



AIRA
AMERICAN IMMUNIZATION
REGISTRY ASSOCIATION

Class 104: Transport & CDC WSDL

Connecting Systems

Minimal Lower Level Protocol (MLLP)

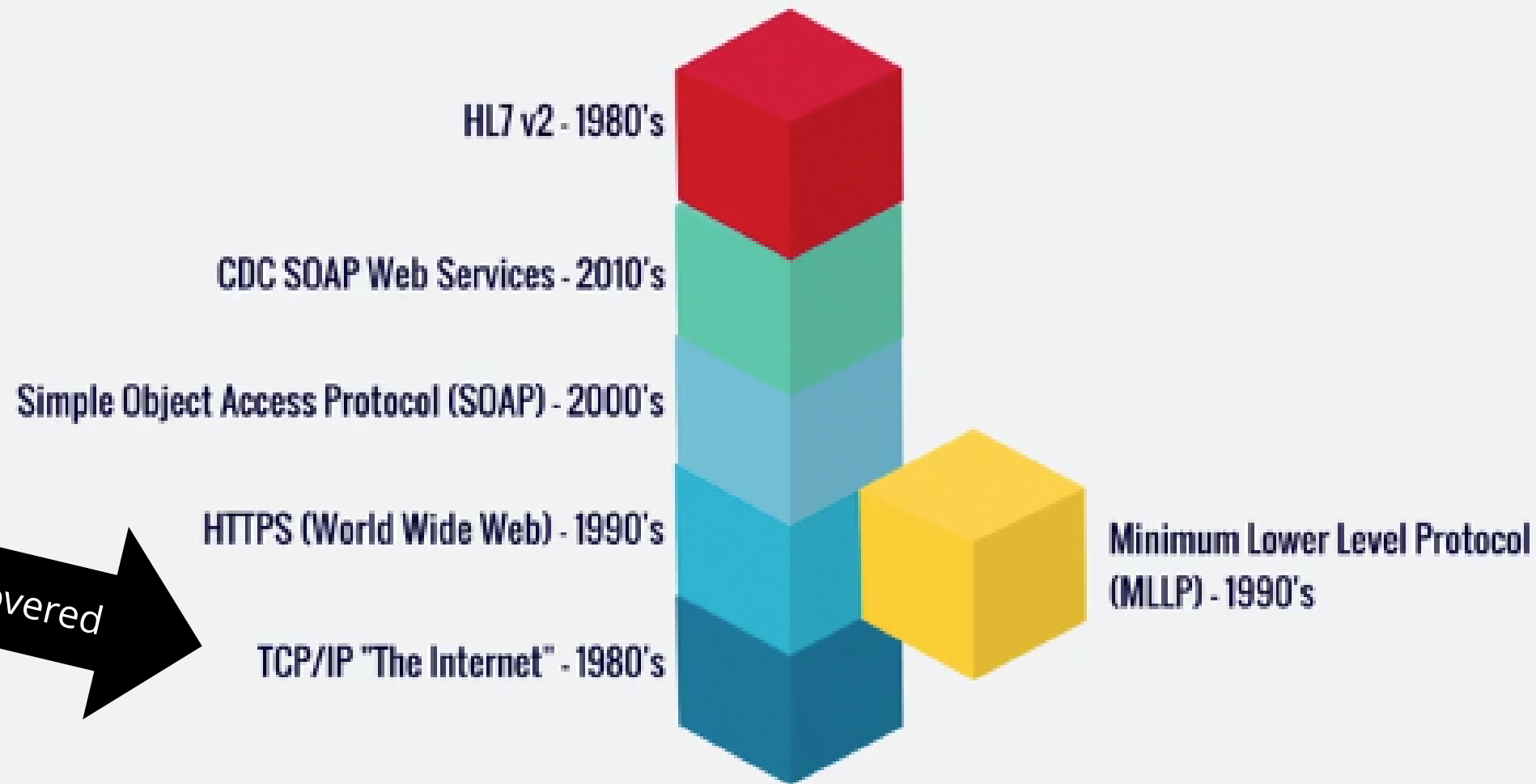
How HL7 v2 messages are transported in legacy systems.

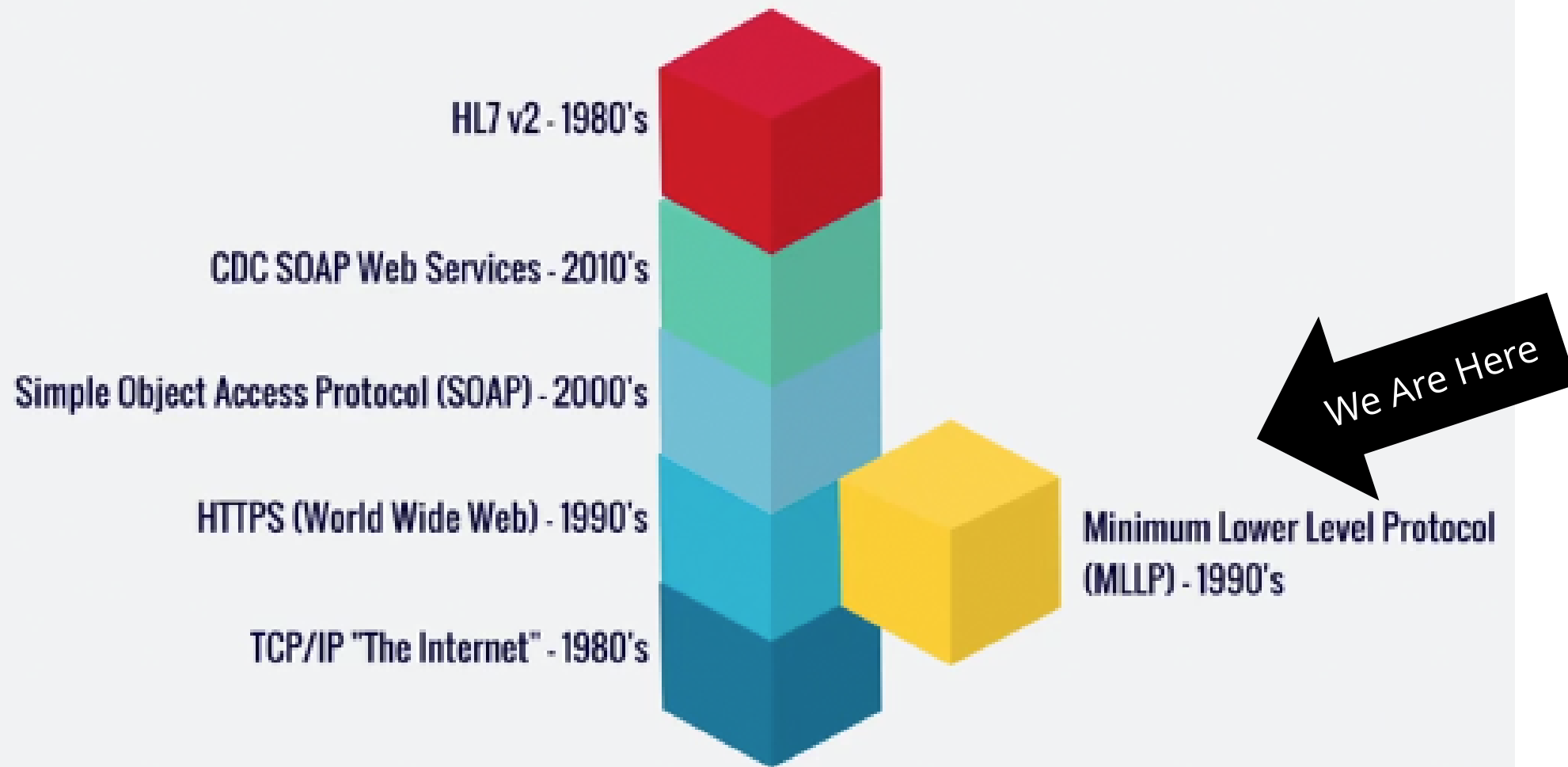


Minimum Lower Level Protocol

- Learn how HL7 v2 doesn't define transport
- Industry settled around MLLP
- IIS do not use MLLP but should be aware of it







Minimum Lower Level Protocol (MLLP)

- HL7 v2 is transport agnostic
- MLLP create for TCP/IP
 - Specification is 4 pages long
 - Widely used for 30 years
 - AKA "TCP/IP"

Transport Specification: MLLP, Release 1

Editor

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 - 1.4 [Examples](#)
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Dec	Hx	Oct	Char
0	0	000	NUL (null)
1	1	001	SOH (start of heading)
2	2	002	STX (start of text)
3	3	003	ETX (end of text)
4	4	004	EOT (end of transmission)
5	5	005	ENQ (enquiry)
6	6	006	ACK (acknowledge)
7	7	007	BEL (bell)
8	8	010	BS (backspace)
9	9	011	TAB (horizontal tab)
10	A	012	LF (NL line feed, new line)
11	B	013	VT (vertical tab)
12	C	014	FF (NP form feed, new page)
13	D	015	CR (carriage return)
14	E	016	SO (shift out)
15	F	017	SI (shift in)
16	10	020	DLE (data link escape)
17	11	021	DC1 (device control 1)
18	12	022	DC2 (device control 2)
19	13	023	DC3 (device control 3)
20	14	024	DC4 (device control 4)
21	15	025	NAK (negative acknowledge)
22	16	026	SYN (synchronous idle)
23	17	027	ETB (end of trans. block)
24	18	030	CAN (cancel)
25	19	031	EM (end of medium)
26	1A	032	SUB (substitute)
27	1B	033	ESC (escape)
28	1C	034	FS (file separator)
29	1D	035	GS (group separator)
30	1E	036	RS (record separator)
31	1F	037	US (unit separator)

1.2 Block Format

HL7 content is enclosed by special characters to form a block.

