web

- Originally, one of several systems for organizing Internet-based information
  - Competitors: WAIS, Gopher, ARCHIE
- Distinctive feature of Web: support for hypertext (text containing links)
  - Communication via Hypertext Transfer Protocol (HTTP)
  - Document representation using Hypertext Markup Language (HTML)

World Wide Web

- The Web is the collection of machines (Web servers) on the Internet that provide information, particularly HTML documents, via HTTP.
- Machines that access information on the Web are known as Web clients.
- A Web browser is software used by an end user to access the Web.

Hypertext Transfer Protocol (HTTP)

- HTTP is based on the request-response communication model:
  - Client sends a request
  - Server sends a response
- HTTP is a stateless protocol:
  - The protocol does not require the server to remember anything about the client between requests.

HTTP

- Normally implemented over a TCP connection (80 is standard port number for HTTP)
- Typical browser-server interaction:
  - User enters Web address in browser
  - Browser uses DNS to locate IP address
  - Browser opens TCP connection to server
  - Browser sends HTTP request over connection
  - Server sends HTTP response to browser over connection
  - Browser displays body of response in the client area of the browser window

HTTP

- The information transmitted using HTTP is often entirely text
- Can use the Internet's Telnet protocol to simulate browser request and view server response

HTTP

Connect

Send
Request

Receive
Response

```
$ telnet www.example.org 80
Trying 192.0.34.166...
Connected to www.example.com (192.0.34.166).
Escape character is ’^]’.
GET / HTTP/1.1
Host: www.example.org

HTTP/1.1 200 OK
Date: Thu, 09 Oct 2020 20:30:49 GMT
…
```

HTTP Request

- Structure of the request:
  - start line
  - header field(s)
  - blank line
  - optional body

HTTP Request

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  - **start line**
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HTTP Request

- Start line
  - Example: `GET / HTTP/1.1`
- Three space-separated parts:
  - HTTP request method
  - Request-URI (Uniform Resource Identifier)
  - HTTP version

HTTP Request

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  - HTTP version

HTTP Request

- Uniform Resource Identifier (URI)
  - Syntax: *`scheme : scheme-depend-part`*
    - Ex: In `http://www.example.com/`
      the scheme is `http`
  - Request-URI is the portion of the requested URI that follows the host name (which is supplied by the required Host header field)
    - Ex: / is Request-URI portion of `http://www.example.com/`

URI

- URI’s are of two types:
  - Uniform Resource Name (URN)
    - Can be used to identify resources with unique names, such as books (which have unique ISBN’s)
    - Scheme is `urn`
  - Uniform Resource Locator (URL)
    - Specifies location at which a resource can be found
    - In addition to `http`, some other URL schemes are `https`, `ftp`, `mailto`, and `file`

HTTP Request

- Start line
  - Example: `GET / HTTP/1.1`
- Three space-separated parts:
  - **HTTP request method**
  - Request-URI
  - HTTP version

HTTP Request

- Common request methods:
  - GET
    - Used if link is clicked or address typed in browser
    - No body in request with GET method
  - POST
    - Used when submit button is clicked on a form
    - Form information contained in body of request
  - HEAD
    - Requests that only header fields (no body) be returned in the response

HTTP Request

- Structure of the request:
  - start line
  - **header field(s)**
  - blank line
  - optional body

HTTP Request

- Header field structure:
  - *field name : field value*
- Syntax
  - Field name is not case sensitive
  - Field value may continue on multiple lines by starting continuation lines with white space
  - Field values may contain MIME types, quality values, and wildcard characters (*'s)

Multipurpose Internet Mail Extensions (MIME)

- Convention for specifying content type of a message
  - In HTTP, typically used to specify content type of the body of the response
- MIME content type syntax:
  - *`top-level type / subtype`*
- Examples: text/html, image/jpeg

HTTP Quality Values and Wildcards

- Example header field with quality values:
  ```
  accept:
    text/xml,text/html;q=0.9,
    text/plain;q=0.8, image/jpeg,
    image/gif;q=0.2,*/*;q=0.1
  ```
- Quality value applies to all preceding items
- Higher the value, higher the preference
- Note use of wildcards to specify quality 0.1 for any MIME type not specified earlier

HTTP Request

- Common header fields:
  - Host: host name from URL (required)
  - User-Agent: type of browser sending request
  - Accept: MIME types of acceptable documents
  - Connection: value `close` tells server to close connection after single request/response
  - Content-Type: MIME type of (POST) body, normally application/x-www-form-urlencoded
  - Content-Length: bytes in body
  - Referer: URL of document containing link that supplied URI for this HTTP request

HTTP Response

- Structure of the response:
  - status line
  - header field(s)
  - blank line
  - optional body

HTTP Response

- Structure of the response:
  - **status line**
  - header field(s)
  - blank line
  - optional body

HTTP Response

- Status line
  - Example: HTTP/1.1 200 OK
- Three space-separated parts:
  - HTTP version
  - status code
  - reason phrase (intended for human use)

HTTP Response

- Status code
  - Three-digit number
  - First digit is class of the status code:
    - 1=Informational
    - 2=Success
    - 3=Redirection (alternate URL is supplied)
    - 4=Client Error
    - 5=Server Error
  - Other two digits provide additional information
  - See http://www.w3.org/Protocols/rfc2616/rfc2616-sec10.html

HTTP Response

- Structure of the response:
  - status line
  - **header field(s)**
  - blank line
  - optional body

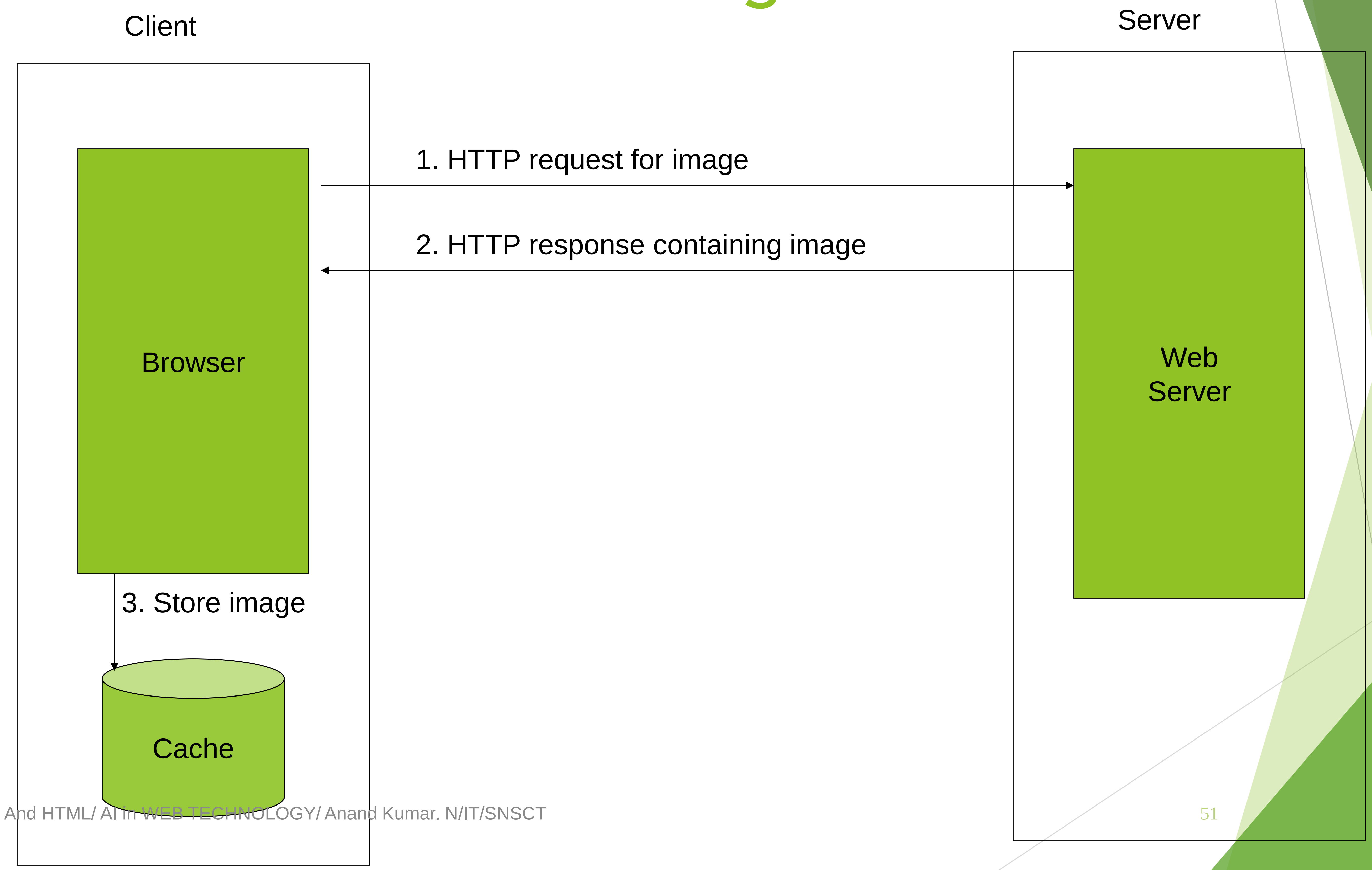
HTTP Response

- Common header fields:
  - Connection, Content-Type, Content-Length
  - Date: date and time at which response was generated (required)
  - Location: alternate URI if status is redirection
  - Last-Modified: date and time the requested resource was last modified on the server
  - Expires: date and time after which the client's copy of the resource will be out-of-date
  - ETag: a unique identifier for this version of the requested resource (changes if resource changes)

