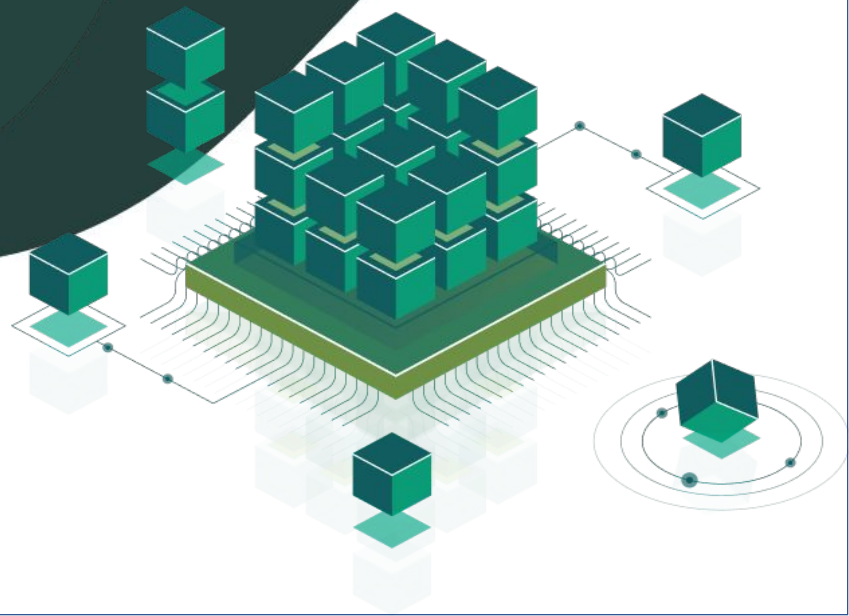
Протоколи передачі даних

(Communication protocols)



Speaker:

Ivan Galas

SDE at Magnise

What is a protocol?

Protocol (diplomacy)

A rule which describes how an activity should be performed

(the proper and generally accepted behavior)

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Protocol (science)

A predefined procedural method in the design and implementation of an experiment.

- equipment used
- procedures
- safety
- calculations and statistics
- reporting

Protocol as record of a sequence

Протокол засідання (кафедри, педради, сільради, комісії, комітету...)

Protocol as record of an action

Протокол про правопорушення (порушення правил - митних, тб, експлуатації...)