The block format is as follows: **< SB> dddd< EB> < CR>**

Element	Description
< SB>	Start Block character (1 byte). ASCII <VT> , i.e., <0x0B> . This should not be confused with the ASCII characters SOH or STX.
dddd	Data (variable number of bytes). This is the HL7 data content of the block. The data can contain any single-byte values greater than 0x1F (see next paragraph for issues related to character encodings) and the ASCII carriage return character, < CR> .
< EB>	End Block character (1 byte). ASCII <FS> , i.e., <0x1C> . This should not be confused with the ASCII characters ETX or EOT.
< CR>	Carriage Return (1 byte). The ASCII carriage return character, i.e., <0x0D> .



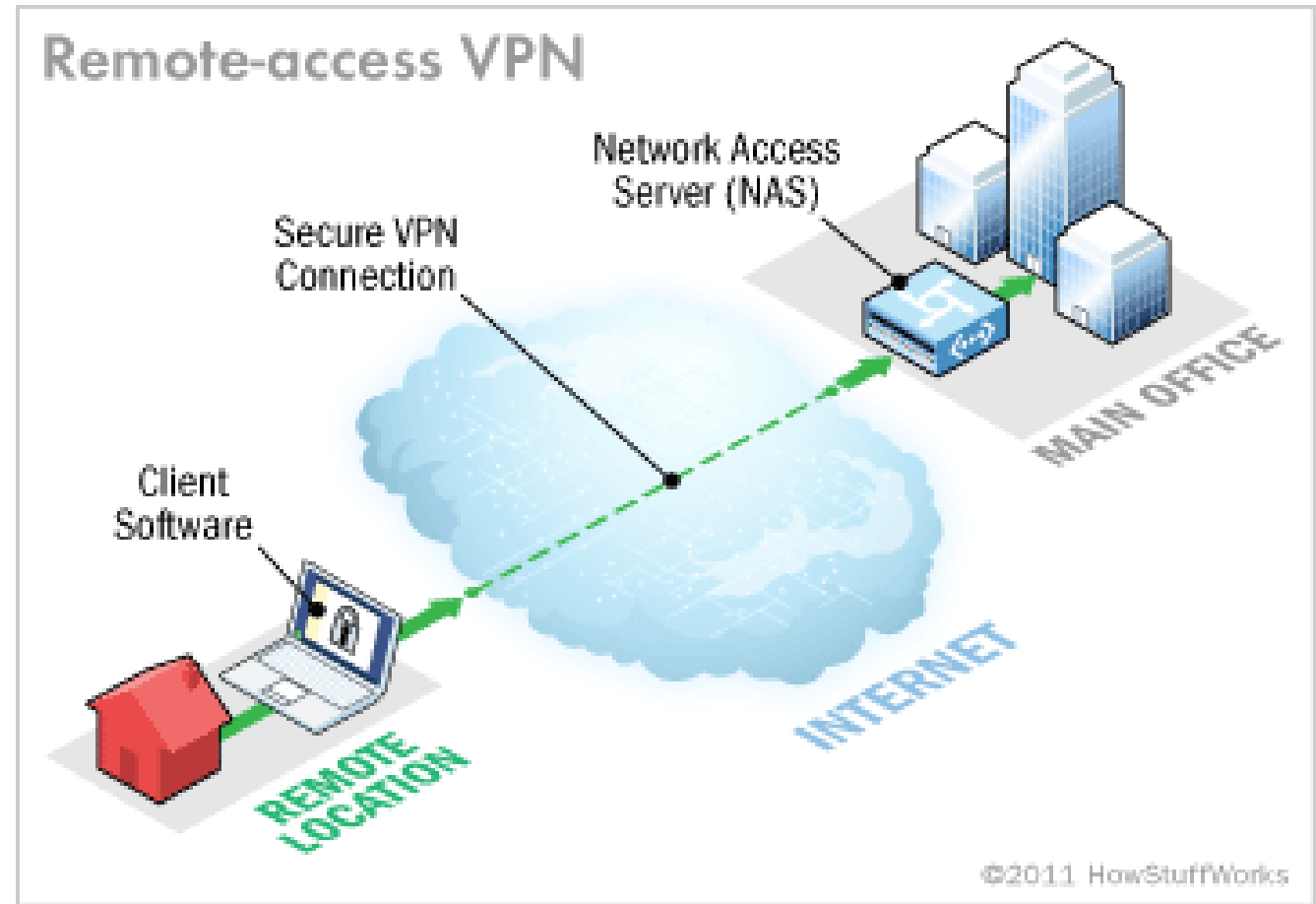
Where is MLLP used?

- Hospital systems
- Health Information Exchanges



Why didn't IIS adopt this?

- No end-to-end security
- Must add security to network
 - Virtual Private Network (VPN)
- Requires network engineer expertise



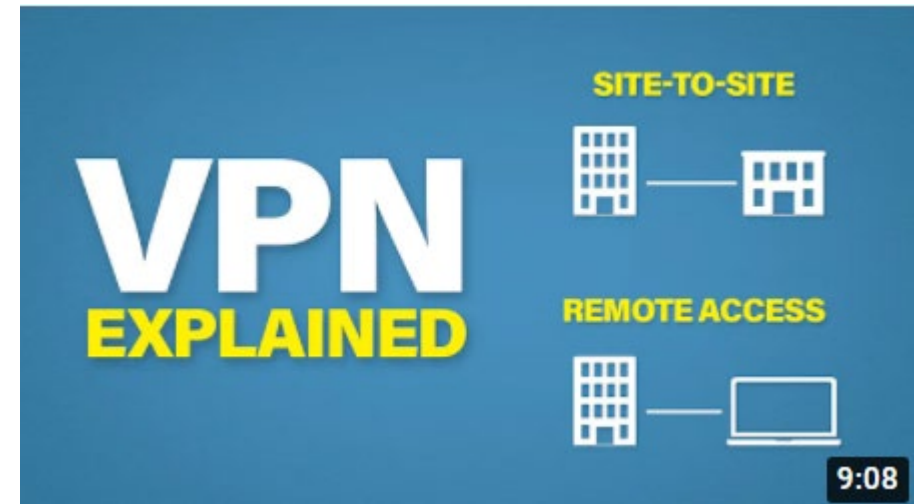
<https://computer.howstuffworks.com/vpn.htm>





Virtual Private Network (VPN)

- Main uses
 - Corporate Site-to-Site
 - Corporate Remote Access
 - Personal
- Security
 - VPN – Network Layer
 - HTTPS – Application Layer

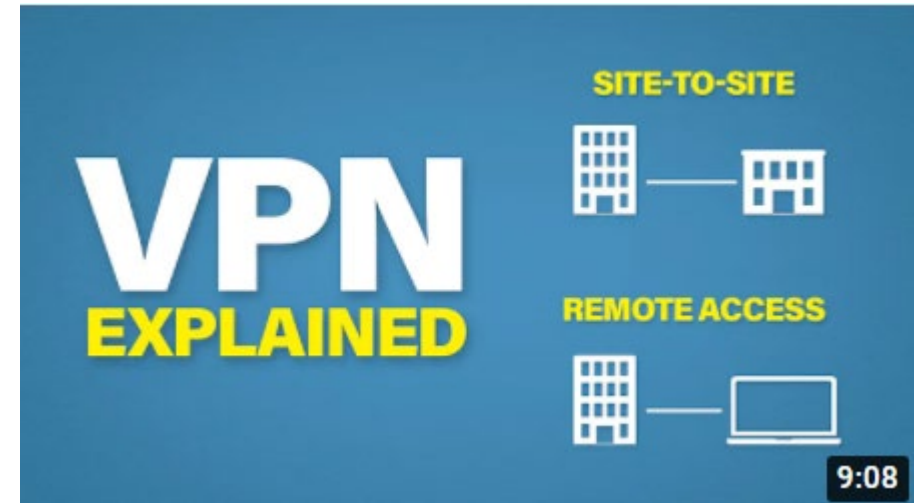


VPNs Explained – CertBros on Youtube
<https://www.youtube.com/watch?v=CWy3x3Wux6o>



Virtual Private Network (VPN)

- Pros
 - Can encrypt data flows for legacy applications that don't support security natively
- Cons
 - Relatively heavy solution
 - May require network engineers
 - May have costs
 - May require software install



VPNs Explained – CertBros on Youtube
<https://www.youtube.com/watch?v=CWy3x3Wux6o>



Minimum Lower Level Protocol

- Learn how HL7 v2 doesn't define transport
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- IIS do not use MLLP but should be aware of it



Hypertext Transfer Protocol (HTTPS)

