WEB SERVICES

WEEK 11 – 11/4/2019

ANNOUNCEMENTS

- Homework 3 has been posted. It is due on Nov. 15 at 11:59 p.m.
- Project Milestone 4 is due on Nov. 8 at 11:59 p.m.

PROTOCOLS

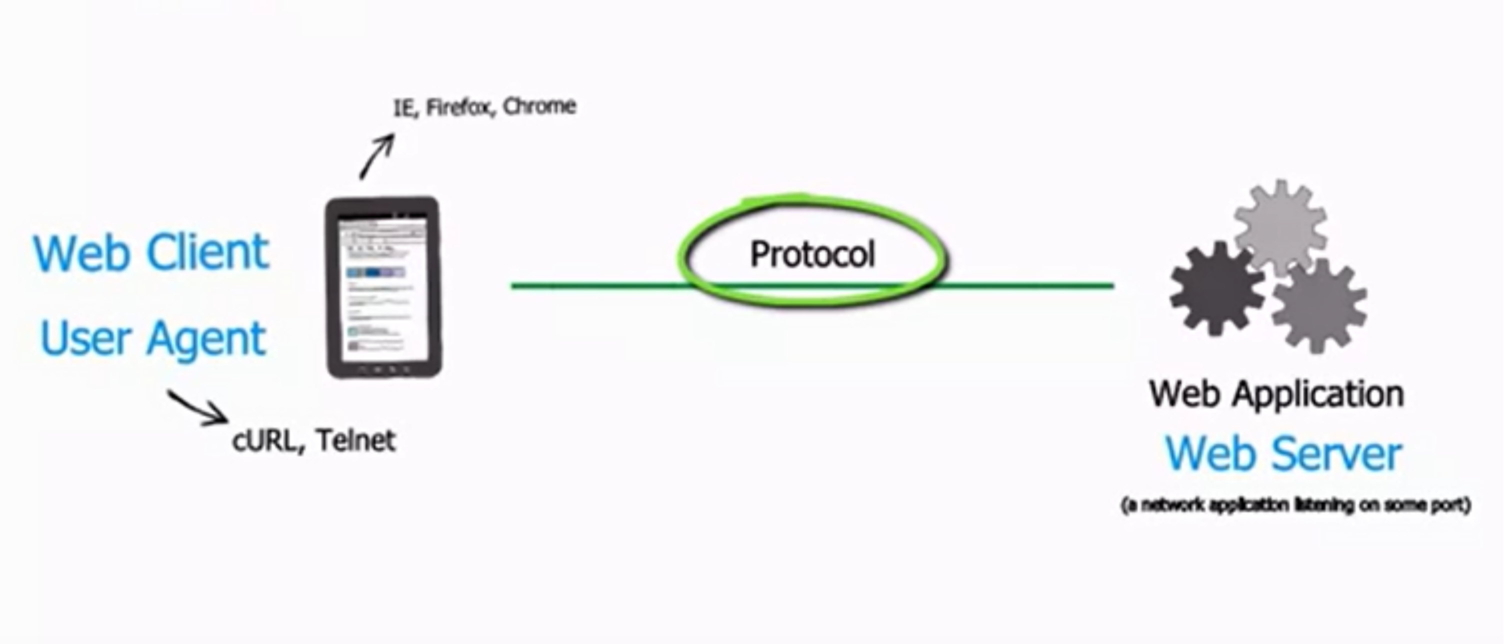
- How do we pass messages and requests from one layer to another?

  PROTOCOLS !

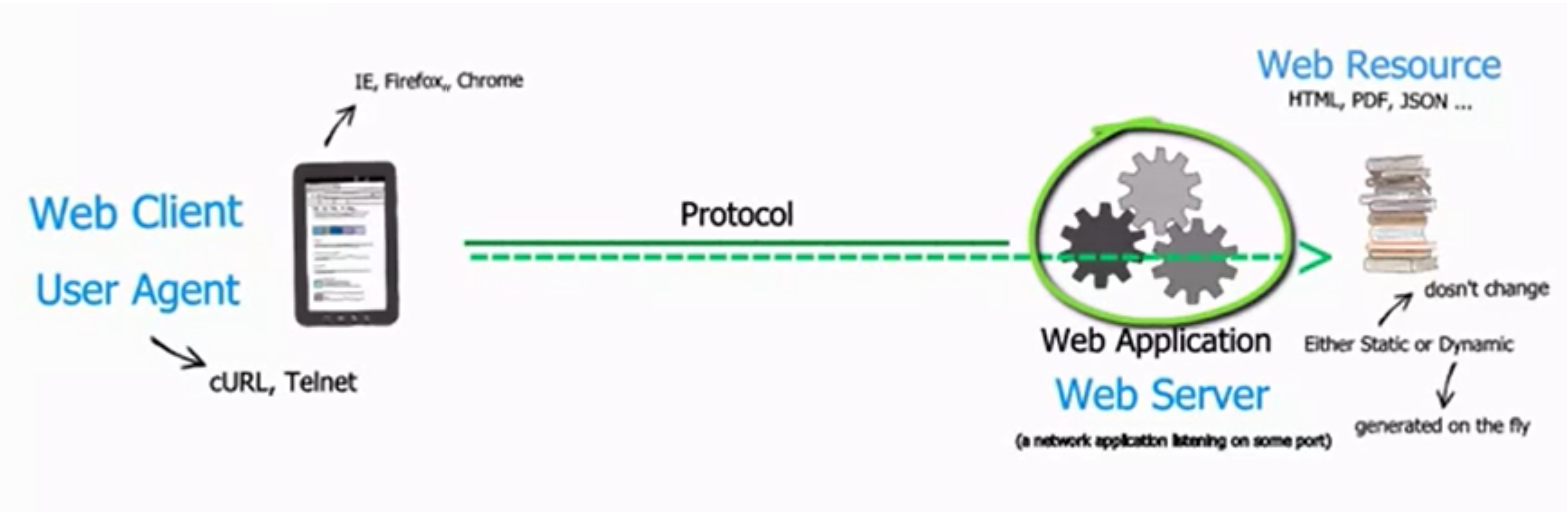
INTERNET PROTOCOLS

- What happens when you type a URL into a browser and press <ENTER>?
- What happens when you click on a hyperlink in a web page?