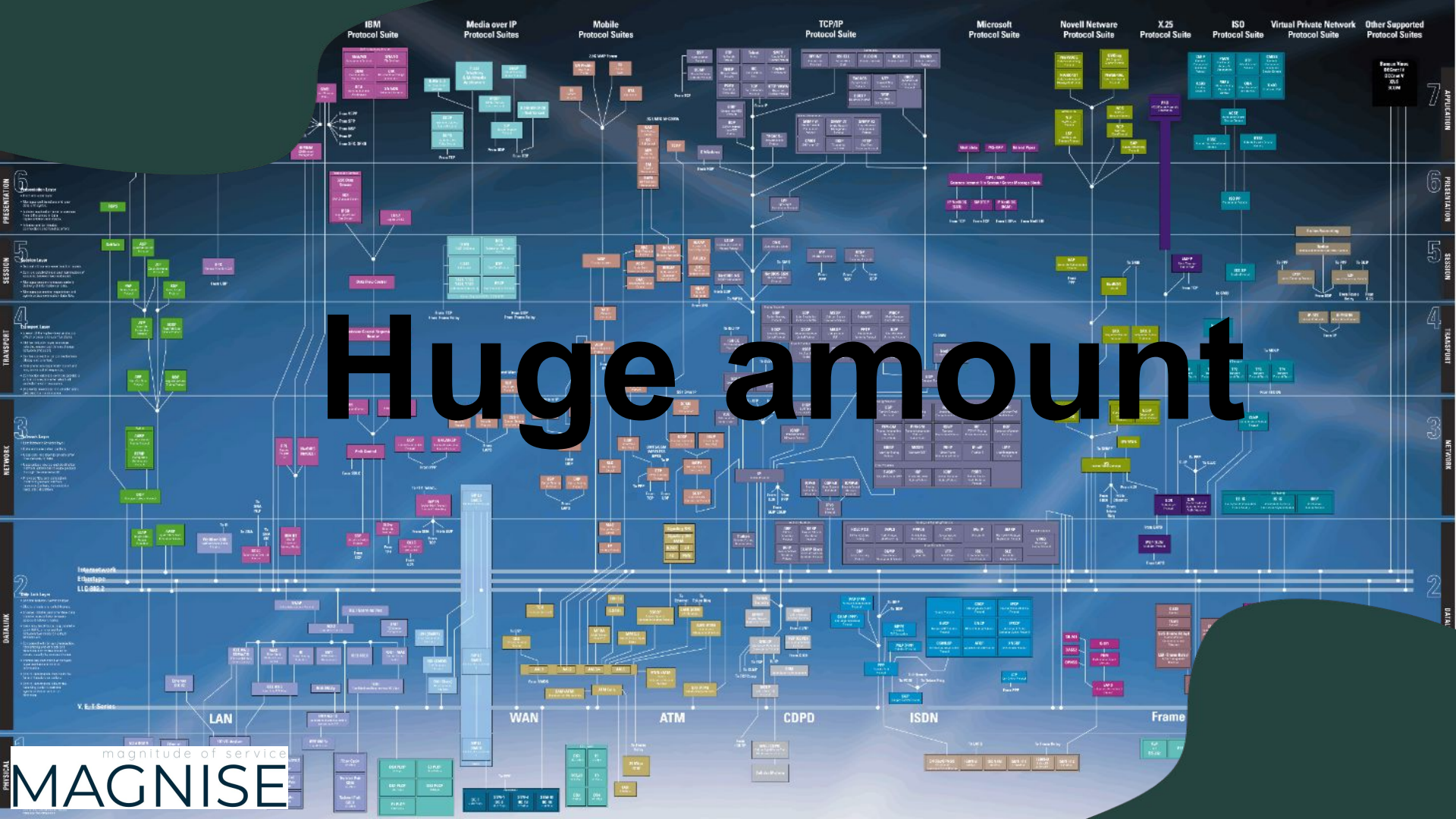
Protocol
(General meaning)

- a set of rules
- a plan for ...

Communication protocol

A **protocol** is a standard set of rules and guidelines that allow electronic devices to communicate with each other.

Rules are defined for each step and process during communication between two or more devices.