How the world wide web was born

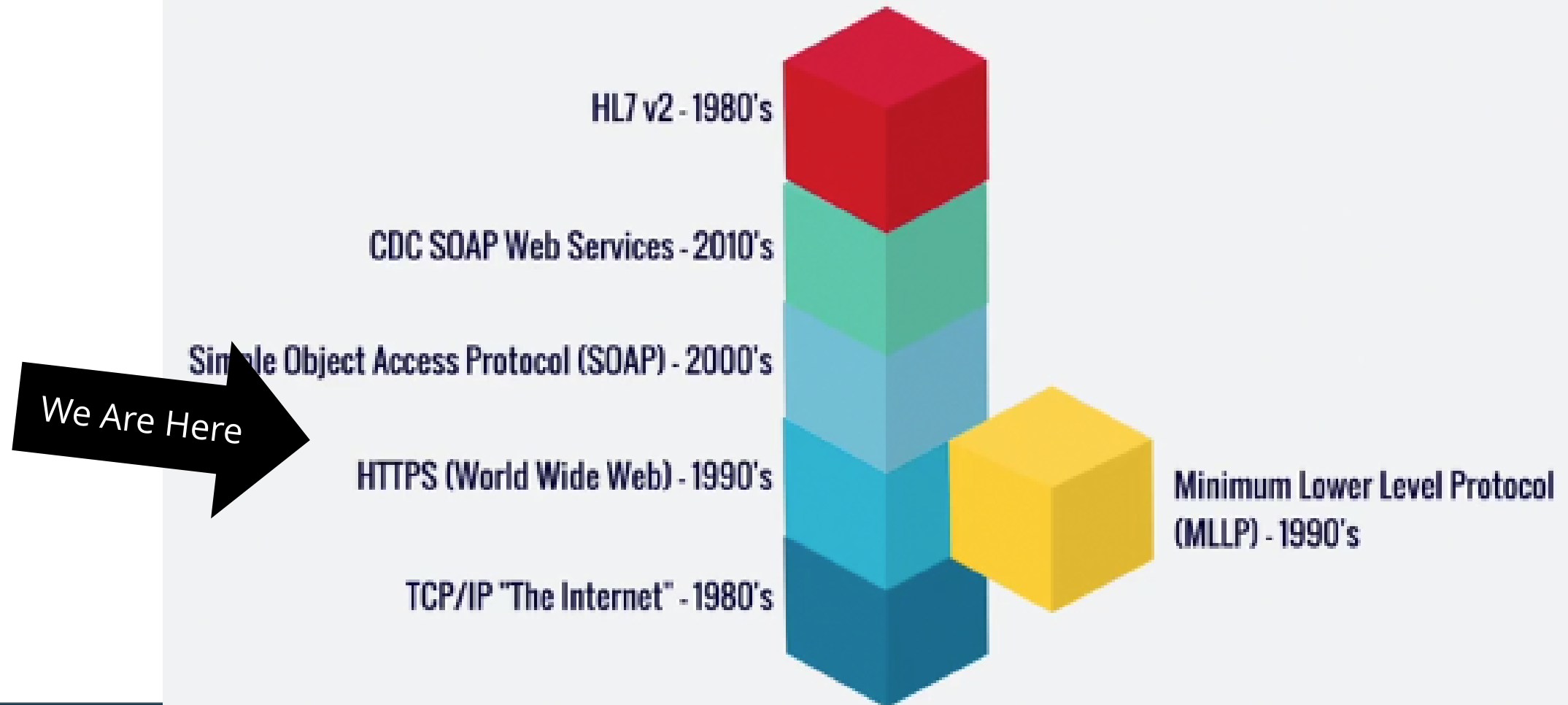


Hypertext Transfer Protocol (HTTPS)

- You will learn about
 - Creation of the World Wide Web (WWW)
 - Use of Uniform Resource Location (URL)
 - HTTP Response Codes

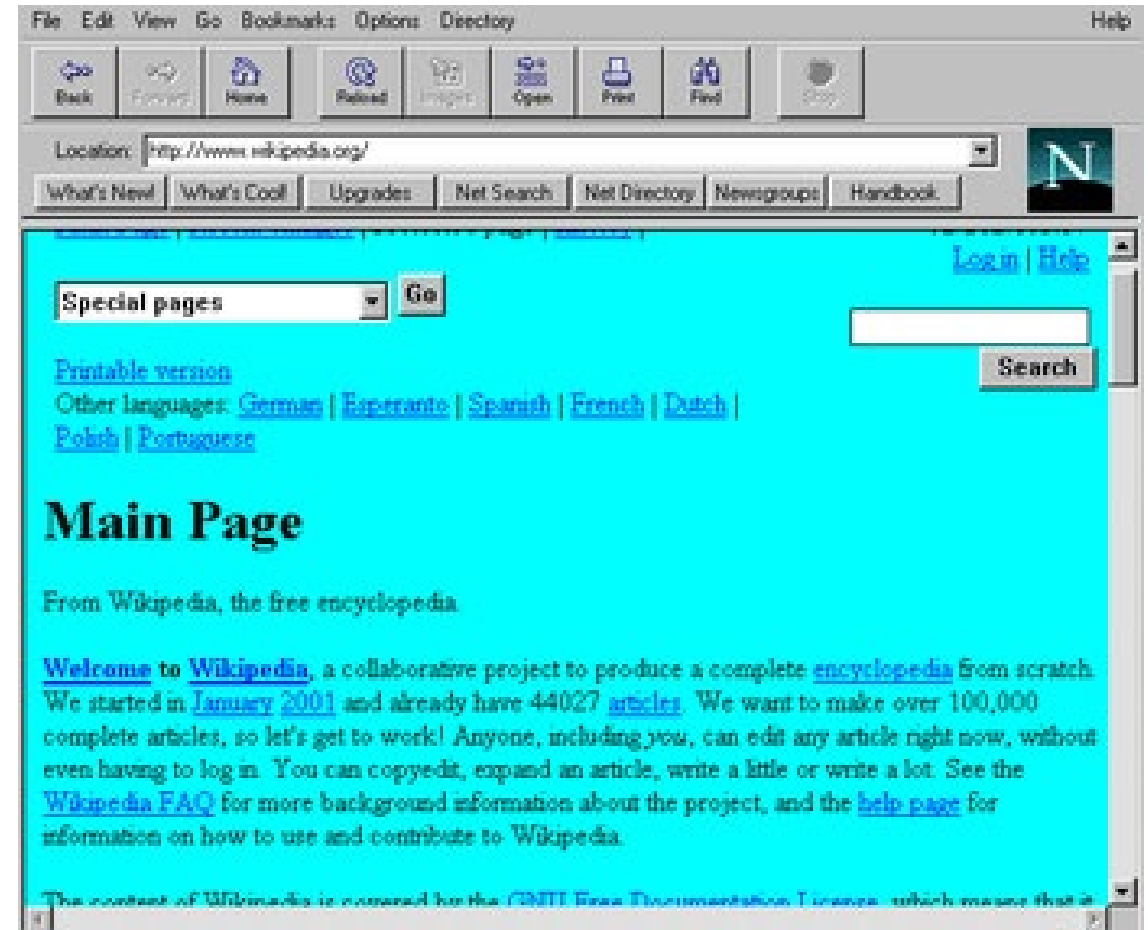


Where are we?

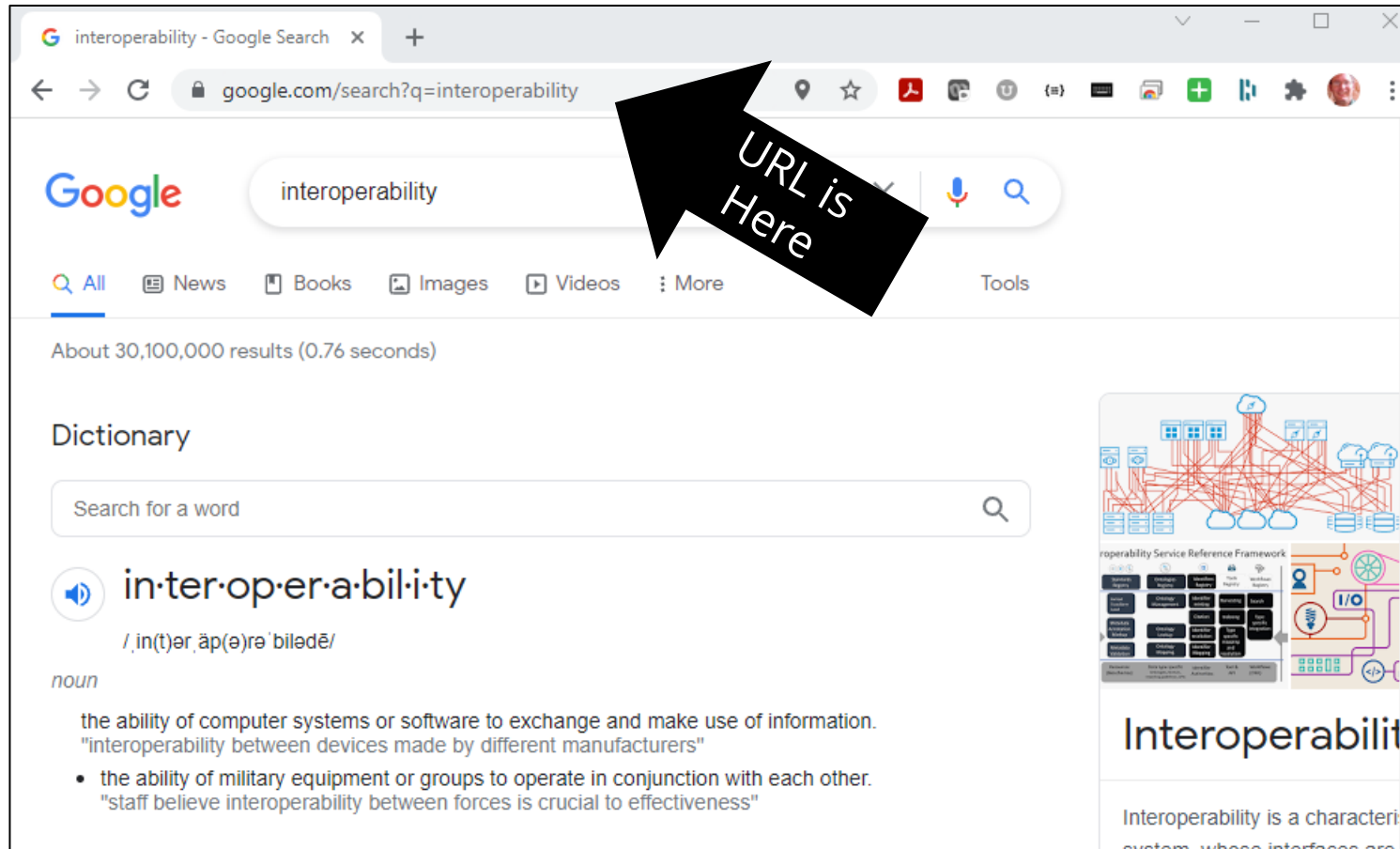


World Wide Web

- Built on top of TCP/IP
- HTTP was developed first
 - Not secure
 - Plain-text
- HTTPS adds security
 - Almost all traffic on the web today is secure
- Will use HTTP/HTTPS interchangeably