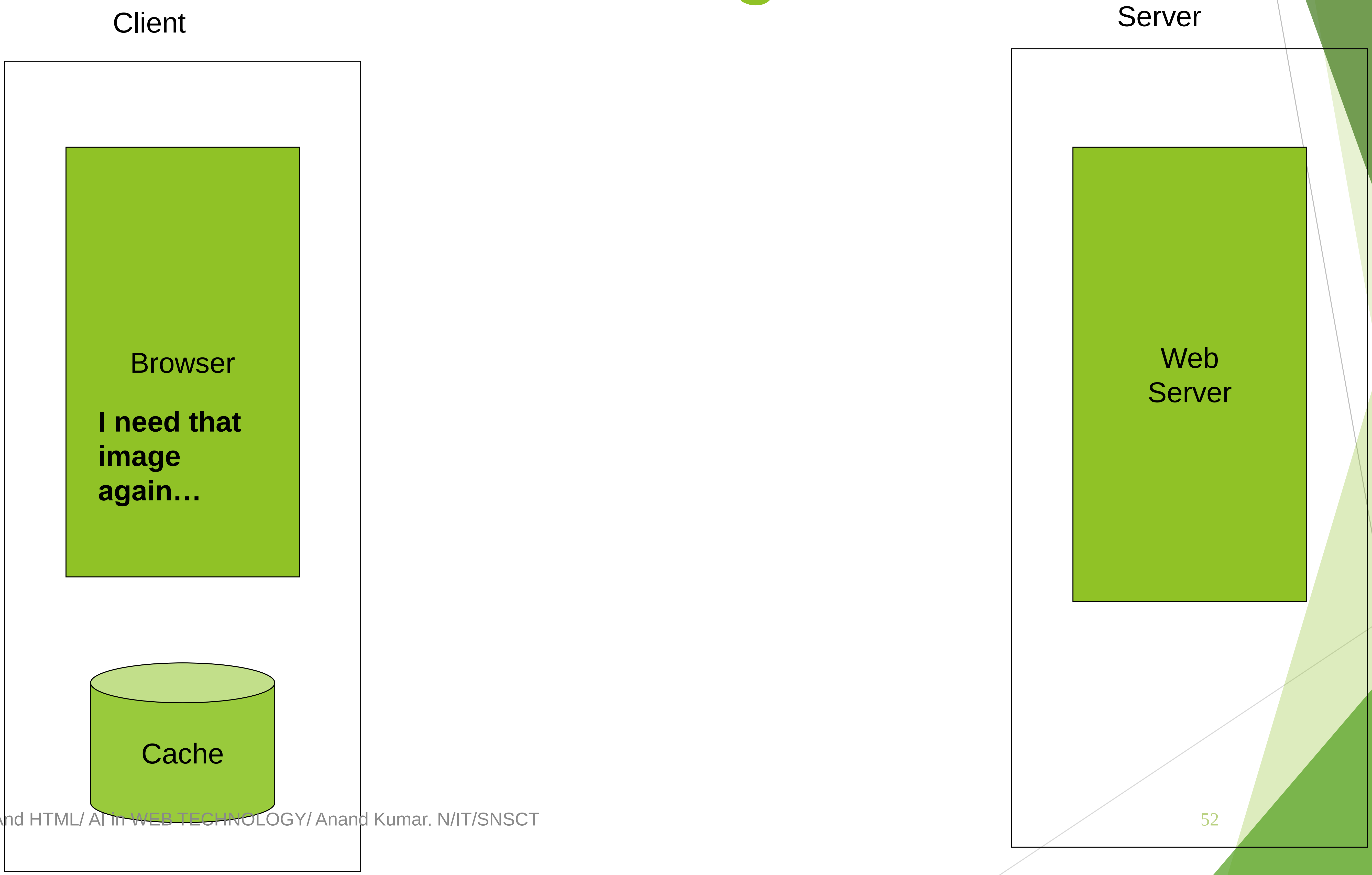
Client Caching

- A cache is a local copy of information obtained from some other source
- Most web browsers use cache to store requested resources so that subsequent requests to the same resource will not necessarily require an HTTP request/response
  - Ex: icon appearing multiple times in a Web page