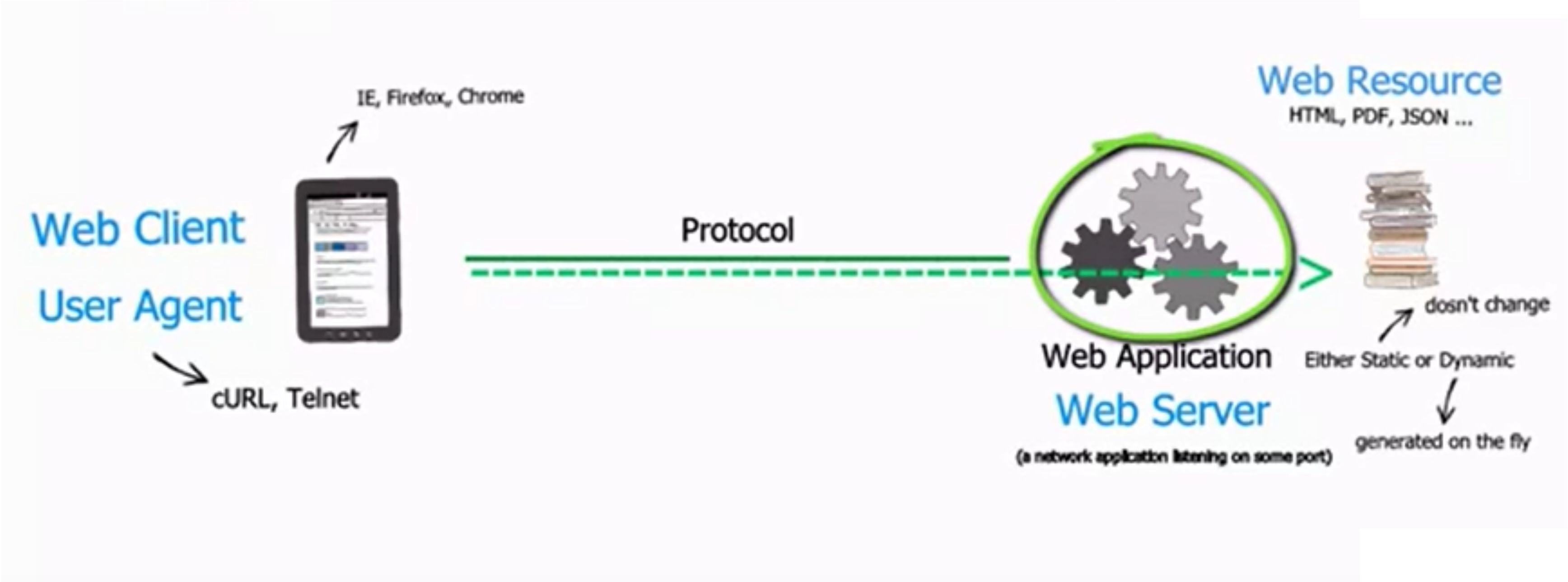
PROTOCOLS


IE, Firefox, Chrome
Web Client
User Agent
cURL, Telnet
Protocol
Web Application
Web Server
(a network application listening on some port)

PROTOCOLS

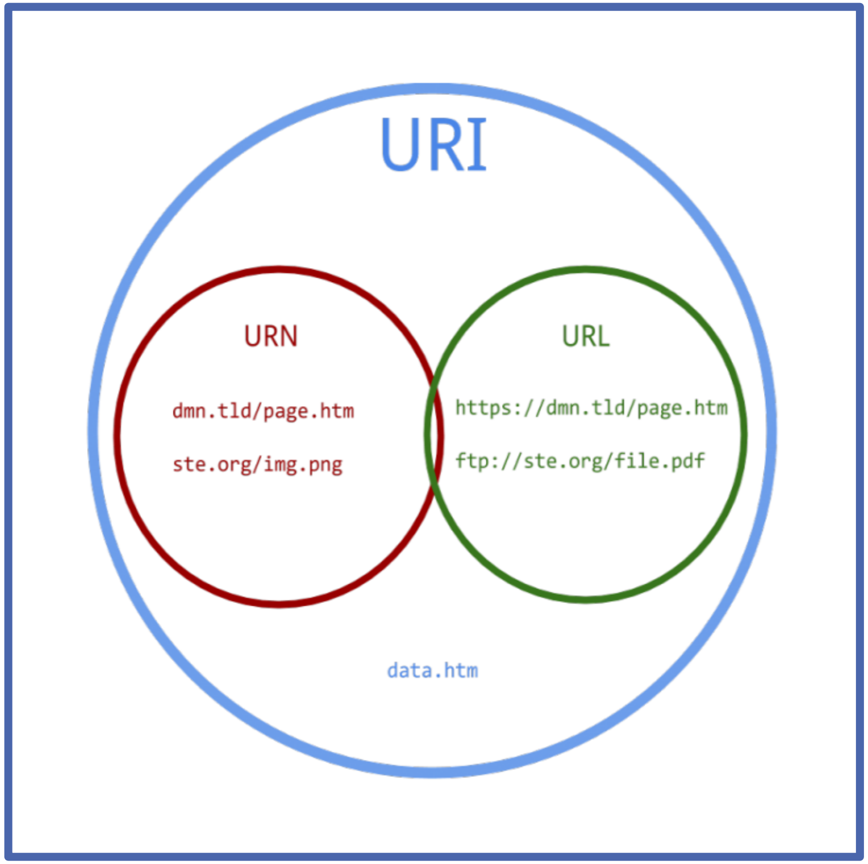

IE, Firefox,, Chrome
Web Client
User Agent
cURL, Telnet
Protocol
Web Resource
HTML, PDF, JSON ...
doesn't change
Either Static or Dynamic
generated on the fly
Web Application
Web Server
(a network application listening on some port)

PROTOCOLS



Each web resource is identified by a URI

THE URI



- http://www.colorado.edu
- URI, URL, URN ?
  - URL = locator

(where/how to find it)

  - URN = name

(what is its name)

  - URI = either one

HTTP – HYPERTEXT TRANSFER PROTOCOL

HTTP – a request/response protocol

- It is **STATELESS**
- The client submits a request, HTTP responds with the requested resource and a return code
  - Resources may be static or dynamic
  - Resources may redirect, include other resources, etc.