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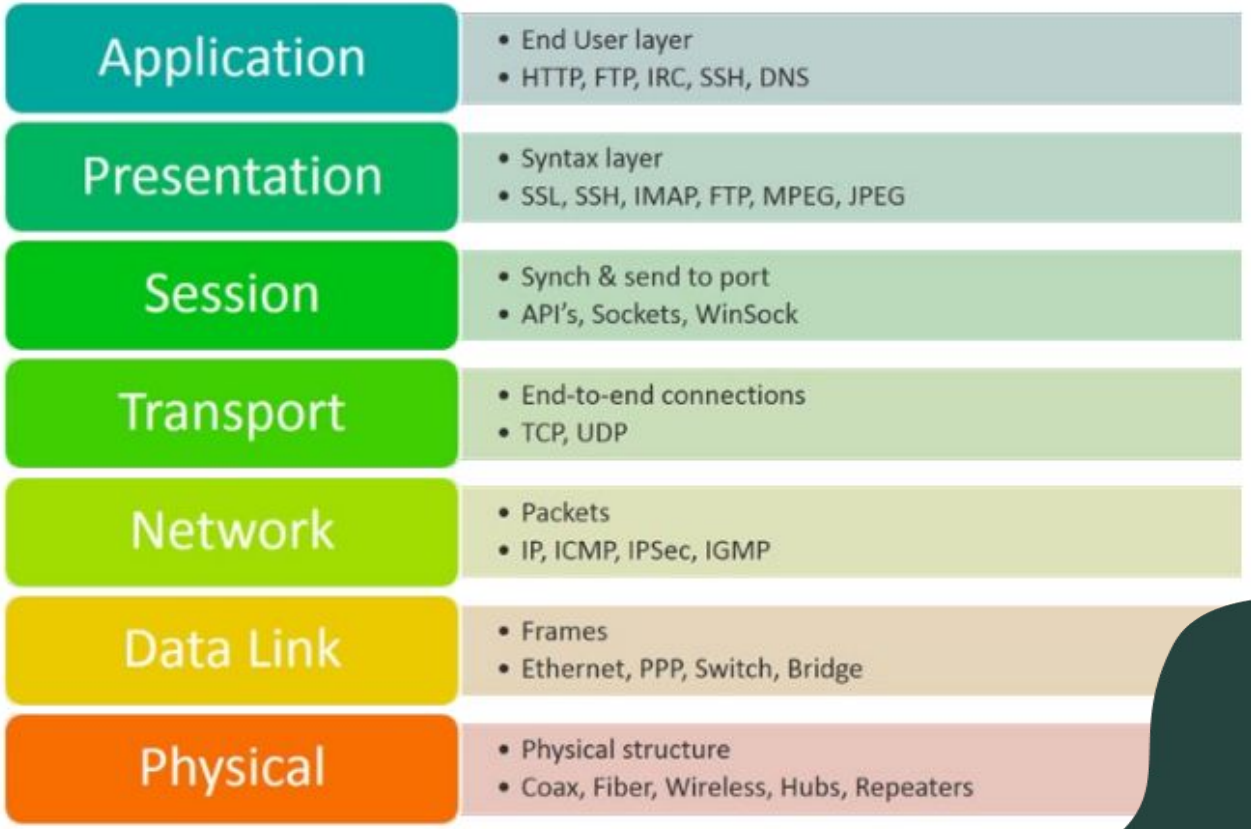
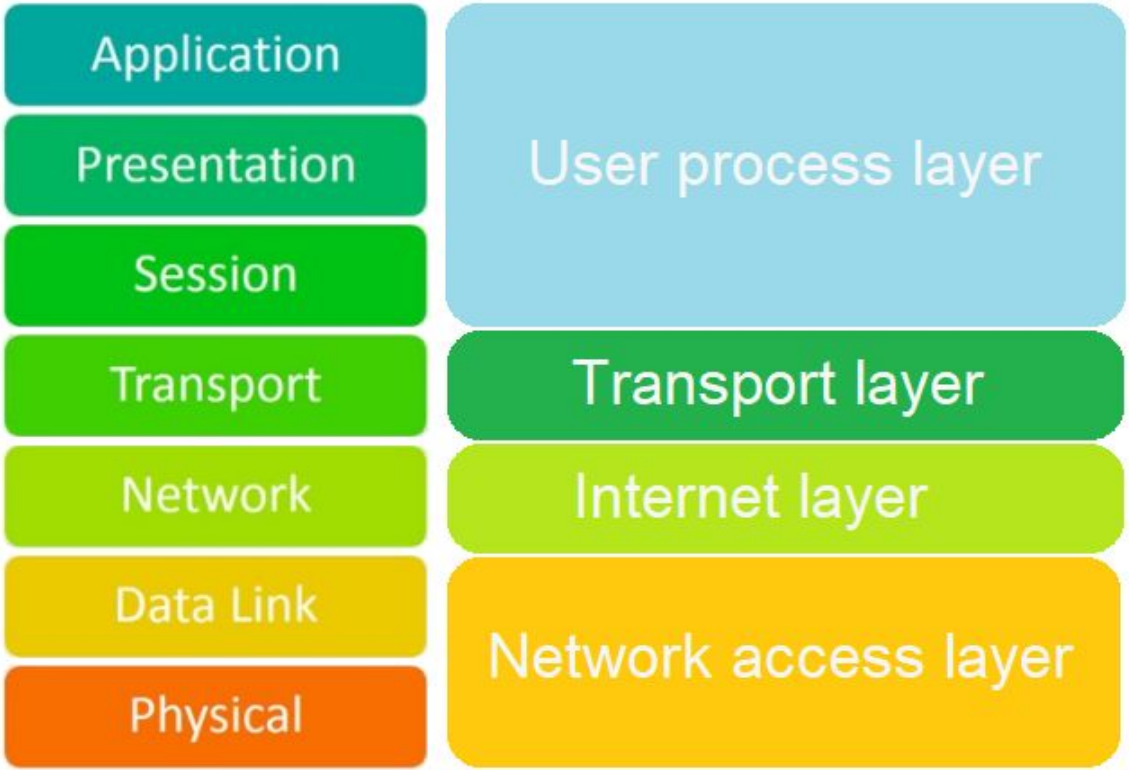
7 Layers of the OSI Model