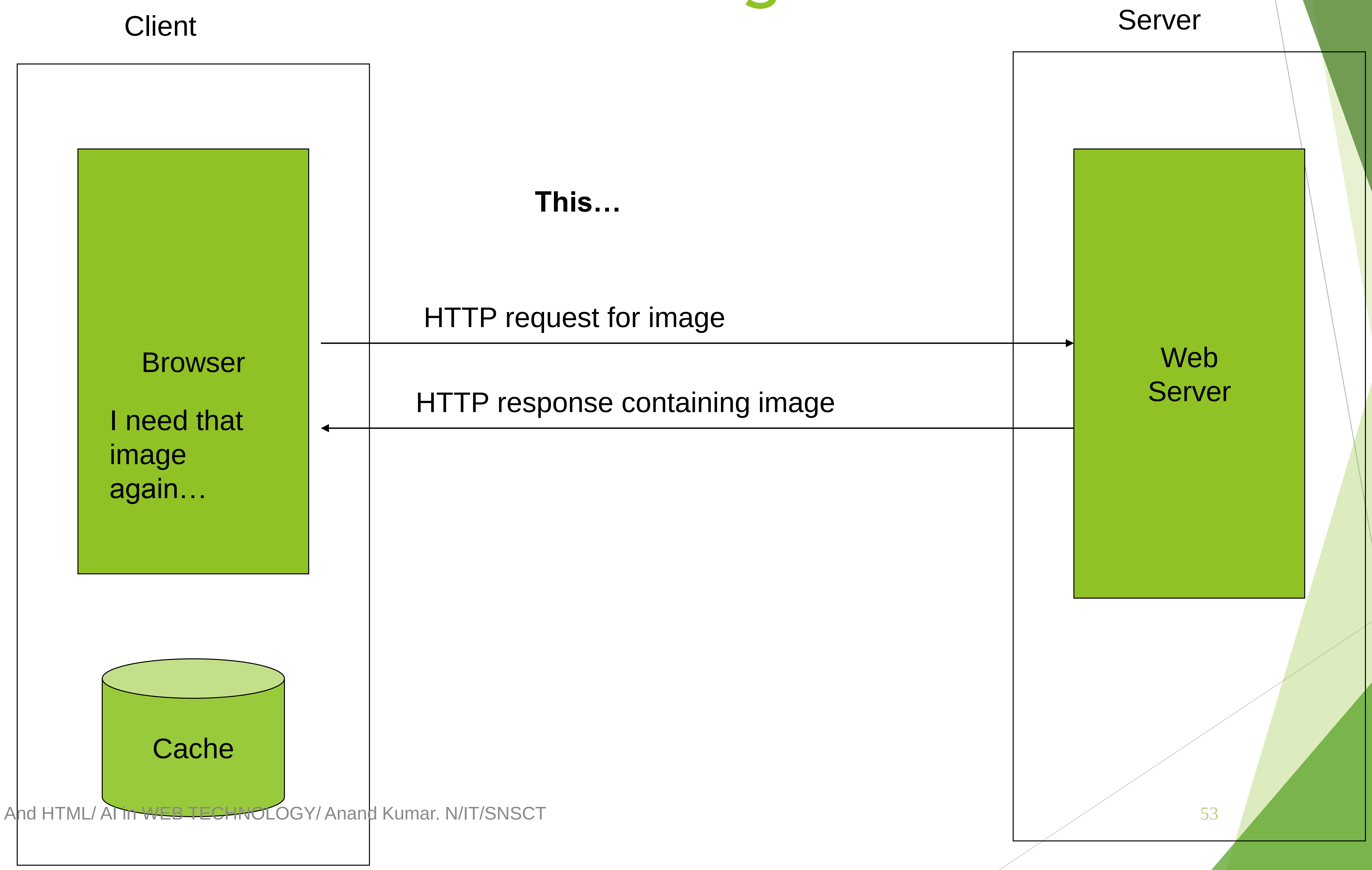
Client Caching



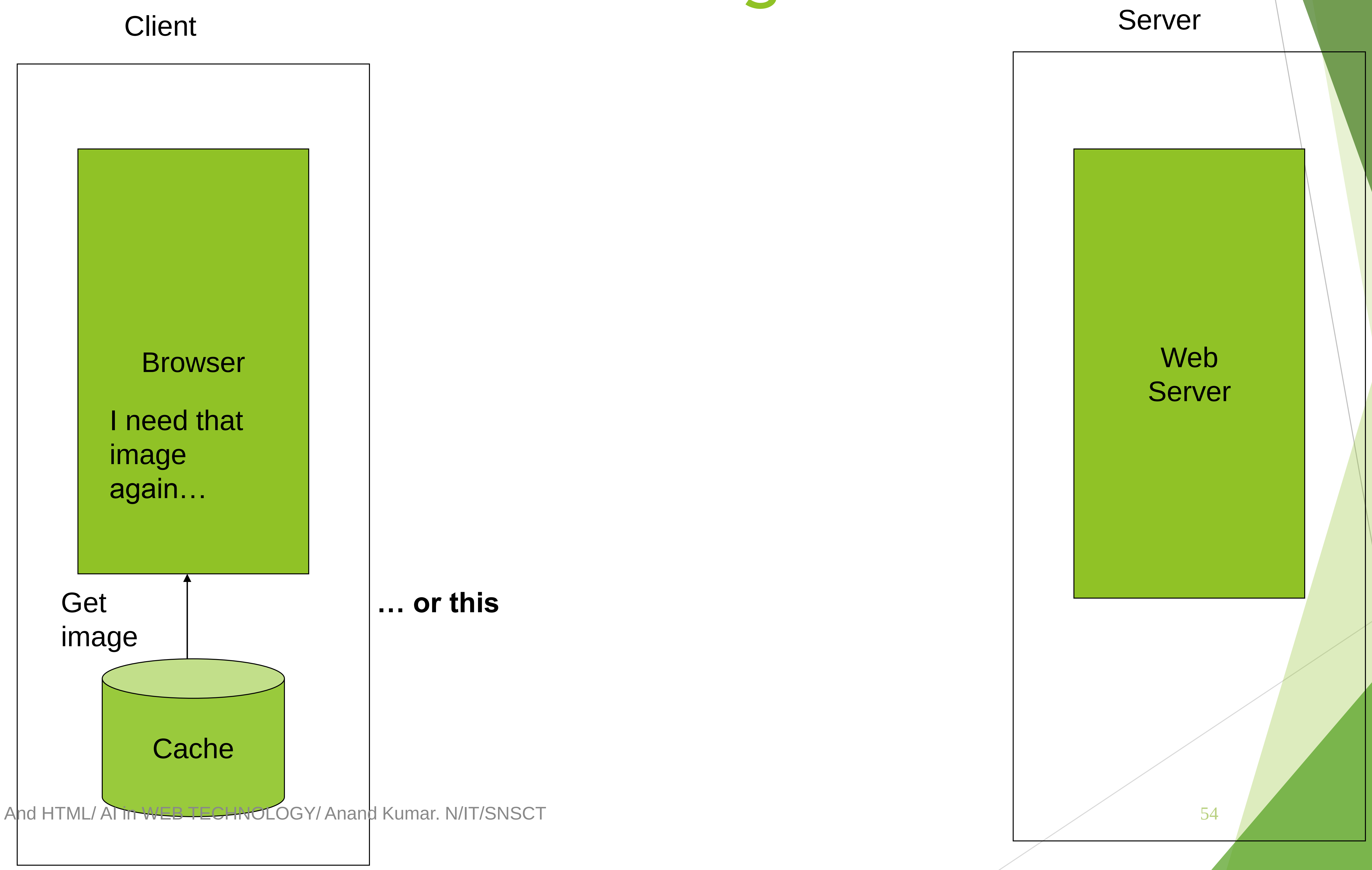
Client Caching



Client Caching



Client Caching



Client Caching

- Cache advantages
  - (Much) faster than HTTP request/response
  - Less network traffic
  - Less load on server
- Cache disadvantage
  - Cached copy of resource may be invalid (inconsistent with remote version)

Client Caching

- Validating cached resource:
  - Send HTTP HEAD request and check Last-Modified or ETag header in response
  - Compare current date/time with Expires header sent in response containing resource
  - If no Expires header was sent, use heuristic algorithm to estimate value for Expires
    - Ex: Expires = 0.01 * (Date – Last-Modified) + Date

Character Sets

- Every document is represented by a string of integer values (code points)
- The mapping from code points to characters is defined by a character set
- Some header fields have character set values:
  - Accept-Charset: request header listing character sets that the client can recognize
    - Ex: accept-charset: ISO-8859-1,utf-8;q=0.7,*;q=0.5
  - Content-Type: can include character set used to represent the body of the HTTP message
    - Ex: Content-Type: text/html; charset=UTF-8

Character Sets

- Technically, many “character sets” are actually character encodings
  - An encoding represents code points using variable-length byte strings
  - Most common examples are Unicode-based encodings UTF-8 and UTF-16
- IANA maintains complete list of Internet-recognized character sets/encodings

Character Sets

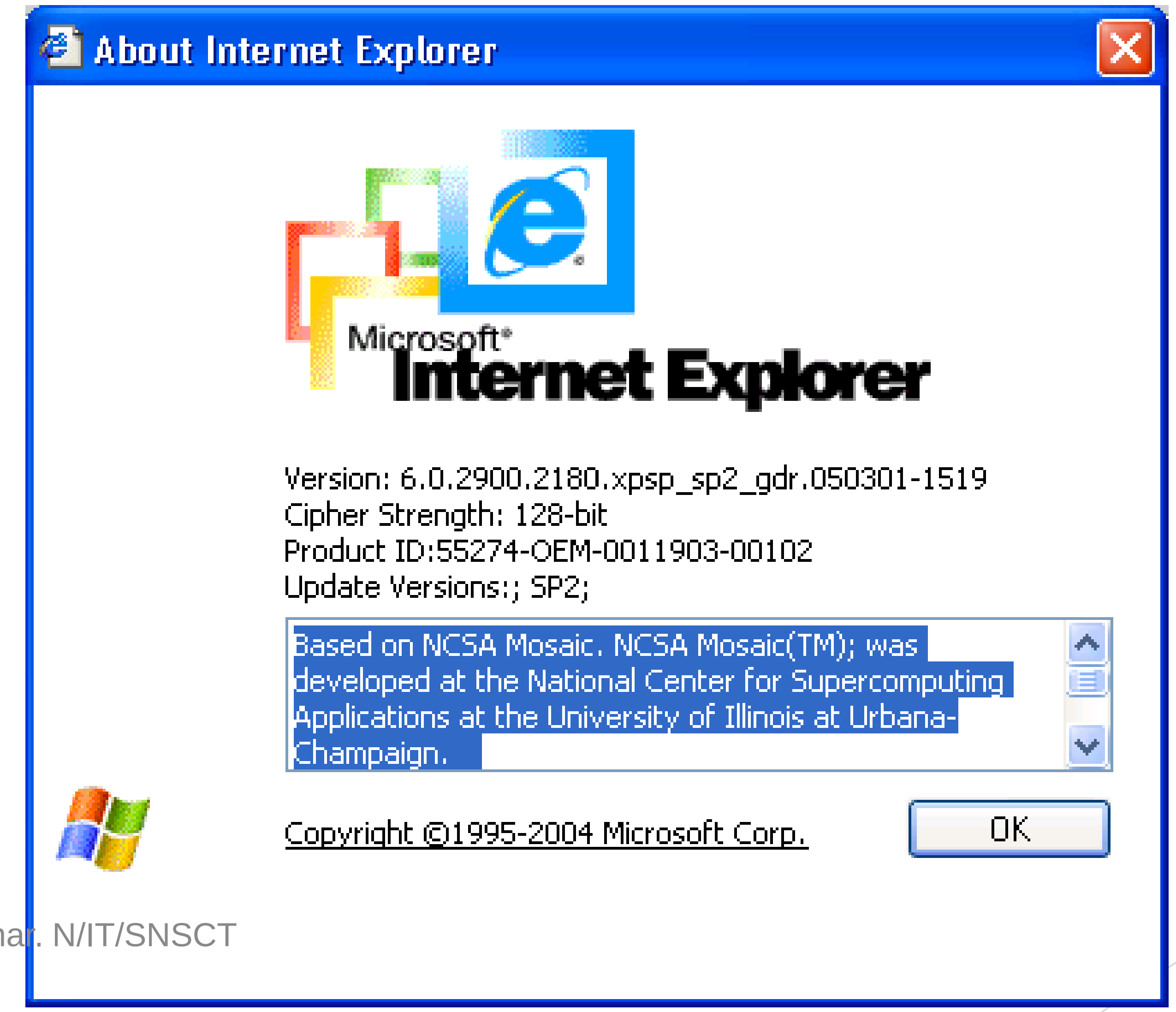
- Typical US PC produces ASCII documents
- US-ASCII character set can be used for such documents, but is not recommended
- UTF-8 and ISO-8859-1 are supersets of US-ASCII and provide international compatibility
  - UTF-8 can represent all ASCII characters using a single byte each and arbitrary Unicode characters using up to 4 bytes each
  - ISO-8859-1 is 1-byte code that has many characters common in Western European languages, such as é

Web Clients

- Many possible web clients:
  - Text-only “browser” (lynx)
  - Mobile phones
  - Robots (software-only clients, e.g., search engine “crawlers”)
  - etc.
- We will focus on traditional web browsers

Web Browsers

- First graphical browser running on general-purpose platforms: Mosaic (1993)



Version: 6.0.2900.2180.xpsp_sp2_gdr.050301-1519
Cipher Strength: 128-bit
Product ID:55274-OEM-0011903-00102
Update Versions:; SP2;

Based on NCSA Mosaic. NCSA Mosaic(TM); was developed at the National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign.