HTTP Methods

- GET - Retrieves the URI
- POST - Submits a resource to the URI - Like submitting a FORM to be processed by a script
- PUT - Stores a resource under the URI
- DELETE - Deletes the URI

COMMON HTTP RETURN CODES

- 200 : OK
- 302 : Redirect
- 400 : Bad Request
- 401 : Unauthorized
- 403 : Forbidden
- 404 : Not Found
- 500 : Server Error

PASSING DATA TO/FROM THE WEB SERVER

XML - EXTENSIBLE MARKUP LANGUAGE

JSON - JAVA SCRIPT OBJECT NOTATION

XML - EXTENSIBLE MARKUP LANGUAGE

- “Tag” based, like HTML
- Tags are user-defined
- XML is human readable AND machine readable
- Tags describe the data (XML tags do NOT display the data like HTML tags do)
- You can use a programming language like javascript or php or python to read, parse, modify and write XML documents sent/received to/from a Web Service
- The XML document structure is defined by a DOM – Document Object Model

XML

```
<bookstore>
    <book category="cooking">
        <title lang="en">Everyday Italian</title>
        <author>Giada De Laurentiis</author>
        <year>2005</year>
        <price>30.00</price> </book>
    <book category="children">
        <title lang="en">Harry Potter</title>
        <author>J K. Rowling</author>
        <year>2005</year>
        <price>29.99</price> </book>
    <book category="web">
        <title lang="en">XQuery Kick Start</title>
        <author>James McGovern</author>
        <author>Per Bothner</author>
        <author>Kurt Cagle</author>
        <author>James Linn</author>
        <author>Vaidyanathan Nagarajan</author>
        <year>2003</year>
        <price>49.99</price> </book>
    <book category="web" cover="paperback">
        <title lang="en">Learning XML</title>
        <author>Erik T. Ray</author>
        <year>2003</year>
        <price>39.95</price> </book>
</bookstore>
```

JSON

- "Java Script Object Notation"
- Represents data in key:value pair format.
- Many think JSON is easier to use than XML
- More compact than XML
- Like XML, JSON is easy for both humans & computers to understand

JSON

JSON:

```
{"employees":[
    { "firstName":"John", "lastName":"Doe" },
    { "firstName":"Anna", "lastName":"Smith" }
,
    { "firstName":"Peter", "lastName":"Jones" }
] }
```

XML:

```
<employees>
    <employee>
        <firstName>John</firstName> <lastNa
me>Doe</lastName>
    </employee>
    <employee>
        <firstName>Anna</firstName> <lastN
ame>Smith</lastName>
    </employee>
    <employee>
        <firstName>Peter</firstName> <lastN
ame>Jones</lastName>
    </employee>
</employees>
```

JSON

JSON is Like XML Because

- Both JSON and XML are "self describing" (human readable)
- Both JSON and XML are hierarchical (values nested within values)
- Both JSON and XML can be parsed and used by lots of programming languages
- Both JSON and XML can be fetched with an HTTP Request

JSON is Unlike XML Because

- JSON doesn't use end tags
- JSON is shorter
- JSON is quicker to read and write
- JSON can use array

JSON

For AJAX applications, JSON is faster and easier than XML:

Using XML

- Fetch an XML document
- Use the XML DOM to loop through the document
- Extract values and store in variables

Using JSON

- Fetch a JSON string
- JSON.Parse the JSON string

AJAX

- OK. So what is AJAX?
- AJAX stands for Asynchronous JavaScript and XML.
- AJAX is a technique for creating better, faster, and more interactive web applications with the help of XML, HTML, CSS, and Java Script.
- Ajax uses XHTML for content, CSS for presentation, along with Document Object Model and JavaScript for dynamic content display. (JavaScript runs on the CLIENT)