Uniform Resource Locator (URL)



The screenshot shows a web browser window with the Google search page. The address bar displays the URL `google.com/search?q=interoperability`. A black arrow with the text "URL is Here" points to this address bar. The search bar contains the word "interoperability". Below the search bar, the results show "About 30,100,000 results (0.76 seconds)". The "Dictionary" section is expanded, showing the word "in·ter·op·er·a·bil·i·ty" with its phonetic transcription `/ˌɪn(t)ərˌɑp(ə)rəˈbɪlədē/` and the definition: "the ability of computer systems or software to exchange and make use of information. 'interoperability between devices made by different manufacturers'". A list of definitions follows, including "the ability of military equipment or groups to operate in conjunction with each other. 'staff believe interoperability between forces is crucial to effectiveness'". On the right side of the page, there is a diagram titled "Interoperability Service Reference Framework" showing a network of interconnected nodes and a table of related terms.

interoperability - Google Search

google.com/search?q=interoperability

Google interoperability

All News Books Images Videos More Tools

About 30,100,000 results (0.76 seconds)

Dictionary

Search for a word

in·ter·op·er·a·bil·i·ty
/ˌɪn(t)ərˌɑp(ə)rəˈbɪlədē/
noun

the ability of computer systems or software to exchange and make use of information.
"interoperability between devices made by different manufacturers"

- the ability of military equipment or groups to operate in conjunction with each other.
"staff believe interoperability between forces is crucial to effectiveness"

Interoperability Service Reference Framework

Interoperability

Interoperability is a characteri
system whose interfaces are



Uniform Resource Locator (URL)

<https://www.google.com/search?q=interoperability>

Protocol	Domain Name	Path	Query
----------	-------------	------	-------



Uniform Resource Locator (URL)

<https://www.google.com/search?q=interoperability>

Protocol	Domain Name	Path	Query
How to get the data	Where to request it	Resource wanted	Additional query parameters



How to URLs work?

- Recommended video



How Do URLs Work? – Techquickie on YouTube
https://www.youtube.com/watch?v=OvF_pnj6zrY

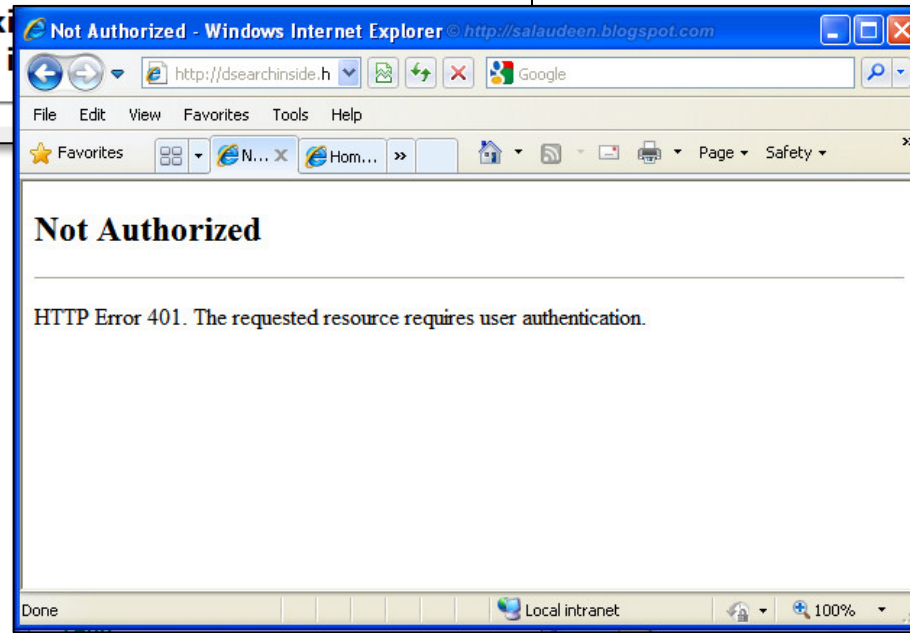
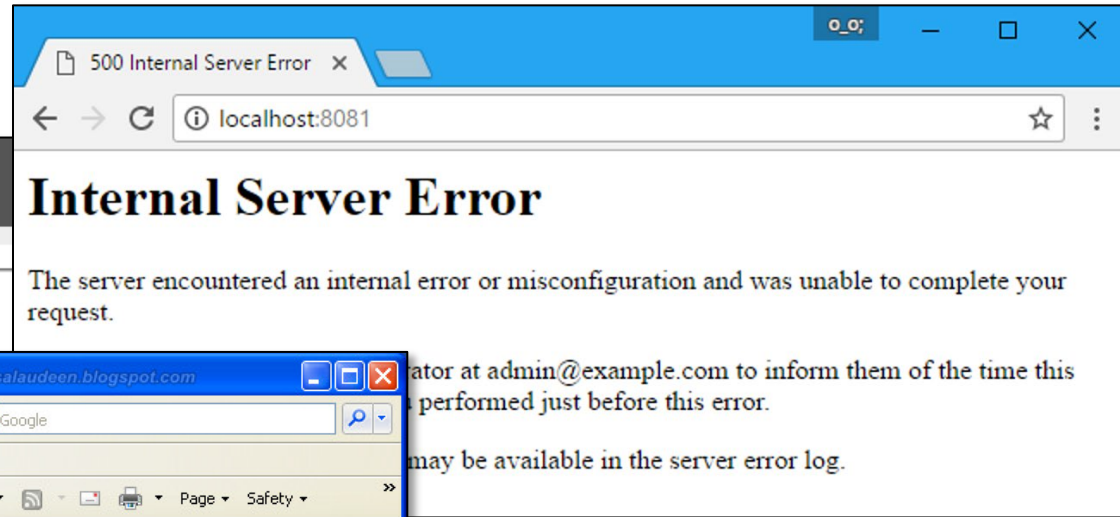


HTTP Response Codes

Server Error

404 - File or directory not found.

The resource you are looking for has its name changed, or it may have been moved.



HTTP Response Codes

Code	Name	Description
1xx	Informational Response	The request was received, continuing process.
2xx	Successful	The request was successfully received, understood, and accepted.
3xx	Redirection	Further action needs to be taken in order to complete the request.
4xx	Client Error	The request contains bad syntax or cannot be fulfilled.
5xx	Server Error	The server failed to fulfil an apparently valid request.



Common HTTP Response Codes

Code	Name	Description
200	OK	Standard response for successful HTTP requests.
403	Forbidden	The request contained valid data and was understood by the server, but the server is refusing action.
404	Not Found	The requested resource could not be found but may be available in the future.
500	Internal Server Error	A generic error message, given when an unexpected condition was encountered and no more specific message is suitable.
502	Bad Gateway	The server was acting as a gateway or proxy and received an invalid response from the upstream server.
504	Gateway Timeout	The server was acting as a gateway or proxy and did not receive a timely response from the upstream server.



Hypertext Transfer Protocol (HTTPS)

- You will learn about
 - Creation of the World Wide Web (WWW)
 - Use of Uniform Resource Location (URL)
 - HTTP Response Codes