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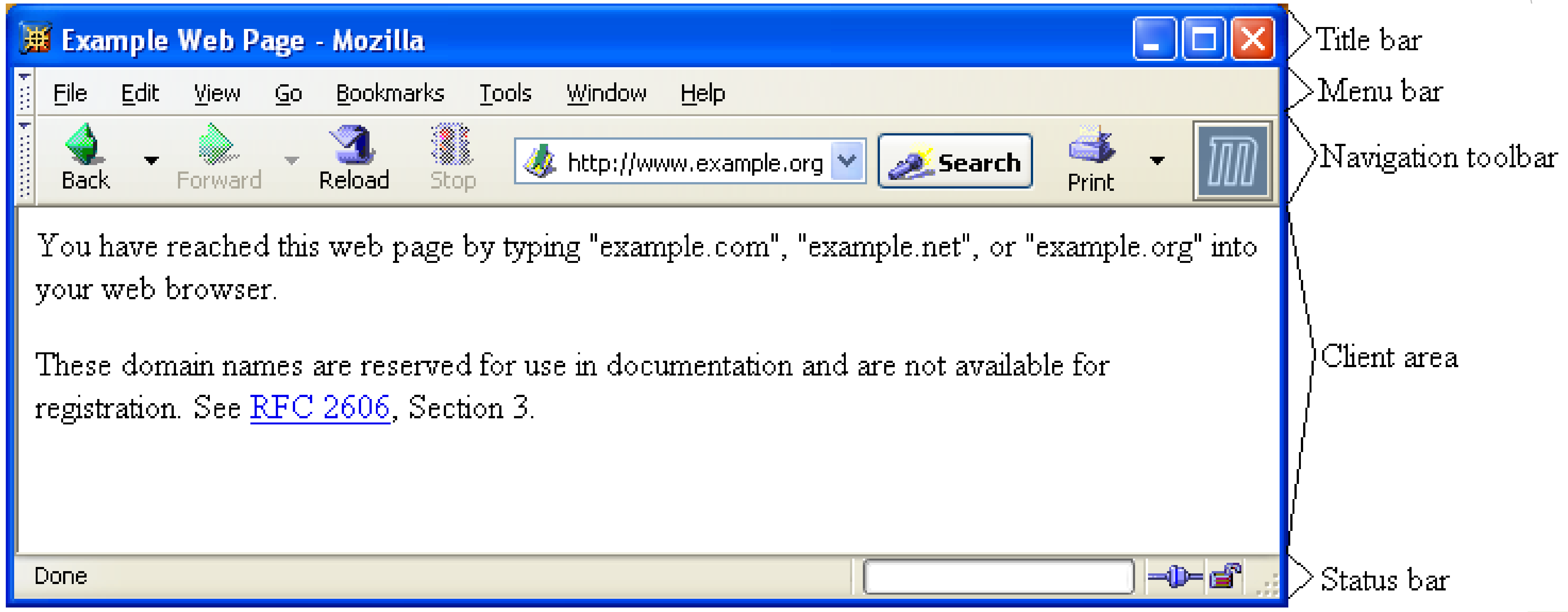
Web Browsers



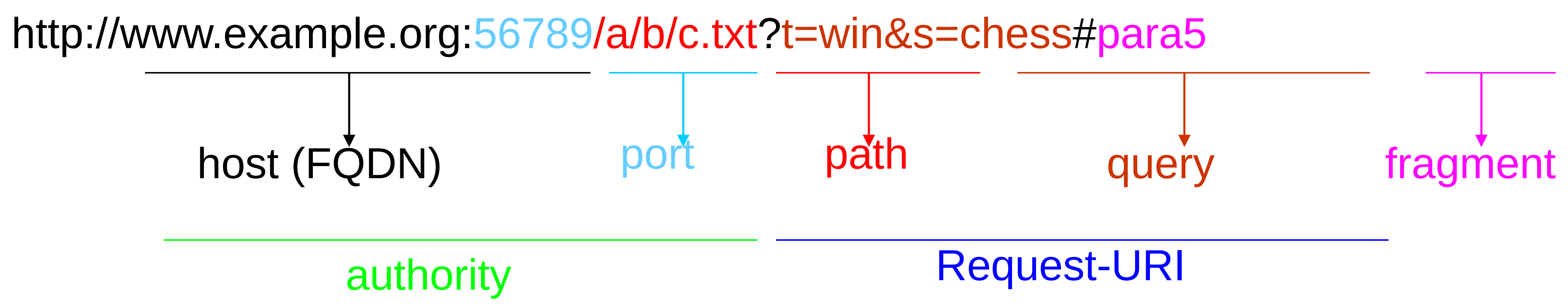
You have reached this web page by typing "example.com", "example.net", or "example.org" into your web browser.

These domain names are reserved for use in documentation and are not available for registration. See RFC 2606, Section 3.

Web Browsers

- Primary tasks:
  - Convert web addresses (URL’s) to HTTP requests
  - Communicate with web servers via HTTP
  - Render (appropriately display) documents returned by a server

HTTP URL's



- Browser uses authority to connect via TCP
- Request-URI included in start line (/ used for path if none supplied)
- Fragment identifier not sent to server (used to scroll browser client area)

Web Browsers

- Standard features
  - Save web page to disk
  - Find string in page
  - Fill forms automatically (passwords, CC numbers, …)
  - Set preferences (language, character set, cache and HTTP parameters)
  - Modify display style (e.g., increase font sizes)
  - Display raw HTML and HTTP header info (e.g., Last-Modified)
  - Choose browser themes (skins)
  - View history of web addresses visited
  - Bookmark favorite pages for easy return

Web Browsers

- Additional functionality:
  - Execution of scripts (e.g., drop-down menus)
  - Event handling (e.g., mouse clicks)
  - GUI for controls (e.g., buttons)
  - Secure communication with servers
  - Display of non-HTML documents (e.g., PDF) via plug-ins

Web Servers

- Basic functionality:
  - Receive HTTP request via TCP
  - Map Host header to specific virtual host (one of many host names sharing an IP address)
  - Map Request-URI to specific resource associated with the virtual host
    - File: Return file in HTTP response
    - Program: Run program and return output in HTTP response
  - Map type of resource to appropriate MIME type and use to set Content-Type header in HTTP response
  - Log information about the request and response

Web Servers

- httpd: UIUC, primary Web server c. 1995
- Apache: “A patchy” version of httpd, now the most popular server (esp. on Linux platforms)
- IIS: Microsoft Internet Information Server
- Tomcat:
  - Java-based
  - Provides container (Catalina) for running Java servlets (HTML-generating programs) as back-end to Apache or IIS
  - Can run stand-alone using Coyote HTTP front-end

Web Servers

- Some Coyote communication parameters:
  - Allowed/blocked IP addresses
  - Max. simultaneous active TCP connections
  - Max. queued TCP connection requests
  - “Keep-alive” time for inactive TCP connections
- Modify parameters to tune server performance