WEB SERVICES

Early Web (CGI) 1989

- hypertext / hyperlinks
- page by page

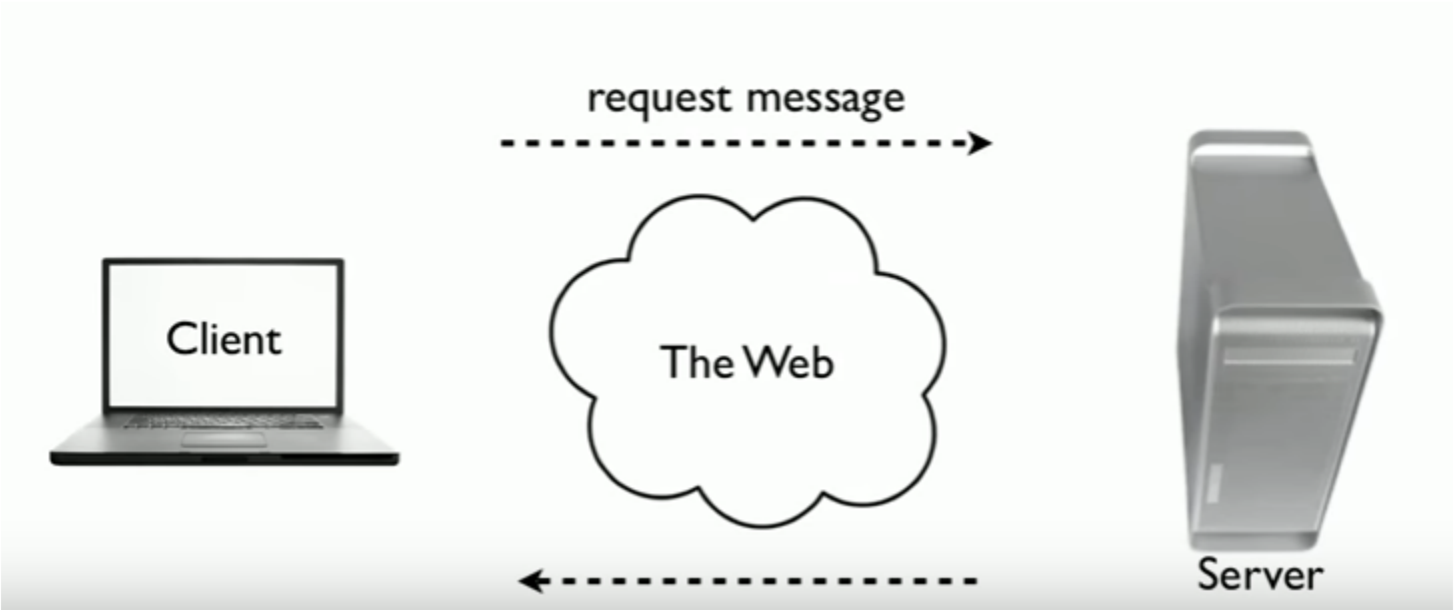
Web 2.0 (AJAX) 2004

- web page stays in place
- parts of the web page are updated

How are web 2.0 requests handled between client and server?

Web Services !

WEB SERVICES



response message

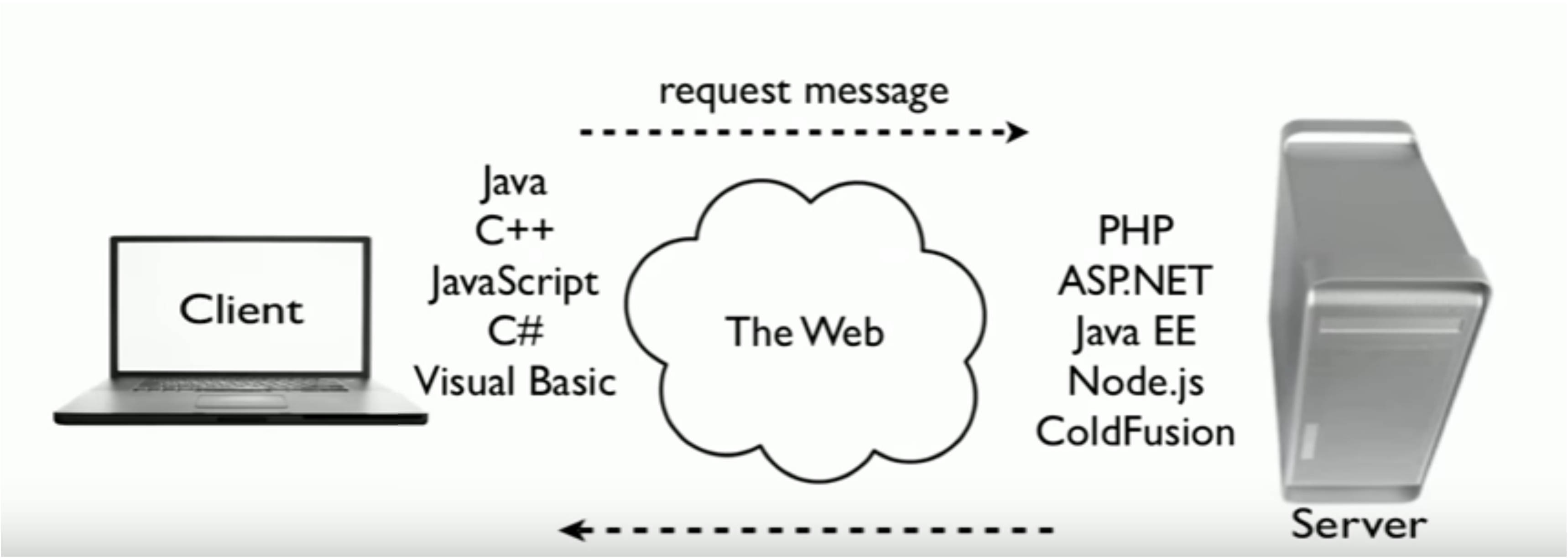
A framework for a conversation between computers over the web

WEB SERVICES

- If you want to use a web service, you must use an API (application programming interface)
- Defines everything you need to know to talk to a web service:
  1. Message format: SOAP, XML, JSON, etc.
  2. Request syntax: URI, Parameters & Data types
  3. Actions on the server: named methods, HTTP verbs
  4. Security: authentication (username & password)
  5. Response format: SOAP, XML, JSON, etc.