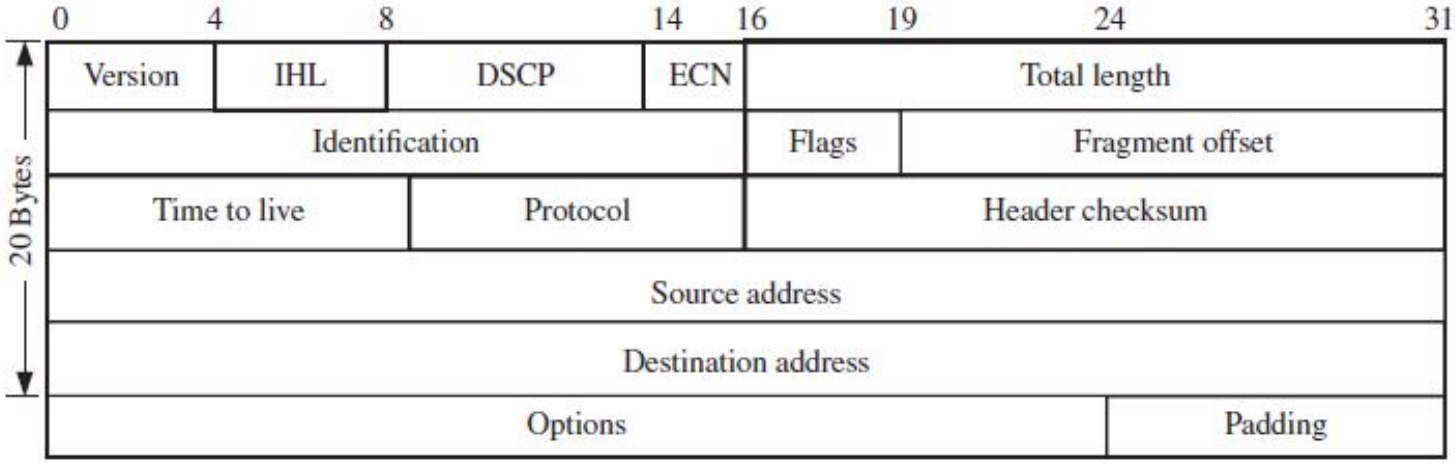


4 Layers of the Internet



IP version 4 (IPv4)