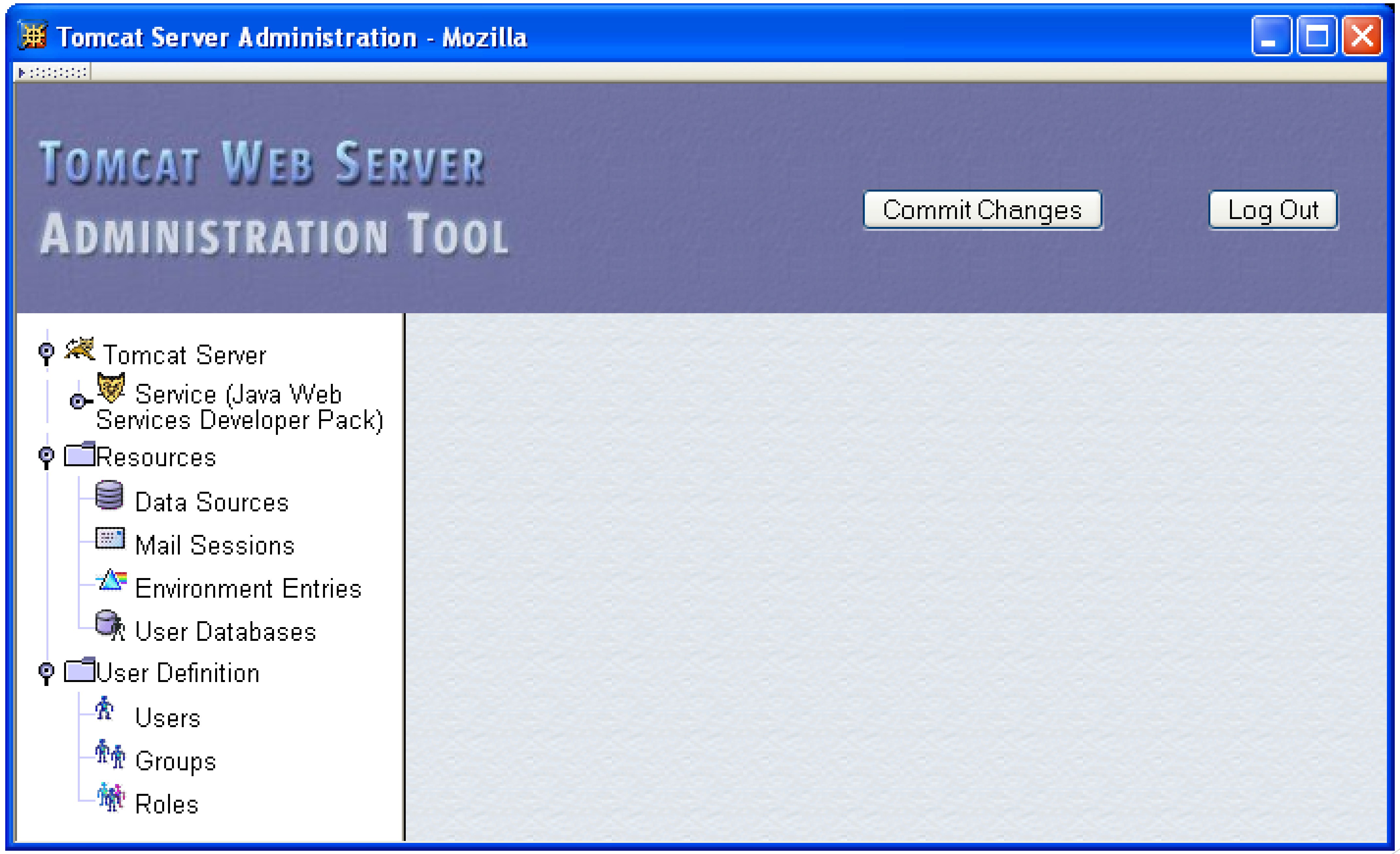
Web Servers

- Some Catalina container parameters:
  - Virtual host names and associated ports
  - Logging preferences
  - Mapping from Request-URI’s to server resources
  - Password protection of resources
  - Use of server-side caching

Tomcat Web Server

- HTML-based server administration
- Browse to
  [`http://localhost:8080`](http://localhost:8080)
  and click on Server Administration link
  - `localhost` is a special host name that means "this machine"

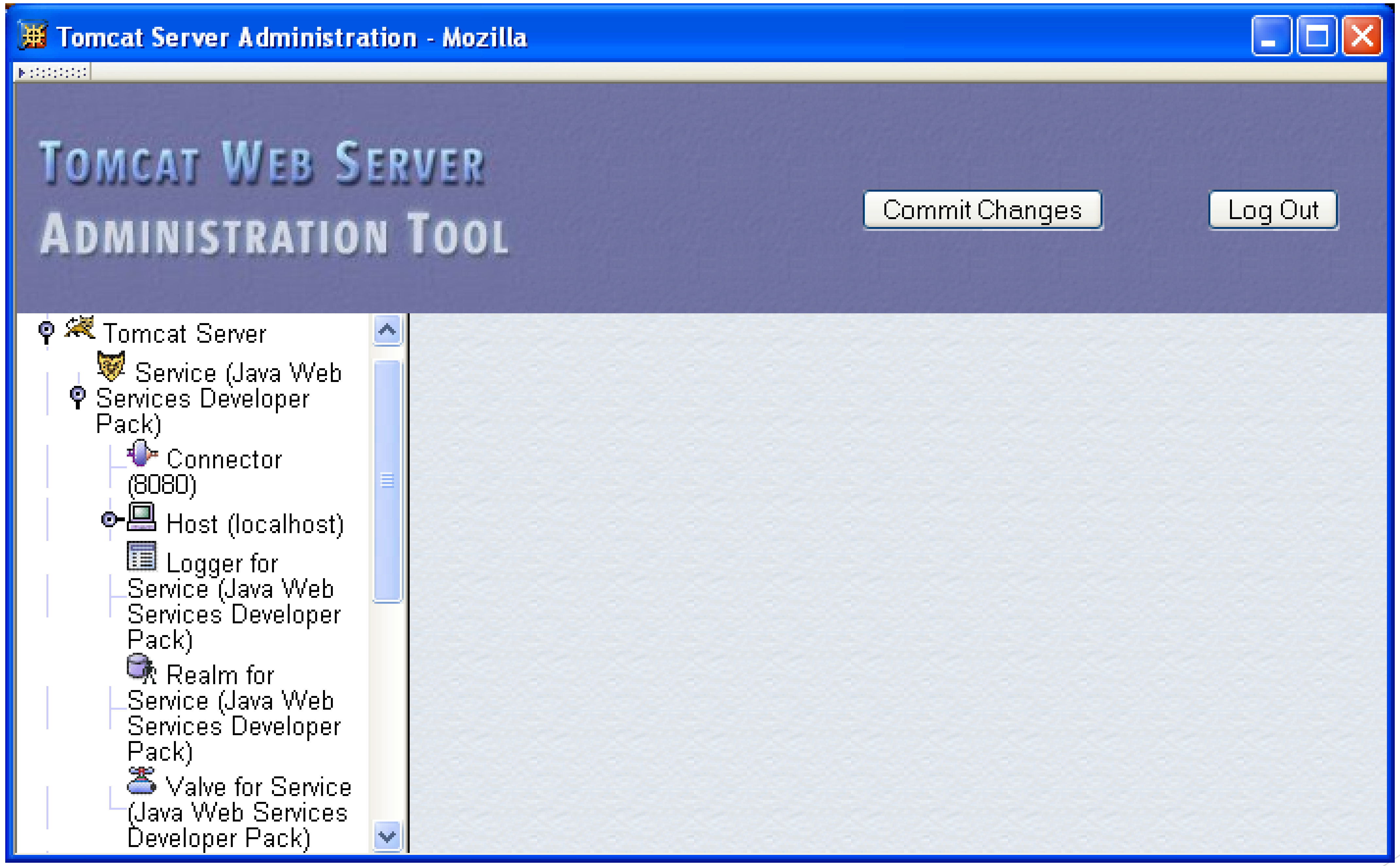
Tomcat Web Server



Tomcat Web Server
Administration Tool

- Tomcat Server
  - Service (Java Web Services Developer Pack)
- Resources
  - Data Sources
  - Mail Sessions
  - Environment Entries
  - User Databases
- User Definition
  - Users
  - Groups
  - Roles