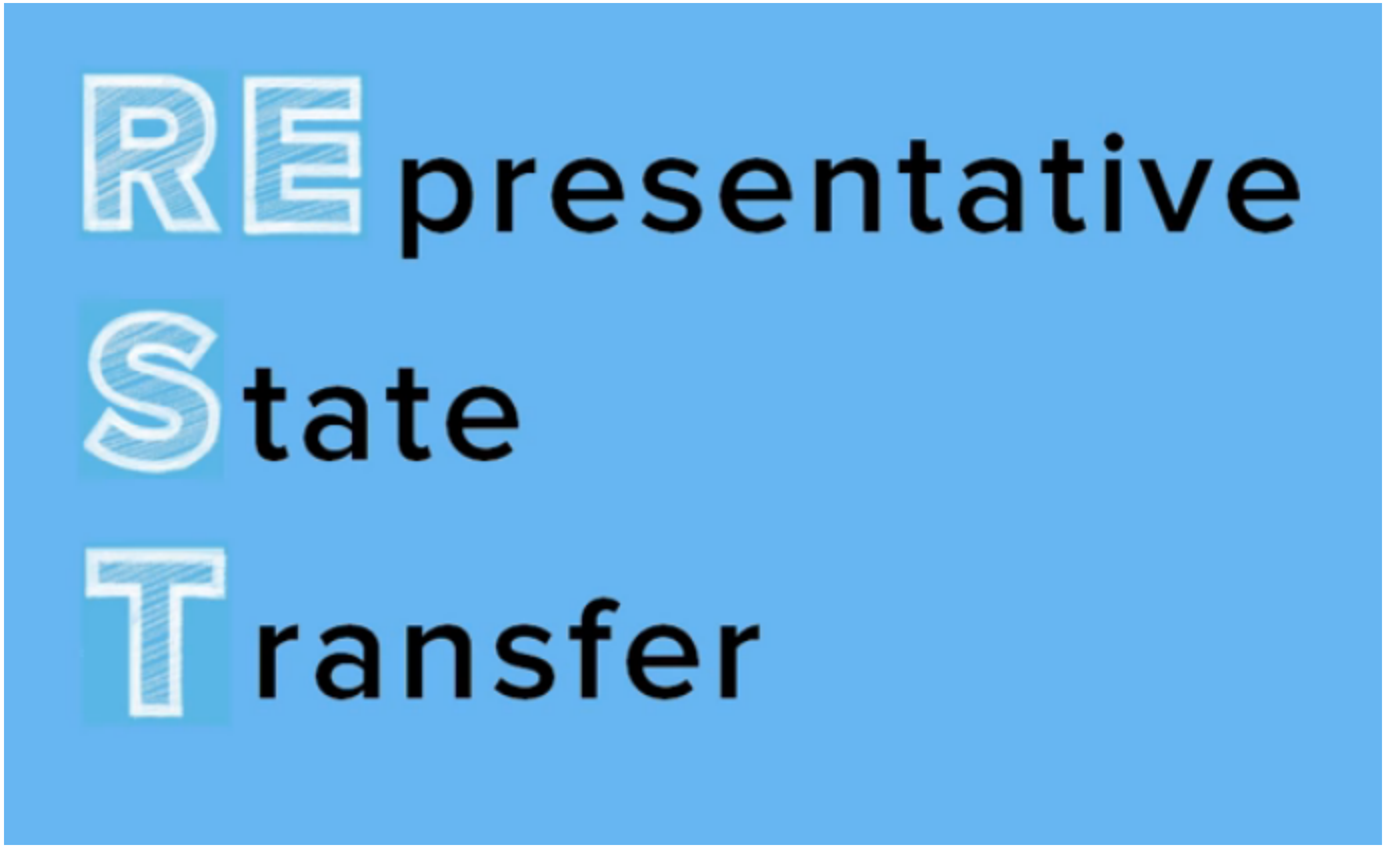
- The web service hides its complexity behind the API

WEB SERVICES



response message

WEB SERVICES



REpresentative

State

Transfer

WEB SERVICES

REST is an *architectural style*

Modern Architectural Style:

Colonial Architectural Style:

WEB SERVICES

- The "architectural style" is an abstract concept - it defines the characteristics and features you would find in a house built according to that style

- It is NOT the same as the house itself.

- REST is an abstract concept that defines the characteristics and features you would find in a web service request built according to the REST style

- REST is not really a protocol – it is a set of standards used to define Web Services

WEB SERVICES

- Everything in REST is considered as a resource.
  - Every resource is identified by an URI.
  - Uses uniform interfaces. Resources are handled using http POST, GET, PUT, DELETE operations
  - Stateless. Every request is an independent request. Each request from client to server must contain all the information necessary to understand the request.

WEB SERVICES

- RESTFul web services are based on HTTP methods
- A RESTFul web service typically defines the base URI for the services, the format/rules of the API, and the set of operations (POST, GET, PUT, DELETE) which are supported.

WEB SERVICES

Characteristics of a request/response following the REST style

- Resources follow the rules
  - URI (identifies the resource being requested)
  - Uniform Interface Methods (GET, PUT, POST, etc.)
  - Uniform Interface Representation (XML, JSON, HTML)

- Protocols offer features
  - Client-Server (like HTTP)
  - Stateless (each request is independent)
  - Layered (may pass through intermediaries)
  - Cacheable (intermediaries may cache for performance)