XML

eXtensible Markup Language

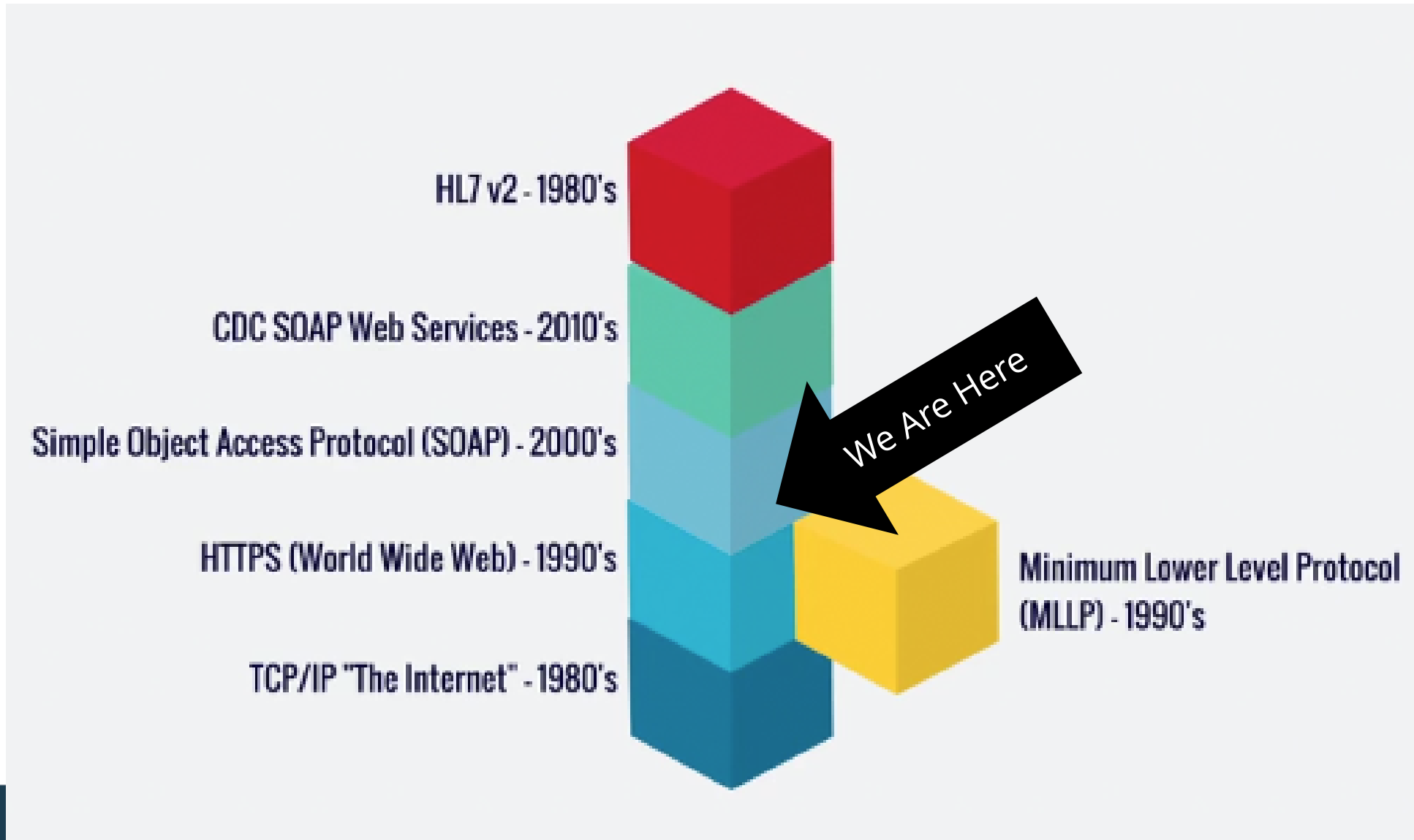


XML

- Generic format for representing data
- Human and machine readable
- Used by a very wide range of standards
 - Internet
 - Software
 - Health Care



Where are we?



XML



- Imagine a breakfast menu





Breakfast Menu

Belgian Waffles - \$5.95

Two of our famous Belgian Waffles with plenty of real maple syrup
650 calories

Strawberry Belgian Waffles - \$7.95

Light Belgian waffles covered with strawberries and whipped cream
900 calories

Berry-Berry Belgian Waffles - \$8.95

Belgian waffles covered with assorted fresh berries and whipped cream
900 calories





Breakfast Menu

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900 calories





```
<?xml version="1.0" encoding="UTF-8"?>
<breakfast_menu>
  <food>
    <name>Belgian Waffles</name>
    <price>$5.95</price>
    <description>
      Two of our famous Belgian Waffles with plenty of real maple syrup
    </description>
    <calories>650</calories>
  </food>
  <food>
    <name>Strawberry Belgian Waffles</name>
    <price>$7.95</price>
    <description>
      Light Belgian waffles covered with strawberries and whipped cream
    </description>
    <calories>900</calories>
  </food>
  <food>
    <name>Berry-Berry Belgian Waffles</name>
    <price>$8.95</price>
    <description>
      Belgian waffles covered with assorted fresh berries and whipped cream
    </description>
    <calories>900</calories>
  </food>
```

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Belgian Waffles - \$5.95

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  <food>
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    <price>$8.95</price>
    <description>
      Belgian waffles covered with assorted fresh berries and whipped cream
    </description>
    <calories>900</calories>
  </food>
```

• Tags

- Start tag *<name>*
- End tag *</name>*
- Start/end *<name/>*
- If you start one, end one
- Can be nested

• Text

- Data is between tags
- Can be text or numbers



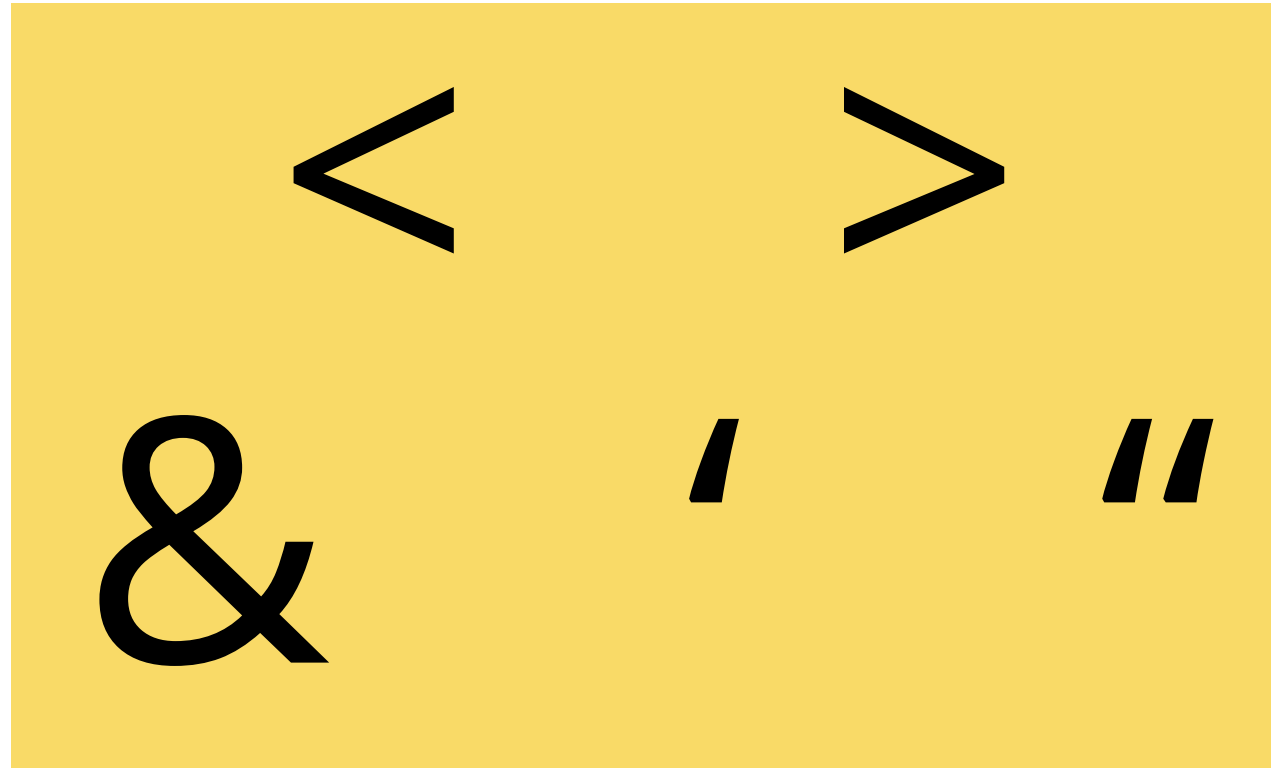
Escaping Characters



O Brother, Where Art Thou? 2000 Movie



Escaping Characters





Escaping Characters

Symbol (name)

< (less-than)

> (greater-than)

& (ampersand)

' (apostrophe or single quote)

" (double-quote)

Escape Sequence

< or <

> or >

& or &

' or "

" or '





Escaping Characters

Symbol (name)

< (less-than)

> (greater-than)

& (ampersand)

' (apostrophe or single quote)

" (double-quote)

Escape Sequence

< or <

> or >

& or &

' or "

" or '

Dec	Hx	Oct	Html	Chr
32	20	040	 	Space
33	21	041	!	!
34	22	042	"	"
35	23	043	#	#
36	24	044	$	\$
37	25	045	%	%
38	26	046	&	&
39	27	047	'	'
40	28	050	((
41	29	051))
42	2A	052	*	*
43	2B	053	+	+
44	2C	054	,	,
45	2D	055	-	-
46	2E	056	.	.
47	2F	057	/	/
48	30	060	0	0
49	31	061	1	1
50	32	062	2	2
51	33	063	3	3
52	34	064	4	4
53	35	065	5	5
54	36	066	6	6
55	37	067	7	7
56	38	070	8	8
57	39	071	9	9
58	3A	072	:	:
59	3B	073	;	;
60	3C	074	<	<
61	3D	075	=	=
62	3E	076	>	>



XML Character Data (CDATA)

- You can mark sections as being non-XML character data

A CDATA section starts with the following sequence:

```
<![CDATA[
```

and ends with the next occurrence of the sequence:

```
]]>
```





Representing Special Characters in XML

Example, send the team name of “John & Sally”

This won't work:

```
<team>John & Sally</team>
```

Option #1:

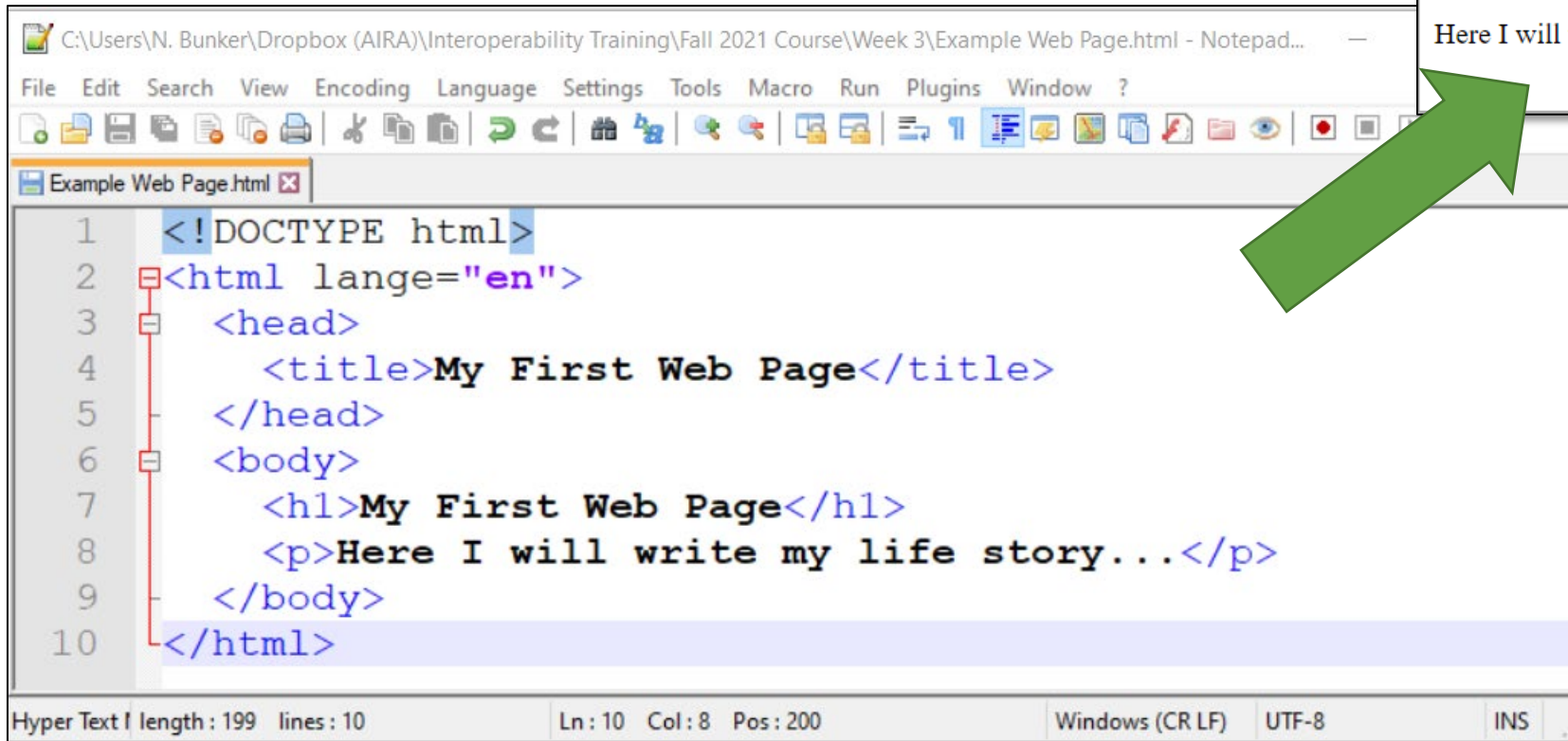
```
<team>John &amp;; Sally</team>
```

Option #2:

```
<team><![CDATA[John & Sally]]></team>
```



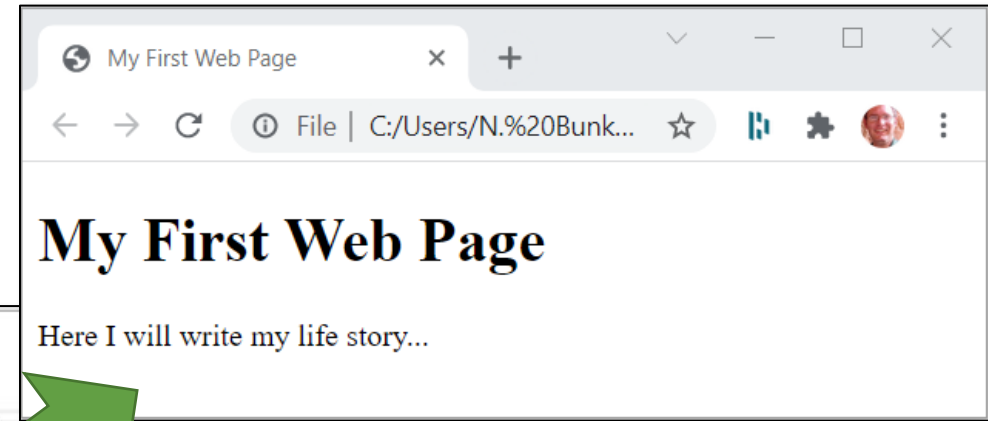
HTML Exercise



The screenshot shows a Notepad++ window with the file path `C:\Users\N. Bunker\Dropbox (AIRA)\Interoperability Training\Fall 2021 Course\Week 3\Example Web Page.html`. The menu bar includes File, Edit, Search, View, Encoding, Language, Settings, Tools, Macro, Run, Plugins, and Window. The toolbar contains various icons for file operations and editing. The code editor shows the following HTML code:

```
1 <!DOCTYPE html>
2 <html lang="en">
3   <head>
4     <title>My First Web Page</title>
5   </head>
6   <body>
7     <h1>My First Web Page</h1>
8     <p>Here I will write my life story...</p>
9   </body>
10 </html>
```

The status bar at the bottom indicates: Hyper Text | length : 199 | lines : 10 | Ln : 10 Col : 8 Pos : 200 | Windows (CR LF) | UTF-8 | INS.



XML

- Generic format for representing data
- Human and machine readable
- Used by a very wide range of standards
 - Internet
 - Software
 - Health Care



CDC WSDL

How SOAP is used to transport HL7 v2 immunization messages.

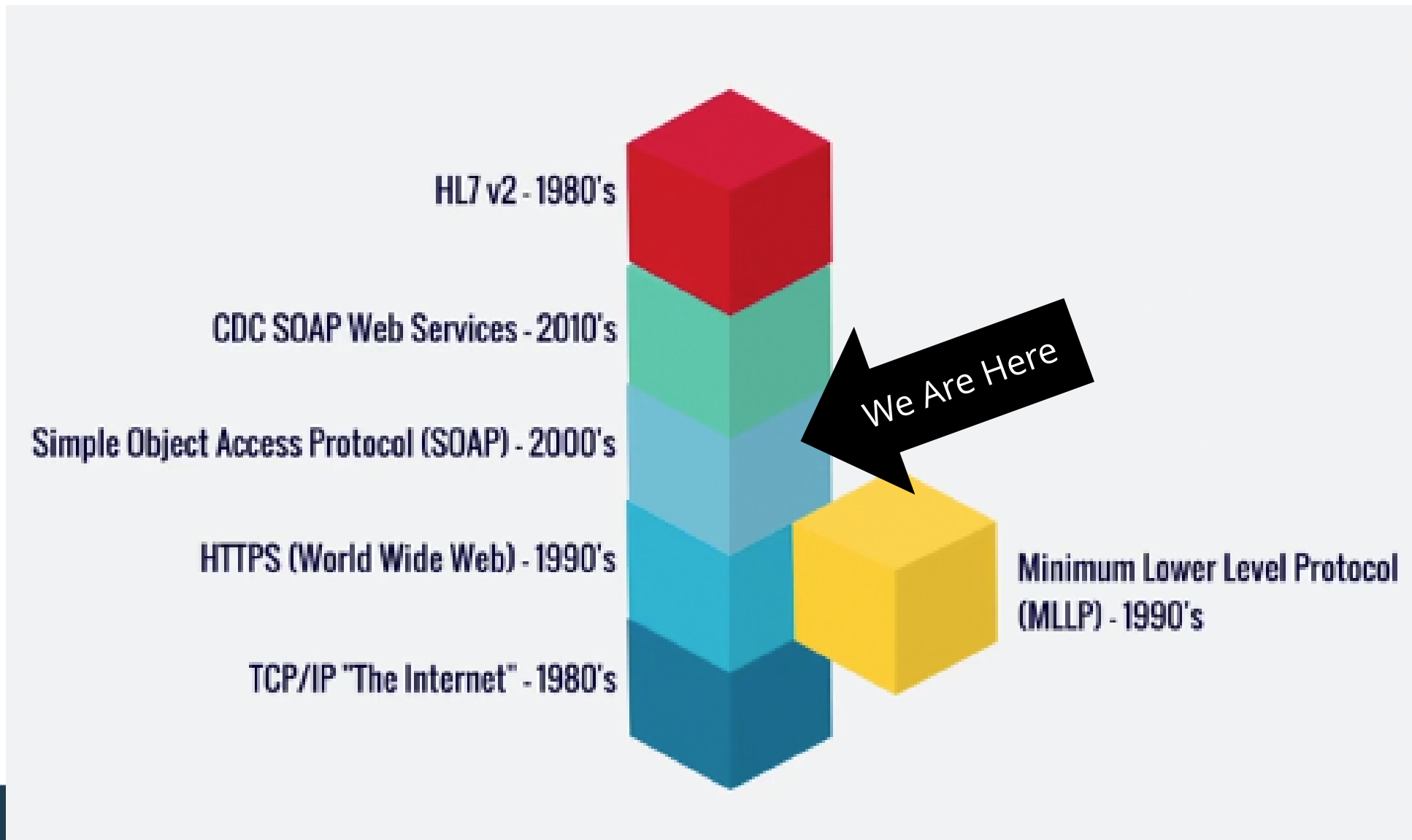


CDC WSDL

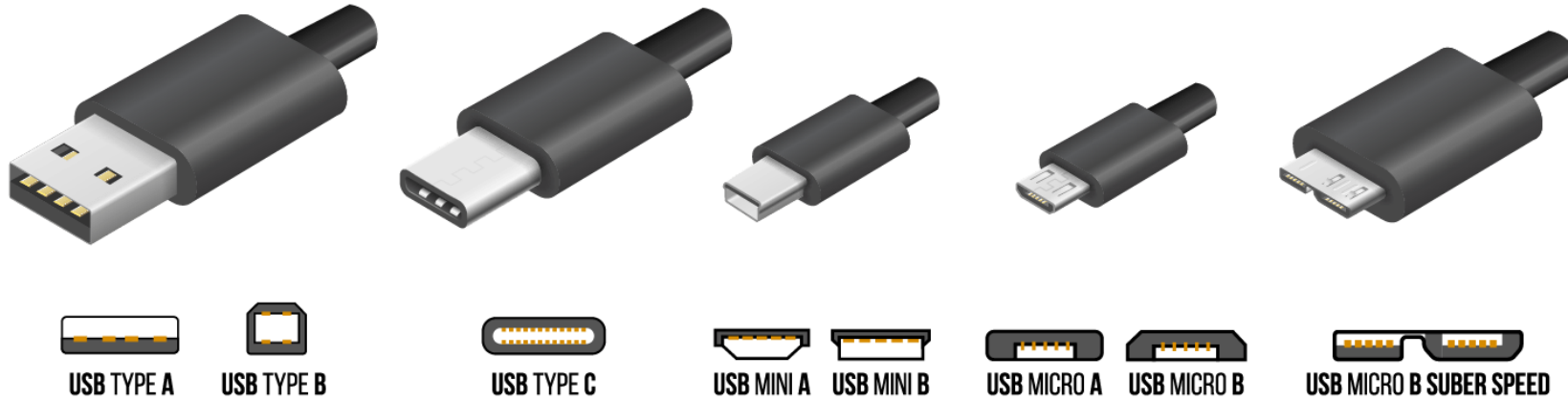
- Learn about:
 - Transport technology chosen by IIS community.
 - What a WSDL is.
 - What operations the CDC defined WSDL supports.



Where are we?



Have you ever had USB confusion?



PC Perspective <https://pcper.com/2019/02/the-state-of-usb-renaming-usb-3-x-is-a-confusing-mess-for-consumers/>



In 2010 IIS community had transport confusion.

PHIN MS

Direct Project

MLLP

SFTP

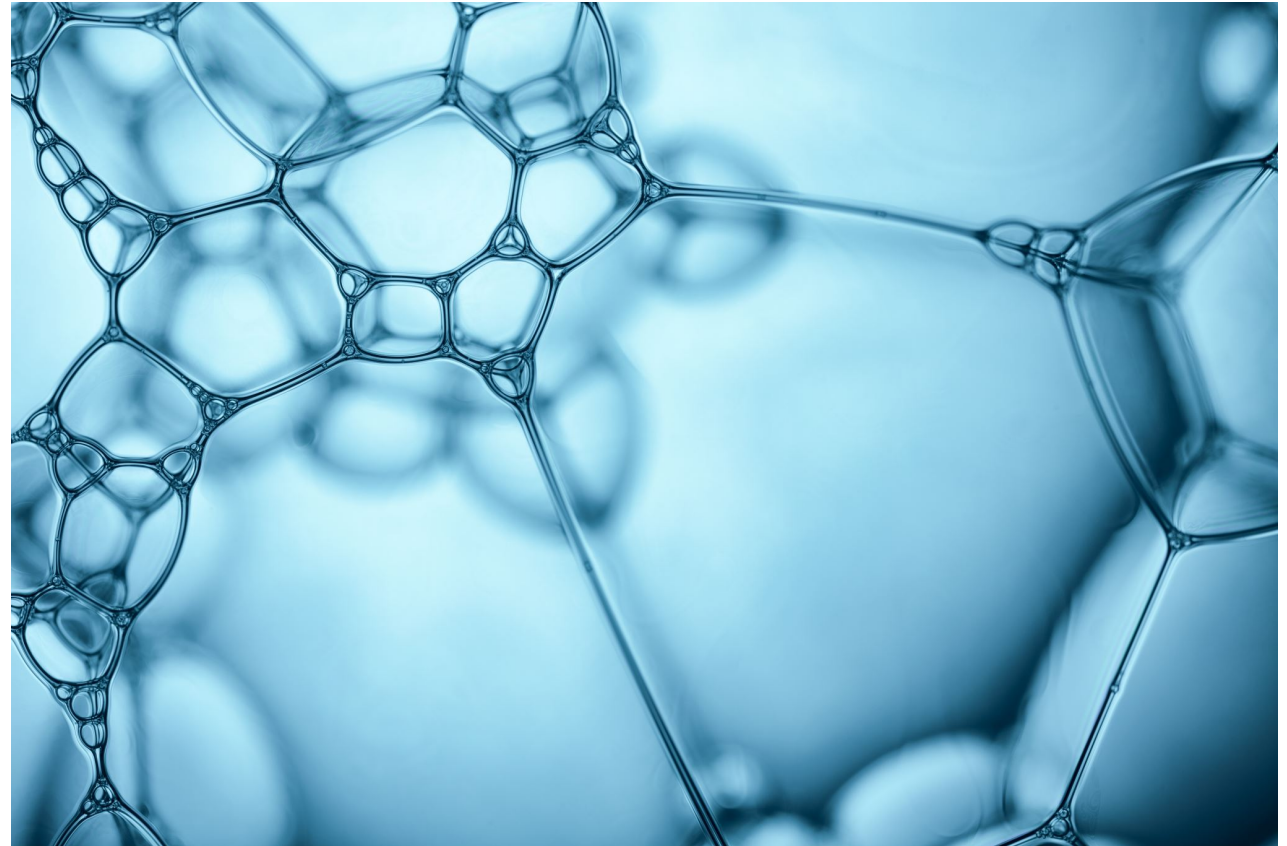
SOAP

HTTPS POST



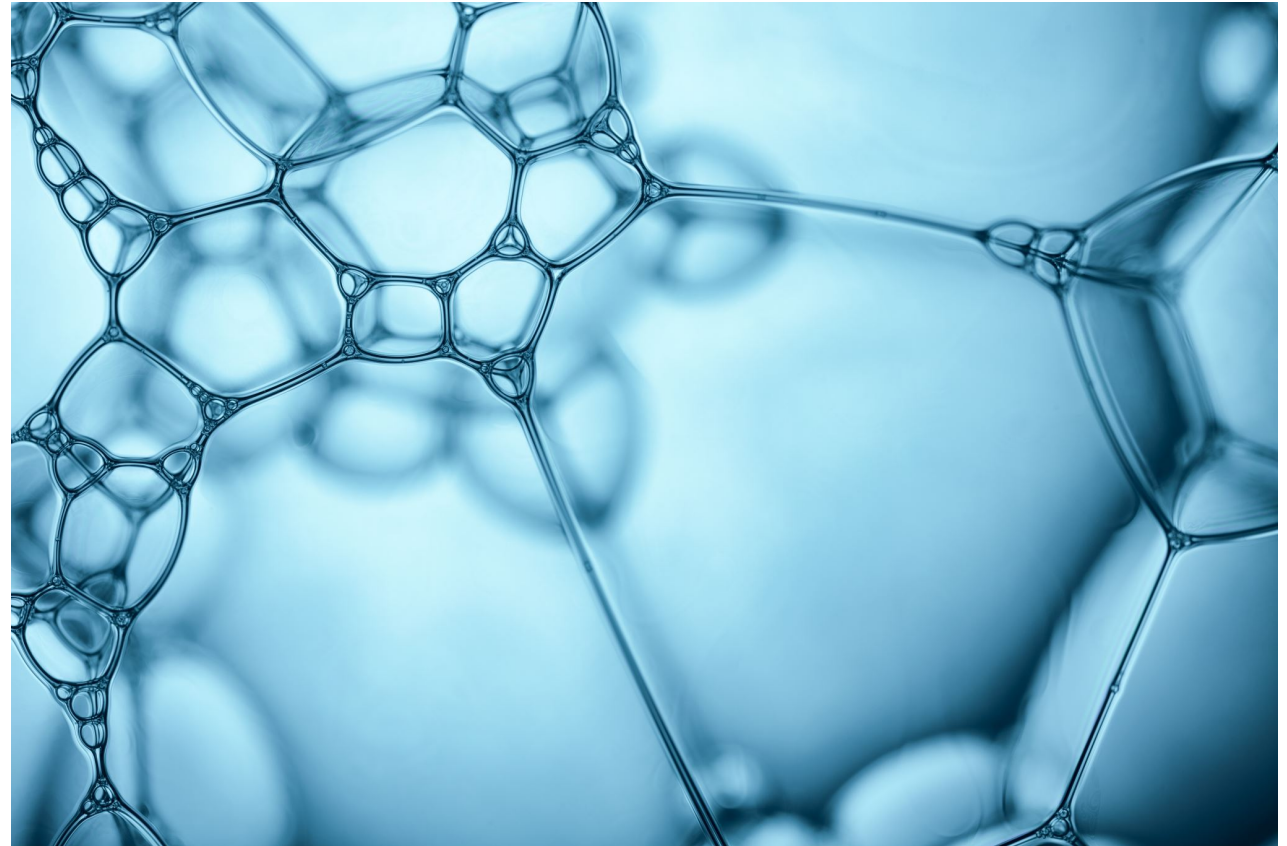
IIS Selected SOAP

- Simple Object Access Protocol
 - Messaging protocol for web services
 - Popular in the 2000s
 - Synchronous protocol
 - Based on XML



IIS Selected SOAP

- Group defined two operations
 - Connectivity Test
 - Submit Single Message



WSDL

- Web Services Description Language
 - XML description of operations
 - Machine readable
 - Can speed up implementation
- CDC WSDL
 - Common term for IIS standard



AIRA Video: SOAP WSDL 101





Connectivity Test

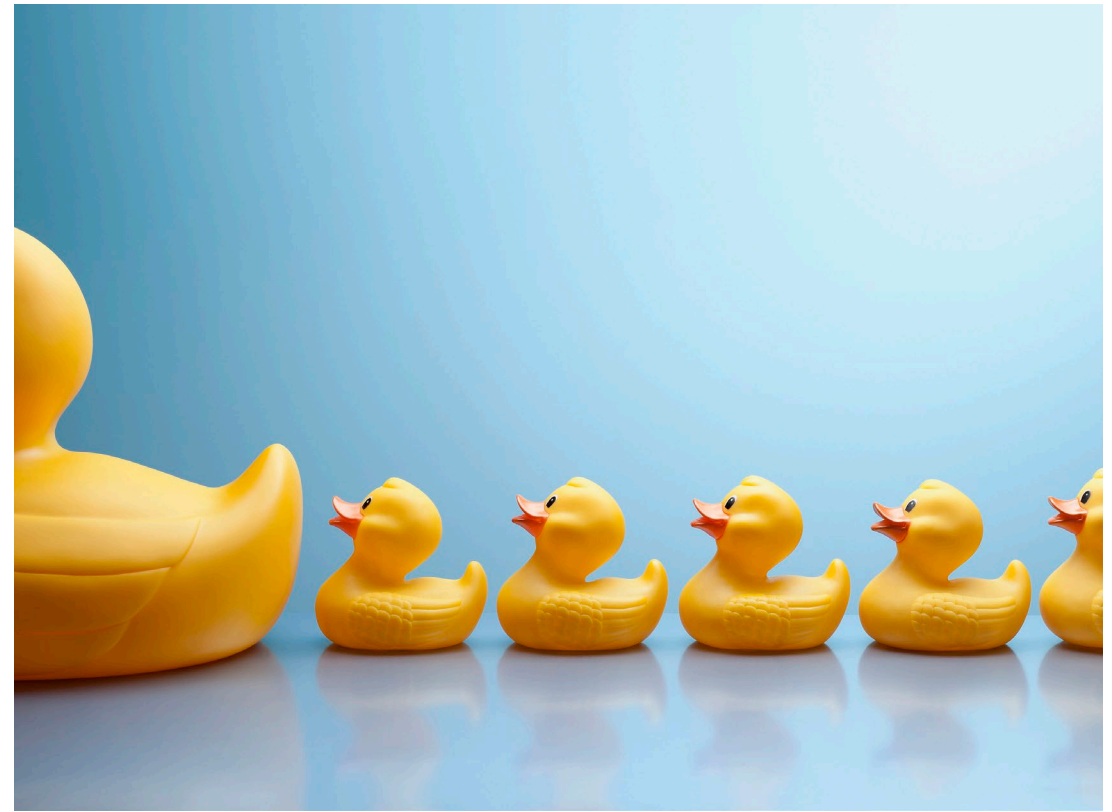
- Verify that IIS end point is visible and ready





Submit Single Message

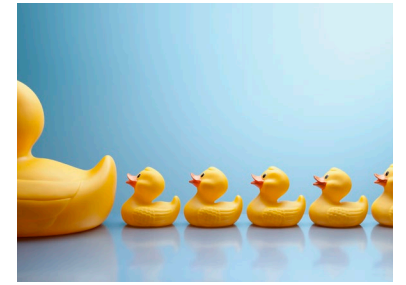
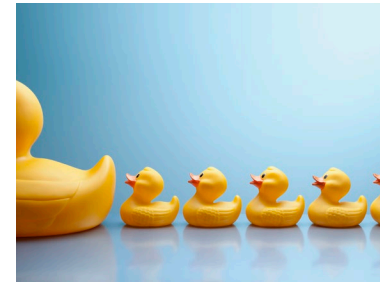
- One message at a time
- Supports update or query messages





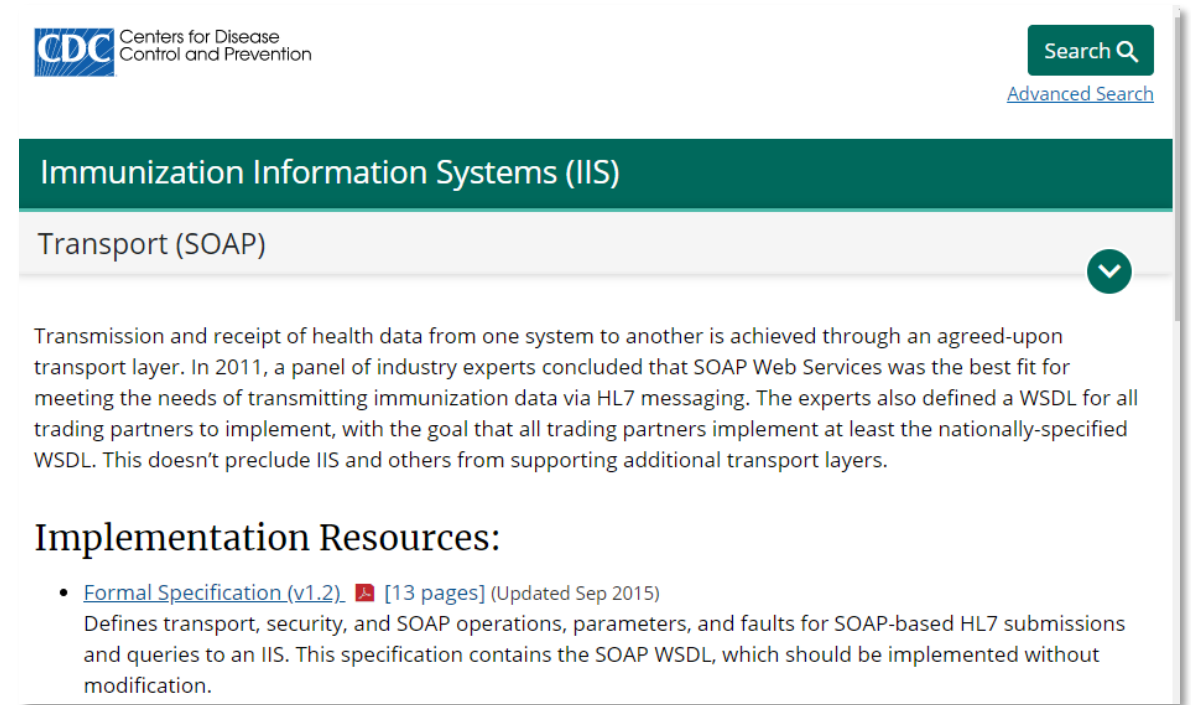
Submit Single Message

- More efficient than you would think
 - Multi-threading
 - Keep alive connections
 - Less overhead



CDC WSDL

- Documented in PDF
 - May confuse some developers
 - CDC WSDL is embedded