Tomcat Web Server

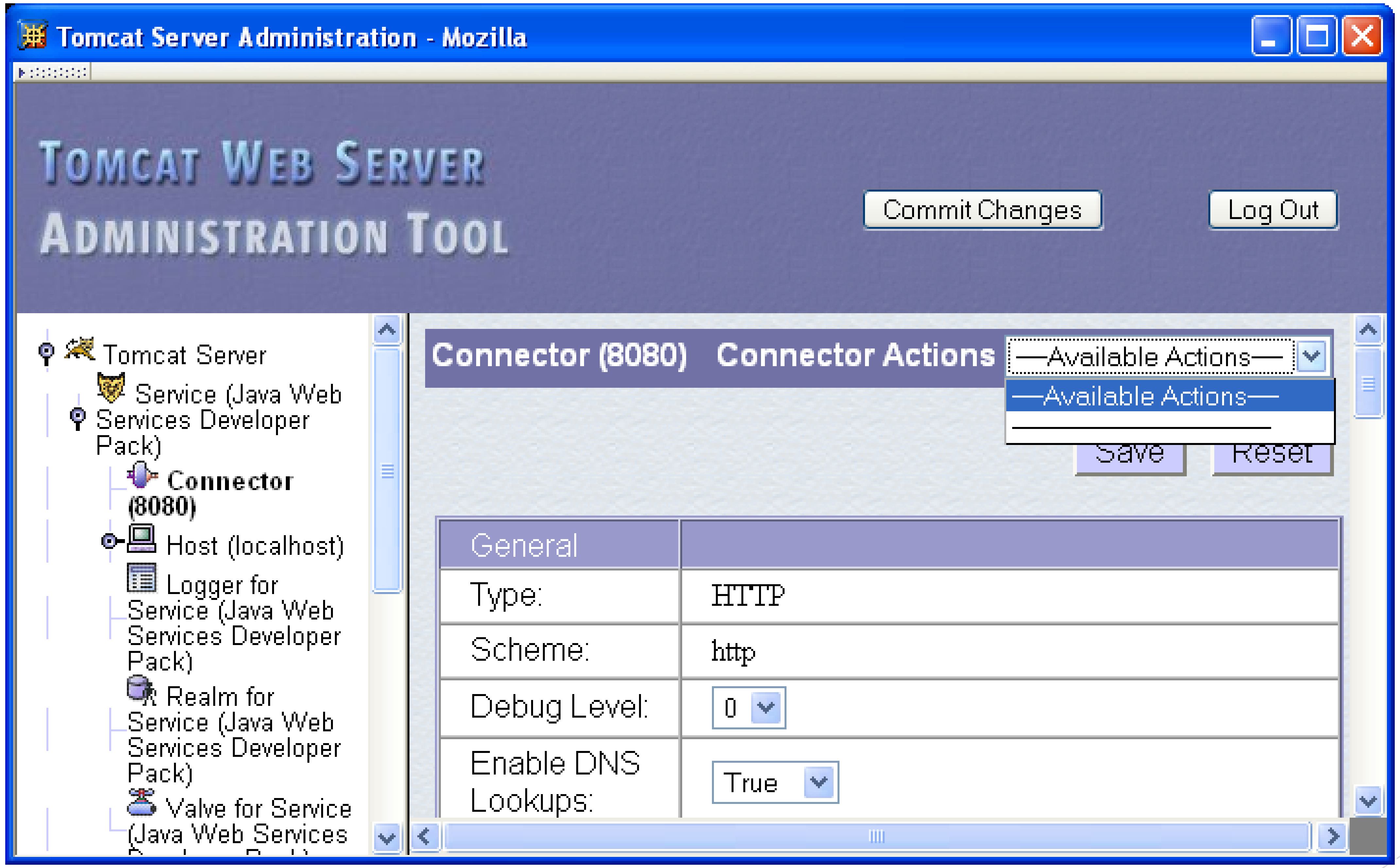


Tomcat Server Administration - Mozilla

TOMCAT WEB SERVER
ADMINISTRATION TOOL

Commit Changes
Log Out
Tomcat Server
Service (Java Web Services Developer Pack)
Connector (8080)
Host (localhost)
Logger for Service (Java Web Services Developer Pack)
Realm for Service (Java Web Services Developer Pack)
Valve for Service (Java Web Services Developer Pack)

Tomcat Web Server



Tomcat Server Administration - Mozilla

TOMCAT WEB SERVER
ADMINISTRATION TOOL

Commit Changes   Log Out

Tomcat Server
Service (Java Web Services Developer Pack)
Connector (8080)
Host (localhost)
Logger for Service (Java Web Services Developer Pack)
Realm for Service (Java Web Services Developer Pack)
Valve for Service (Java Web Services

Connector (8080)   Connector Actions   —Available Actions—

—Available Actions—

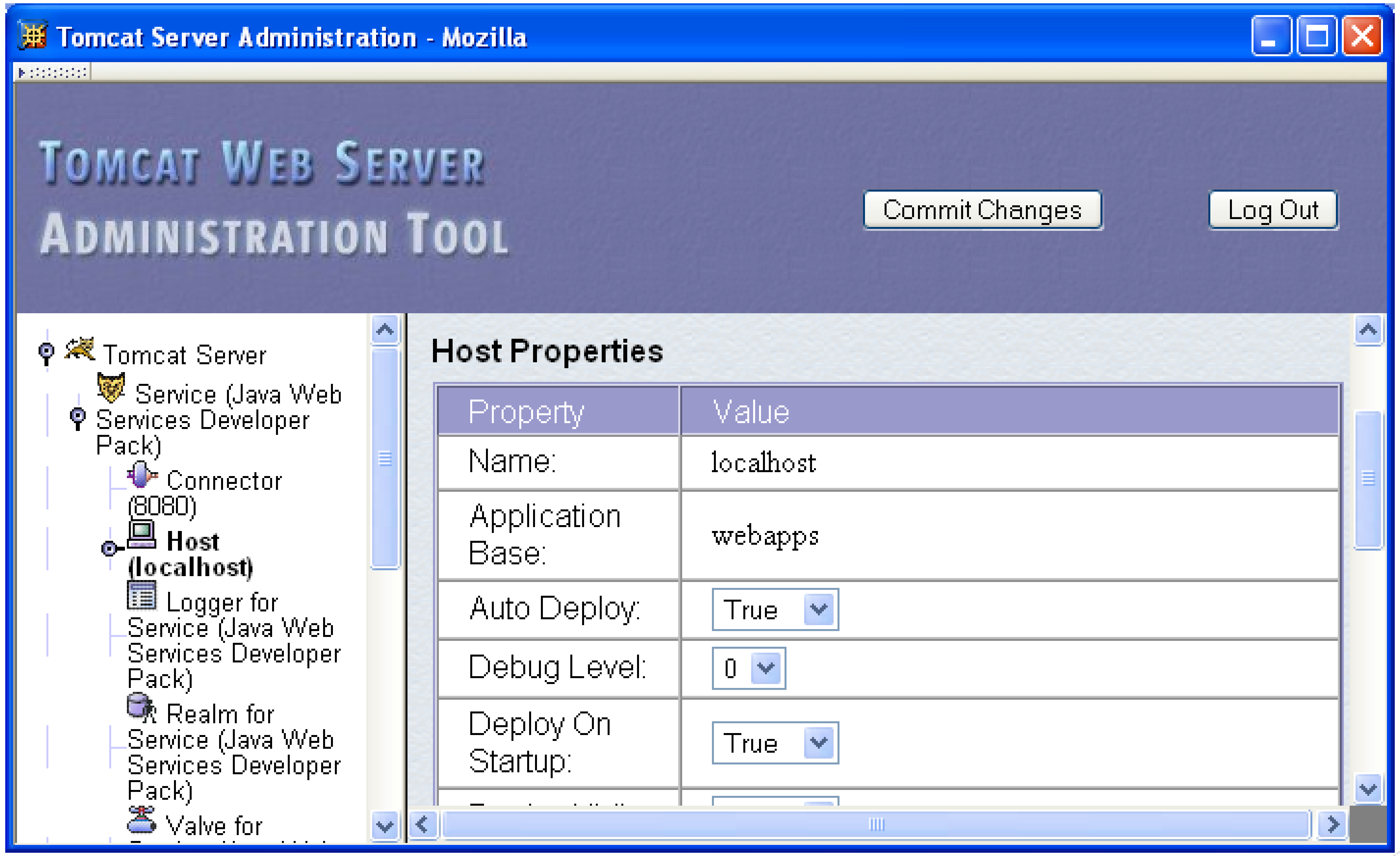
Save   Reset

General	
Type:	HTTP
Scheme:	http
Debug Level:	0
Enable DNS Lookups:	True

Tomcat Web Server

- Some Connector fields:
  - Port Number: port “owned” by this connector
  - Max Threads: max connections processed simultaneously
  - Connection Timeout: keep-alive time

Tomcat Web Server


Tomcat Server Administration - Mozilla
TOMCAT WEB SERVER
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Host (localhost)
Logger for Service (Java Web Services Developer Pack)
Realm for Service (Java Web Services Developer Pack)
Valve for