WEB SERVICES

Advantages of a request/response following the REST protocol

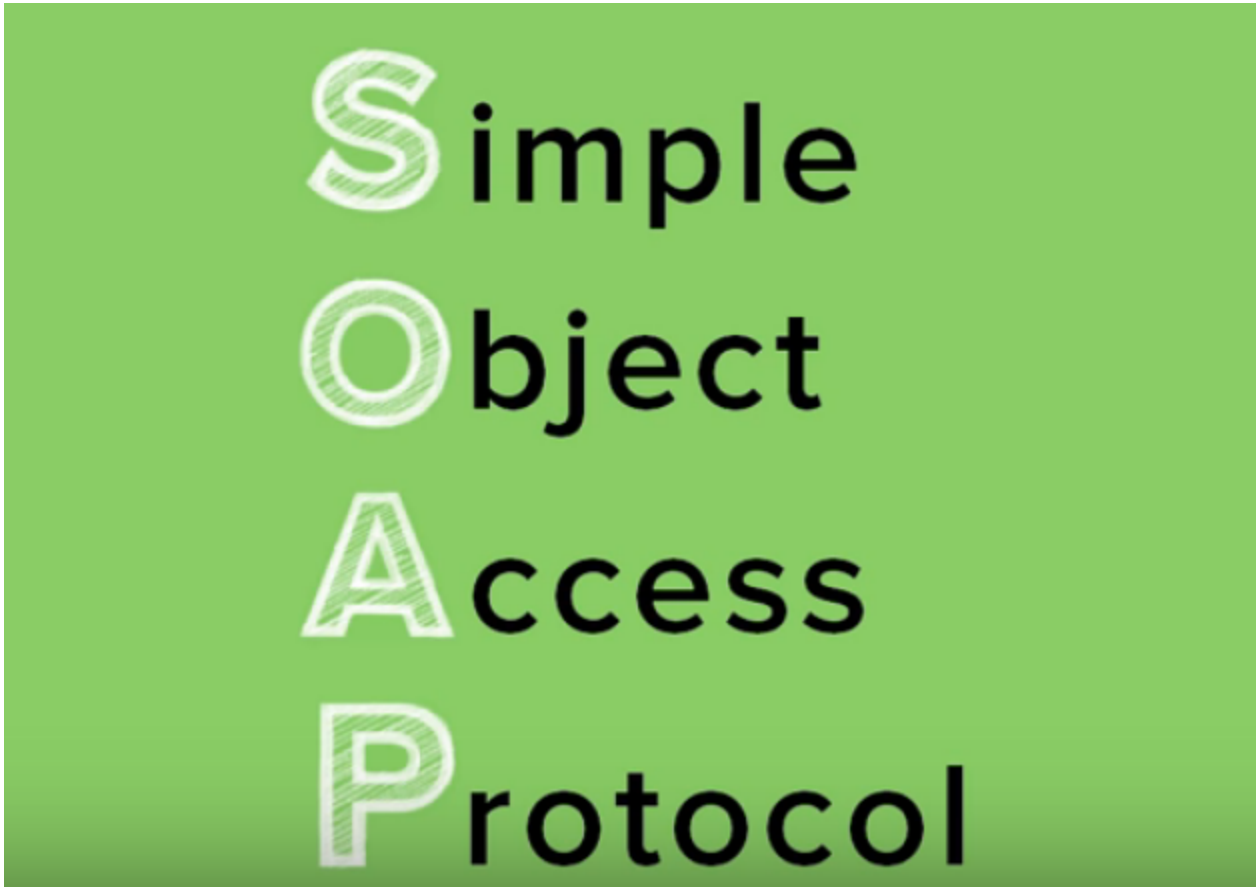
- Efficiency

  (through caching & compression)
- Scalability

  (gateways distribute traffic, caching, statelessness allows different intermediaries)
- User Perceived Performance

  (code on demand, client validation, caching)
- Simplicity

WEB SERVICES



Simple

Object

Access

Protocol

WEB SERVICES

REST	SOAP
Representational State Transfer	Simple Object Access Protocol
Architecture Style	An actual protocol
Uses simple HTTP	Uses SOAP envelope, then HTTP (or FTP, or other) to transfer the data
Uses many different data formats like JSON, XML, YAML*	Supports only XML format
Performance & Scalability & Caching	Slower performance. Scalability is limited and complex. Caching is not possible.
Widely and frequently used	Used where REST is not possible

*YAML: YAML Ain't Markup Language
What It Is: YAML is a human friendly data serialization standard for all programming languages.

WEB SERVICES

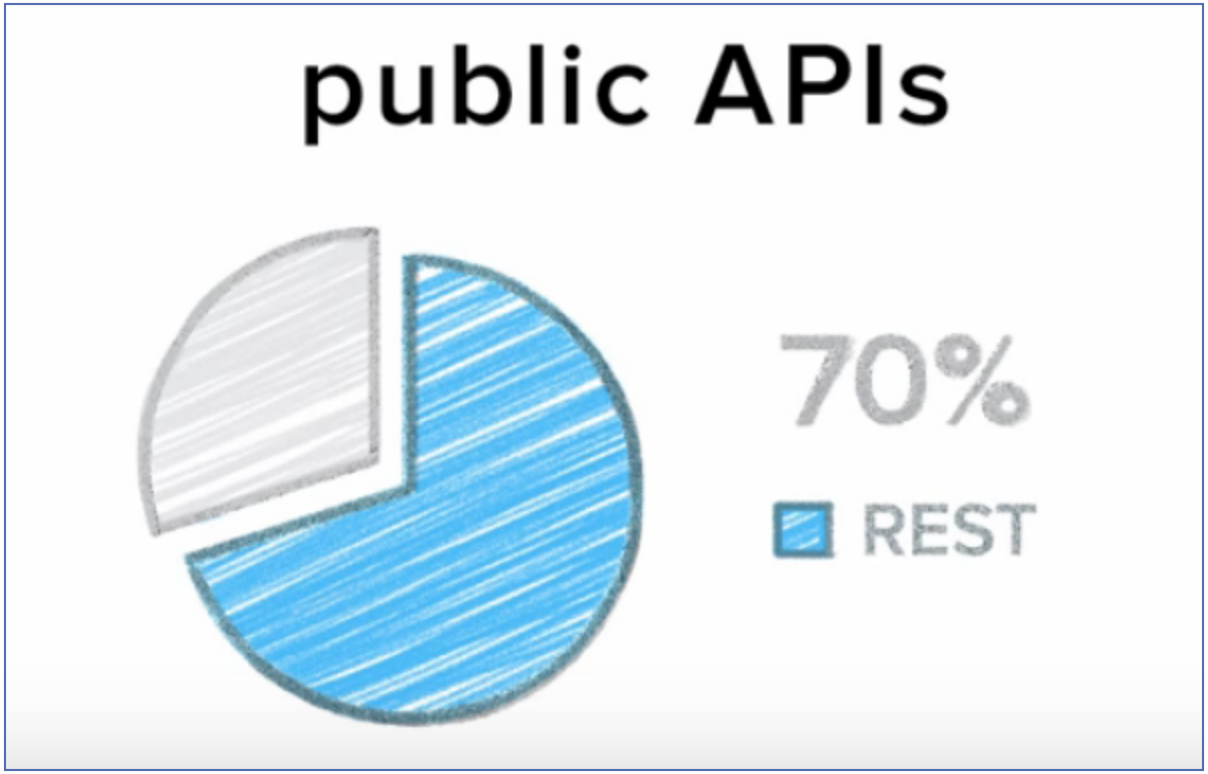
REST

REST (Representational State Transfer) was Created in 2000 by Roy Fielding in UC, Irvine. Developed in an academic environment, this protocol embraces the philosophy of the open Web.