The screenshot shows the CDC website header with the logo and "Centers for Disease Control and Prevention" text. A search bar is in the top right. Below the header is a green banner for "Immunization Information Systems (IIS)". Underneath is a grey bar for "Transport (SOAP)" with a dropdown arrow. The main content area explains that transmission and receipt of health data is achieved through an agreed-upon transport layer, mentioning a 2011 panel of experts who concluded that SOAP Web Services was the best fit for HL7 messaging. It also states that a WSDL was defined for all trading partners to implement, with the goal of at least the nationally-specified WSDL. Below this is a section titled "Implementation Resources:" with a bullet point linking to the "Formal Specification (v1.2)" PDF, which is 13 pages long and updated in September 2015. The description of the PDF states it defines transport, security, and SOAP operations, parameters, and faults for SOAP-based HL7 submissions and queries to an IIS, and that it contains the SOAP WSDL to be implemented without modification.

CDC Centers for Disease Control and Prevention

Search Q

[Advanced Search](#)

Immunization Information Systems (IIS)

Transport (SOAP)

Transmission and receipt of health data from one system to another is achieved through an agreed-upon transport layer. In 2011, a panel of industry experts concluded that SOAP Web Services was the best fit for meeting the needs of transmitting immunization data via HL7 messaging. The experts also defined a WSDL for all trading partners to implement, with the goal that all trading partners implement at least the nationally-specified WSDL. This doesn't preclude IIS and others from supporting additional transport layers.

Implementation Resources:

- [Formal Specification \(v1.2\)](#) [13 pages] (Updated Sep 2015)
Defines transport, security, and SOAP operations, parameters, and faults for SOAP-based HL7 submissions and queries to an IIS. This specification contains the SOAP WSDL, which should be implemented without modification.

CDC: <https://www.cdc.gov/vaccines/programs/iis/technical-guidance/soap/services.html>



NIST Example

<https://hl7v2-iz-r1.5-testing.nist.gov/iztool/#/soapEnv>

SOAP Envelope

```
1 <Envelope xmlns="http://www.w3.org/2003/05/soap-envelope">
2   <Header />
3   <Body>
4     <submitSingleMessage xmlns="urn:cdc:iisb:2011">
5       <username>leonidas</username>
6       <password>Spartans300!</password>
7       <facilityID>EHR1234</facilityID>
8       <hl7Message>MSH|^~\&|Test EHR Application|X68||NIST Tes
9     </submitSingleMessage>
10  </Body>
11 </Envelope>
```



CDC WSDL

- Learn about:
 - Transport technology chosen by IIS community.
 - What a WSDL is.
 - What operations the CDC defined WSDL supports.