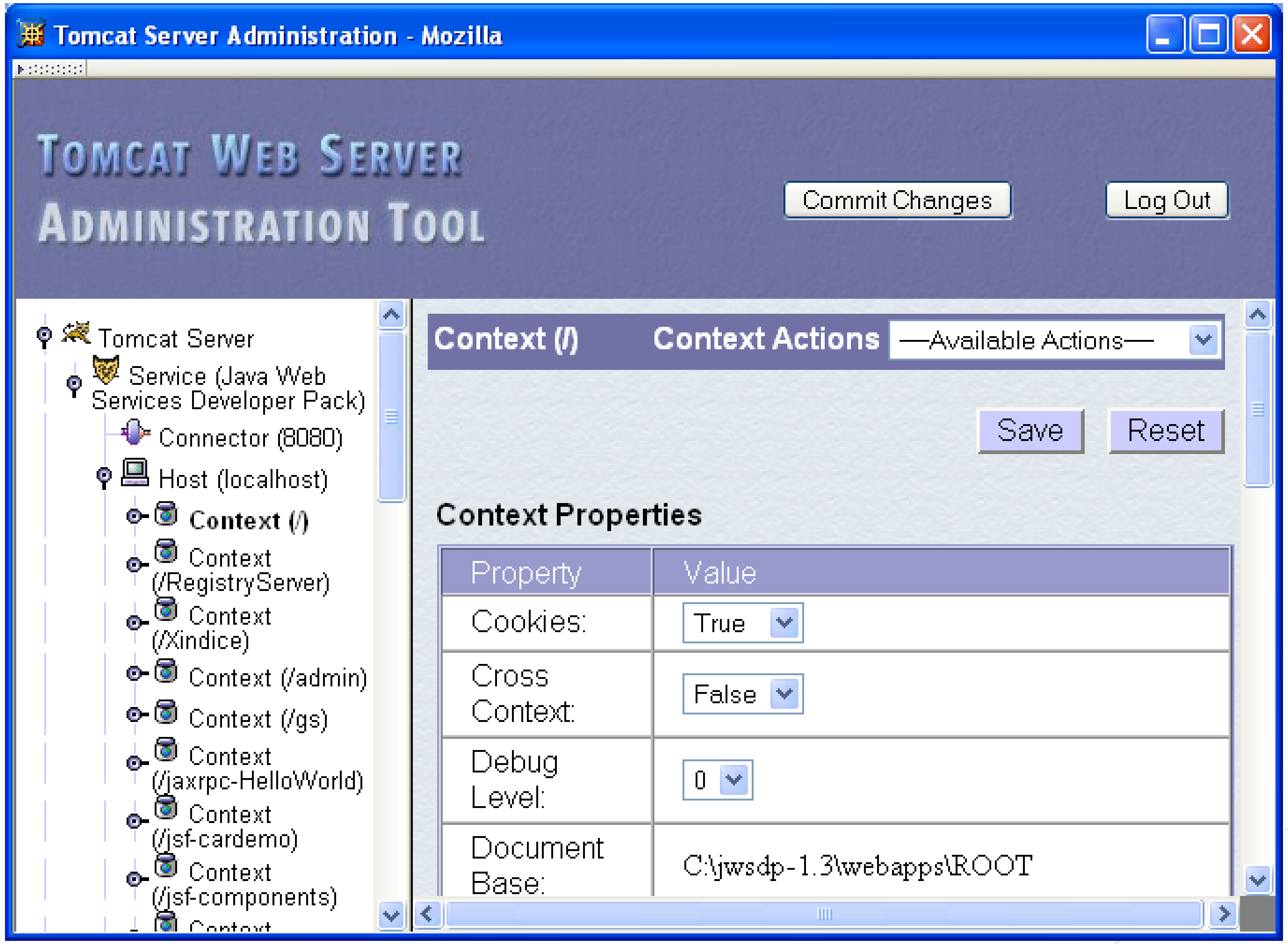
Host Properties

Property	Value
Name:	localhost
Application Base:	webapps
Auto Deploy:	True
Debug Level:	0
Deploy On Startup:	True

Tomcat Web Server

- Each Host is a virtual host (can have multiple per Connector)
- Some fields:
  - Host: localhost or a fully qualified domain name
  - Application Base: directory (may be path relative to JWSDP installation directory) containing resources associated with this Host

Tomcat Web Server



Tomcat Server Administration - Mozilla

TOMCAT WEB SERVER
ADMINISTRATION TOOL

- Tomcat Server
  - Service (Java Web Services Developer Pack)
    - Connector (8080)
    - Host (localhost)
      - **Context (/)**
      - Context (/RegistryServer)
      - Context (/Xindice)
      - Context (/admin)
      - Context (/gs)
      - Context (/jaxrpc-HelloWorld)
      - Context (/jsf-cardemo)
      - Context (/jsf-components)
      - Context

Context (/) **Context Actions** —Available Actions—

Context Properties

Property	Value
Cookies:	True
Cross Context:	False
Debug Level:	0
Document Base:	C:\jwsdp-1.3\webapps\ROOT

Tomcat Web Server

- Context provides mapping from Request-URI path to a web application
- Document Base field is directory (possibly relative to Application Base) that contains resources for this web application
- For this example, browsing to `http://localhost:8080/` returns resource from `c:\jwsdp-1.3\webapps\ROOT`
  - Returns index.html (standard welcome file)

Tomcat Web Server

- Access log records HTTP requests
- Parameters set using AccessLogValve
- Default location: `logs/access_log.*` under JWSDP installation directory
- Example "common" log format entry (one line):

```
www.example.org - admin
[20/Jul/2005:08:03:22 -0500]
"GET /admin/frameset.jsp HTTP/1.1"
200 920
```

Tomcat Web Server

- Other logs provided by default in JWSDP:
  - Message log messages sent to log service by web applications or Tomcat itself
    - `logs/jwsdp_log.*`: default message log
    - `logs/localhost_admin_log.*`: message log for web apps within /admin context
  - System.out and System.err output (exception traces often found here):
    - `logs/launcher.server.log`

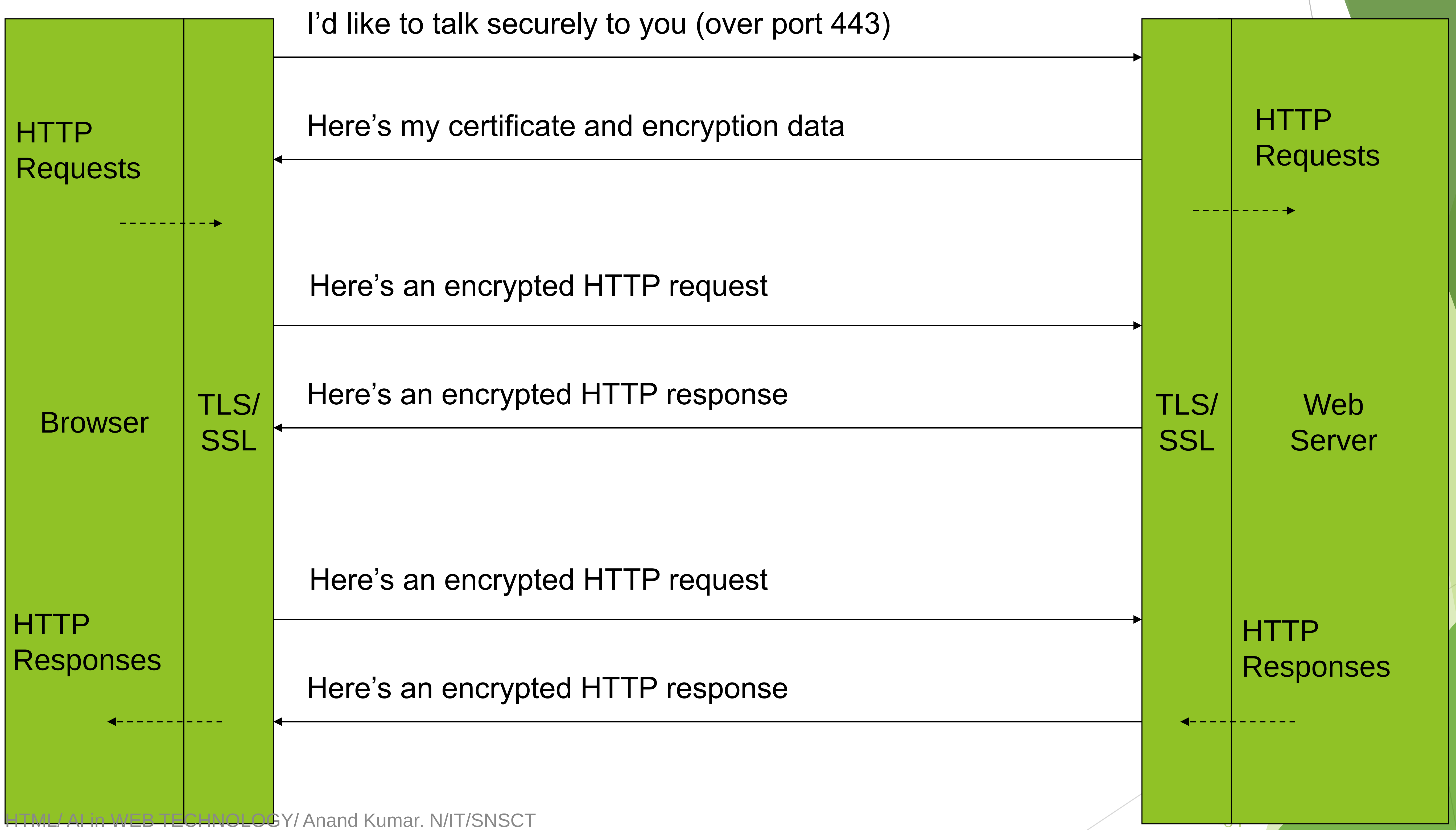
Tomcat Web Server

- Access control:
  - Password protection (e.g., admin pages)
    - Users and roles defined in `conf/tomcat-users.xml`
  - Deny access to machines
    - Useful for denying access to certain users by denying access from the machines they use
    - List of denied machines maintained in RemoteHostValve (deny by host name) or RemoteAddressValve (deny by IP address)