SOAP

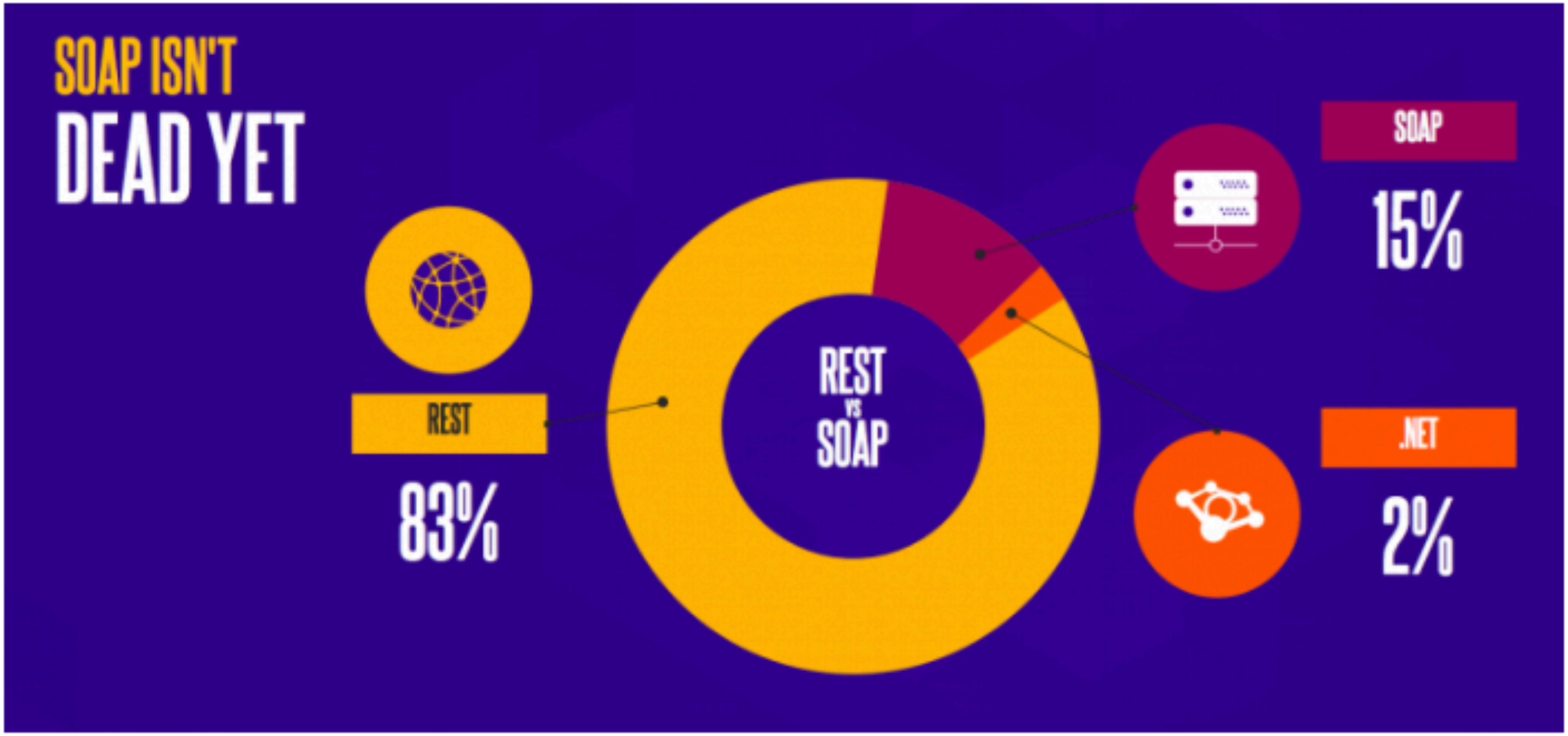
SOAP (Simple Object Access Protocol), was created in 1998 by Dave Winer et al in collaboration with Microsoft. Developed by a large software company, this protocol addresses the goal of addressing the needs of the enterprise market.

WEB SERVICES



As of 2016

According to this year's report, one area that continues to come up year after year is the balance of power between SOAP and REST. Although REST dominates the scene, there is still a decent percentage SOAP APIs out there that can't be ignored – at least 15% based on Cloud Elements' experience.



The State of API Integration report 2017

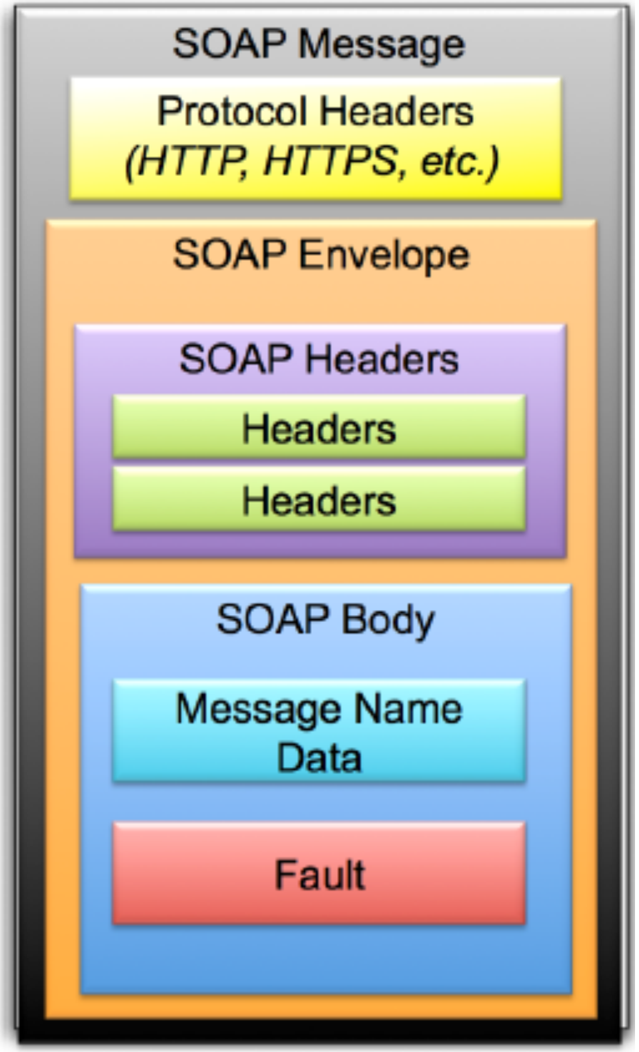
WEB SERVICES

- WSDL (Web Service Description Language) is an XML document that defines "contract" between client and service and is static by its nature.