Header structure



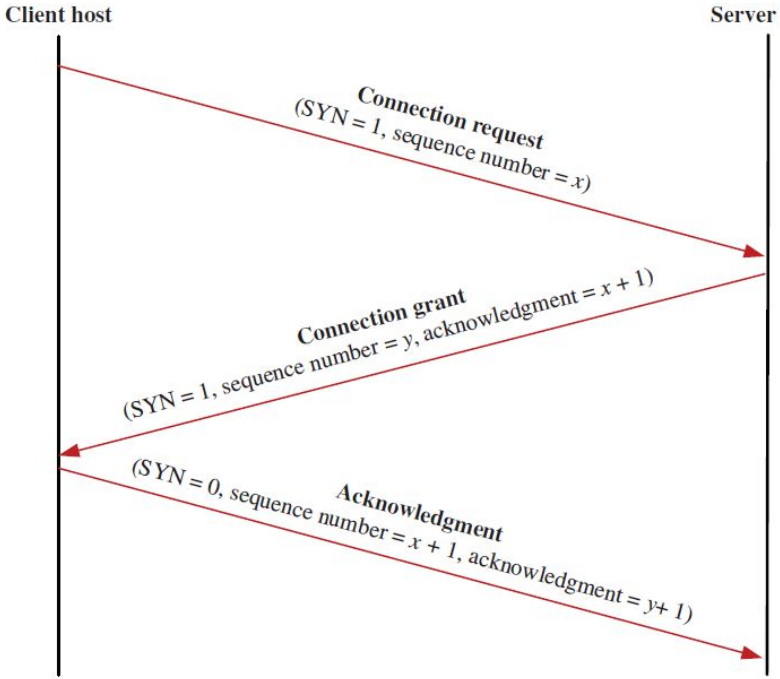
TCP

Header structure

<table>
<tr><th colspan="8">0</th><th colspan="8">1</th><th colspan="8">2</th><th colspan="8">3</th></tr>
<tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td>17</td><td>18</td><td>19</td><td>20</td><td>21</td><td>22</td><td>23</td><td>24</td><td>25</td><td>26</td><td>27</td><td>28</td><td>29</td><td>30</td><td>31</td></tr>
<tr><td colspan="16">Source port</td><td colspan="16">Destination port</td></tr>
<tr><td colspan="32">Sequence number</td></tr>
<tr><td colspan="32">Acknowledgment number (if ACK is set)</td></tr>
<tr><td colspan="4">Data offset</td><td colspan="4">Reserved</td><td>NS</td><td>CWR</td><td>ECE</td><td>URG</td><td>ACK</td><td>PSH</td><td>RST</td><td>SYN</td><td>FIN</td><td colspan="16">Window size</td></tr>
<tr><td colspan="16">Checksum</td><td colspan="16">Urgent pointer (if URG is set)</td></tr>
<tr><td colspan="32">Options (if Data offset > 5; padded at the end with “0” bytes if necessary)</td></tr>
</table>

TCP

Three way handshake



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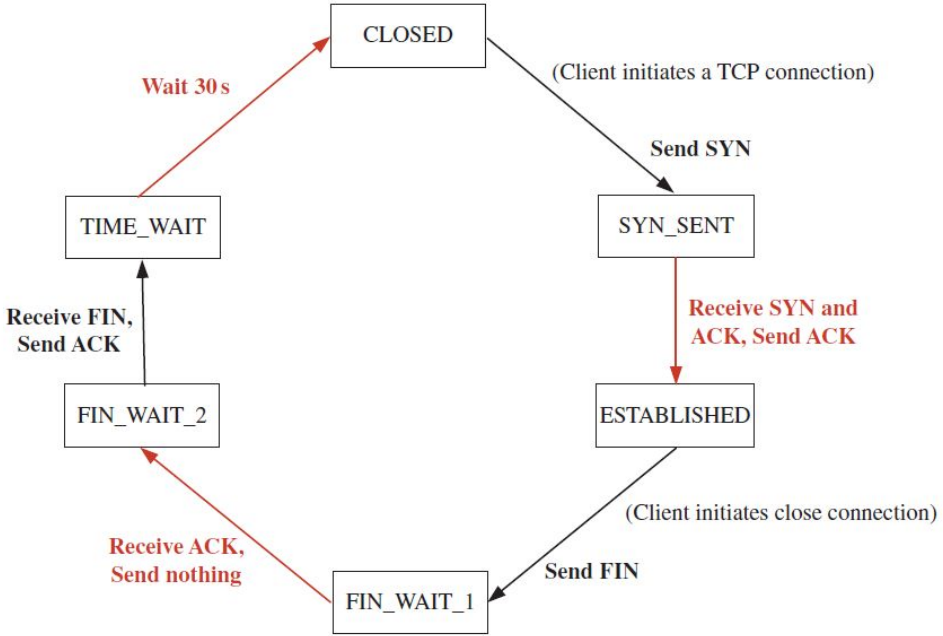
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Source port																Destination port															
Sequence number																															
Acknowledgment number (if ACK is set)																															
Data offset			Reserved				NS	CWR	ECE	URG	ACK	PSH	RST	SYN	FIN	Window size															
Checksum																Urgent pointer (if URG is set)															
Options (if Data offset > 5; padded at the end with "0" bytes if necessary)																															