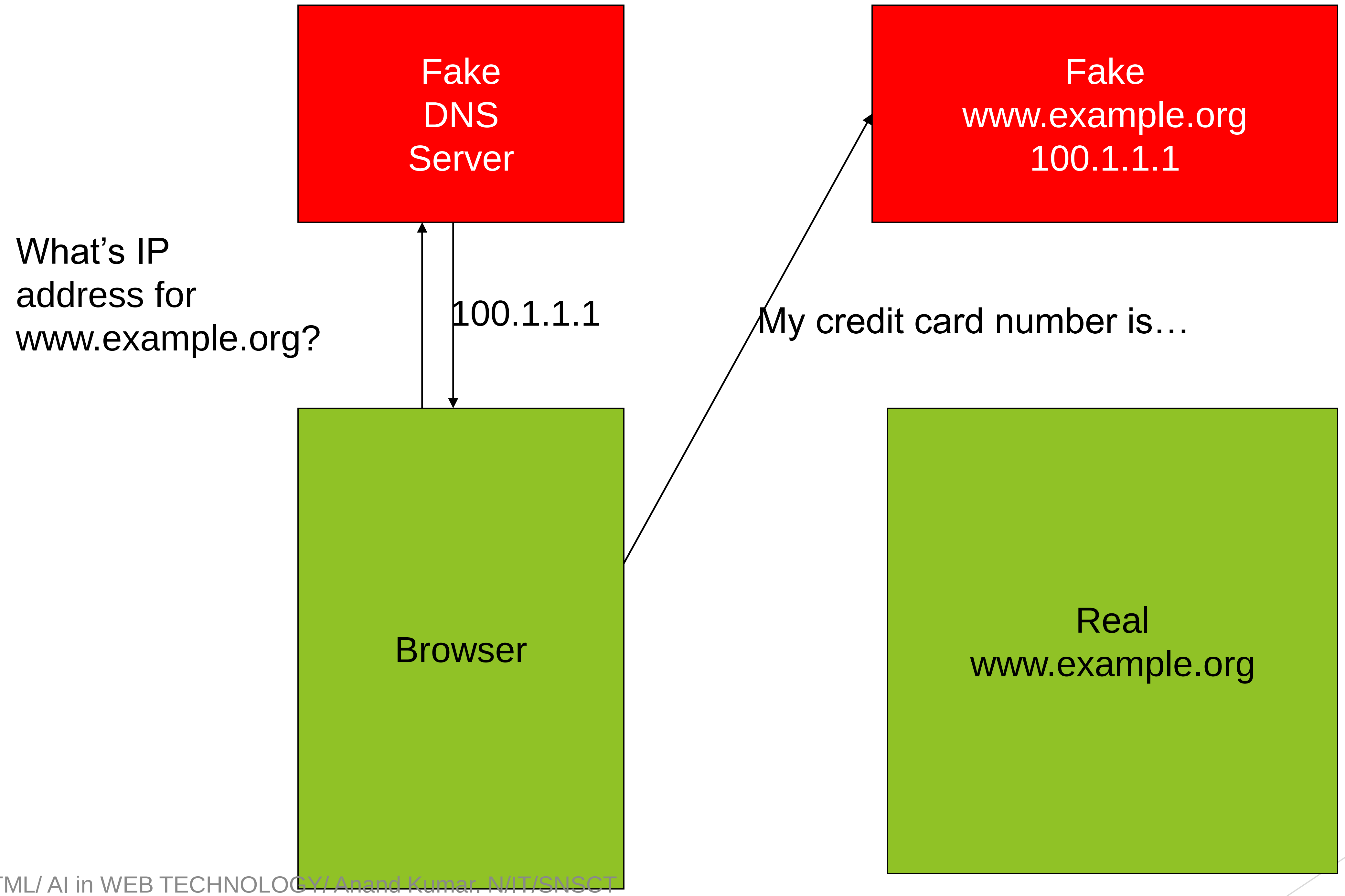
Secure Servers

- Since HTTP messages typically travel over a public network, private information (such as credit card numbers) should be encrypted to prevent eavesdropping
- https URL scheme tells browser to use encryption
- Common encryption standards:
  - Secure Socket Layer (SSL)
  - Transport Layer Security (TLS)

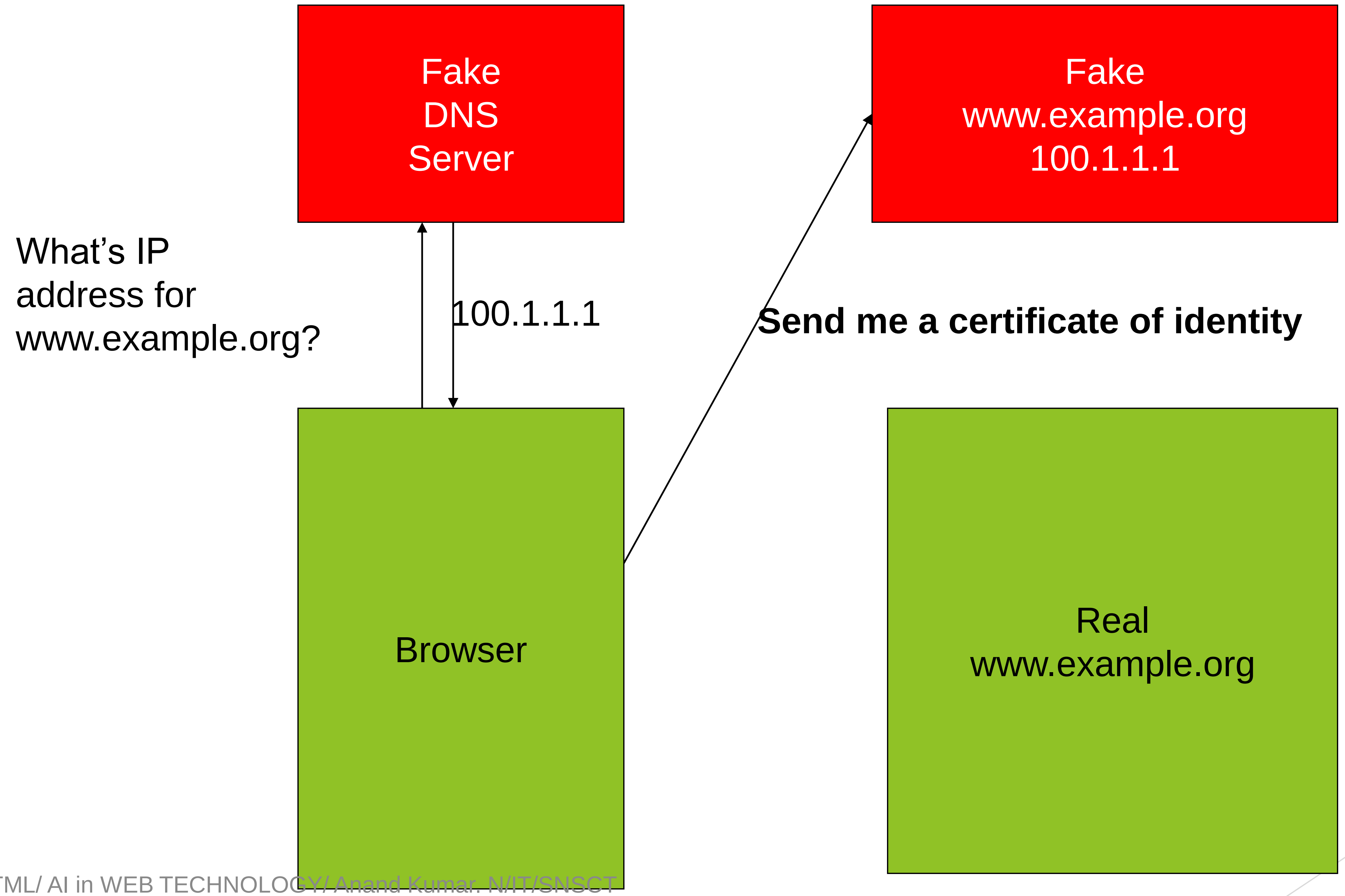
Secure Servers


I'd like to talk securely to you (over port 443)
Here's my certificate and encryption data
Here's an encrypted HTTP request
Here's an encrypted HTTP response
Here's an encrypted HTTP request
Here's an encrypted HTTP response
HTTP Requests
Browser
HTTP Responses
TLS/ SSL
TLS/ SSL
HTTP Requests
Web Server
HTTP Responses

Secure Servers
Man-in-the-Middle Attack


Fake DNS Server
Fake www.example.org 100.1.1.1
What's IP address for www.example.org?
100.1.1.1
My credit card number is…
Browser
Real www.example.org

Secure Servers
Preventing Man-in-the-Middle


Fake
DNS
Server
Fake
www.example.org
100.1.1.1
What's IP
address for
www.example.org?
100.1.1.1
Send me a certificate of identity
Browser
Real
www.example.org