- SOAP builds an XML based protocol on top of HTTP or some other protocol according to the rules described in the WSDL for that Web Service.

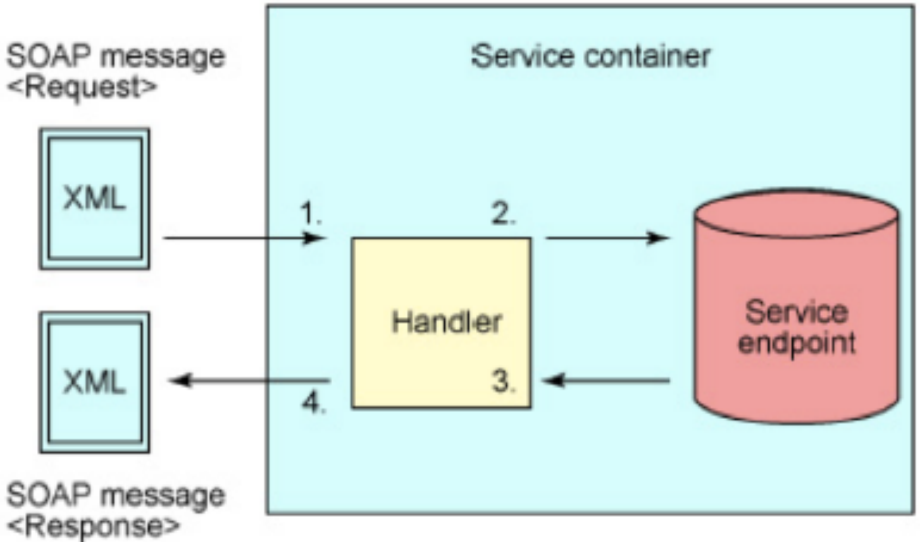
SOAP

- A SOAP message is an XML document containing the following elements:
  - An **Envelope** element that identifies the XML document as a SOAP message
  - A **Header** element that contains header information
  - A **Body** element that contains call and response information
  - A **Fault** element containing errors and status information

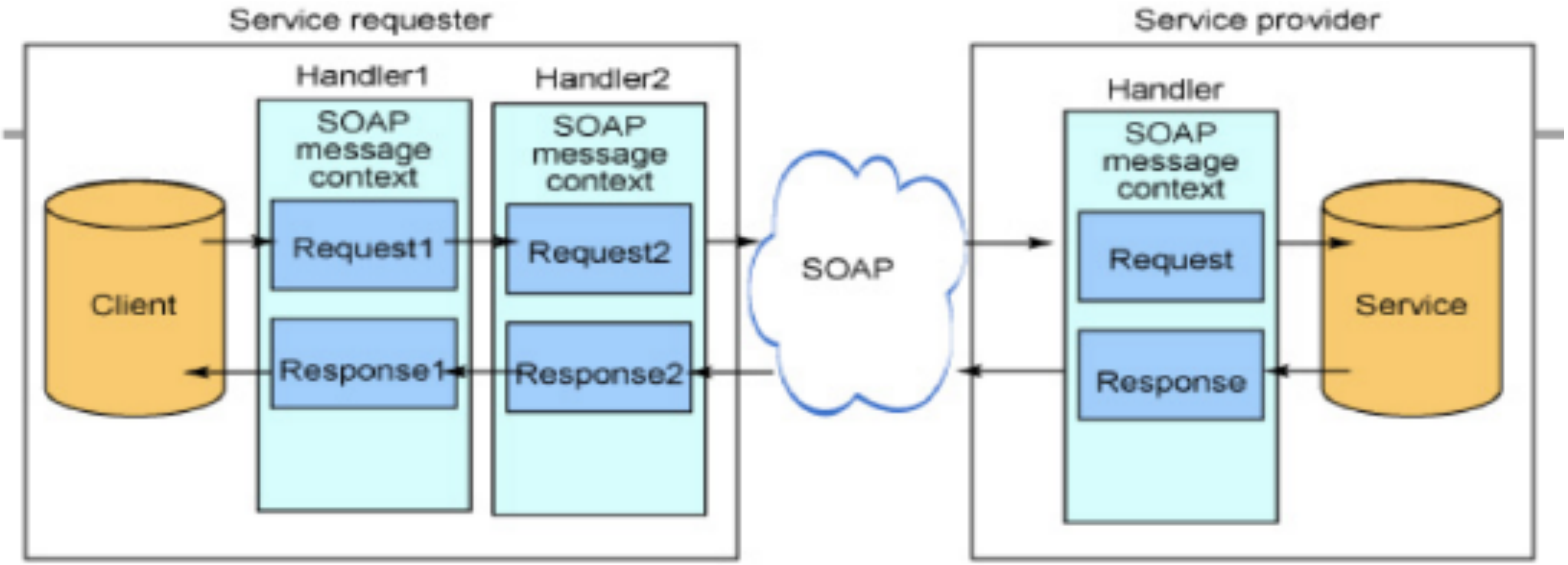


SOAP Handlers

- **Handlers** are pluggable classes that can be associated with a Web service or Web service client to provide pre-processing or post-processing of XML messages.
  - Ex: logging XML traffic through a Web service
  - Ex: measure performance by accessing the SOAP header to insert initial and finish times between two checkpoints



WEB SERVICES



WEB SERVICES

http://www.w3schools.com/graphics/google_maps_basic.asp

Demo of an API for using a web service

Requires a Google account & KEY

```
center:new google.maps.LatLng(40.0150,-105.2705),
zoom:14,
```

https://www.computersciencezone.org/50-most-useful-apis-for-developers/

A list of published web services and APIs

WEB SERVICES

https://www.youtube.com/watch?v=7YcW25PHnAA

- This video shows a clear example of how we can use REST framework API for using a web service

https://www.youtube.com/watch?v=RTjd1nwvlj4

- This video shows a clear example of how we can code php to do a RESTful php program to send form data to a web service and process its response.

  (He goes really fast. You should pause often to let it sink in.)