TCP

Client side state diagram



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Source port																Destination port															
Sequence number																															
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Data offset			Reserved				NS	CWR	ECE	URG	ACK	PSH	RST	SYN	FIN	Window size															
Checksum																Urgent pointer (if URG is set)															
Options (if Data offset > 5; padded at the end with "0" bytes if necessary)																															

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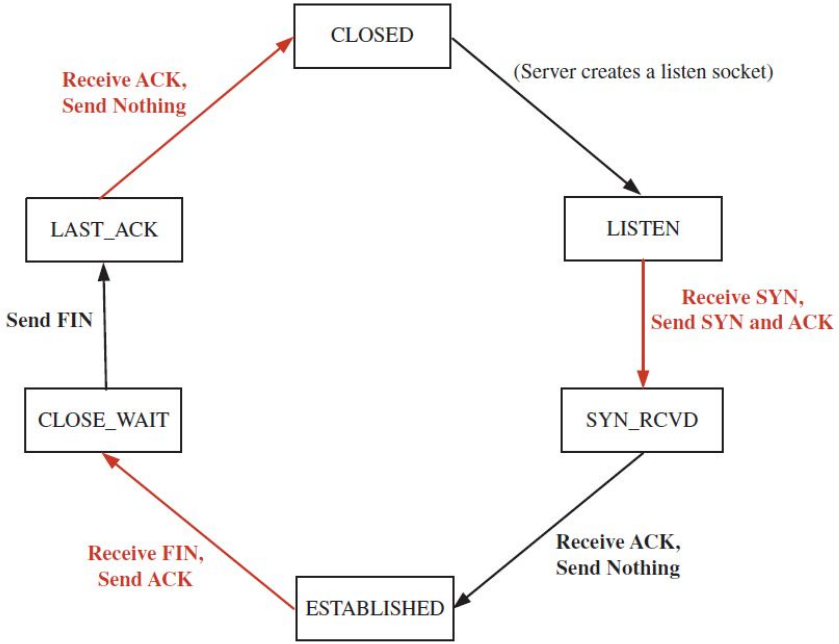
TCP

Server side state diagram



0								1								2								3							
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Source port																Destination port															
Sequence number																															
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Data offset			Reserved				NS	CWR	ECE	URG	ACK	PSH	RST	SYN	FIN	Window size															
Checksum																Urgent pointer (if URG is set)															
Options (if Data offset > 5; padded at the end with "0" bytes if necessary)																															

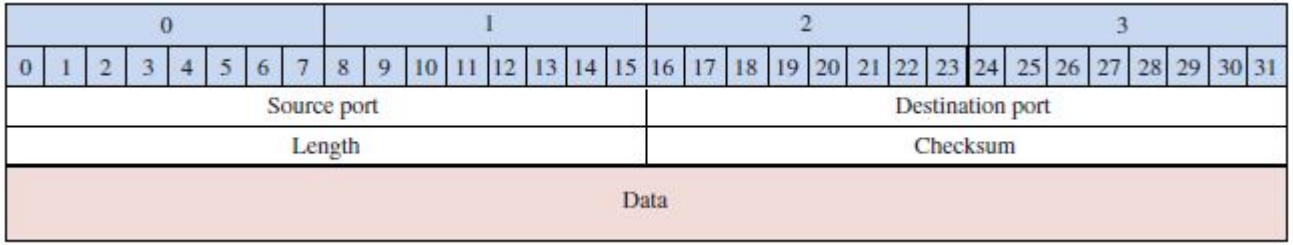
TCP

Examples of system ports

Port	Protocol	Use
21	FTP	File transfer
23	Telnet	Remote login
25	SMTP	E-mail
69	TFTP	Unreliable file transfer
79	Finger	Look up information about a user
80	HTTP	World Wide Web
110	POP-3	Remote e-mail access

UDP

Header structure



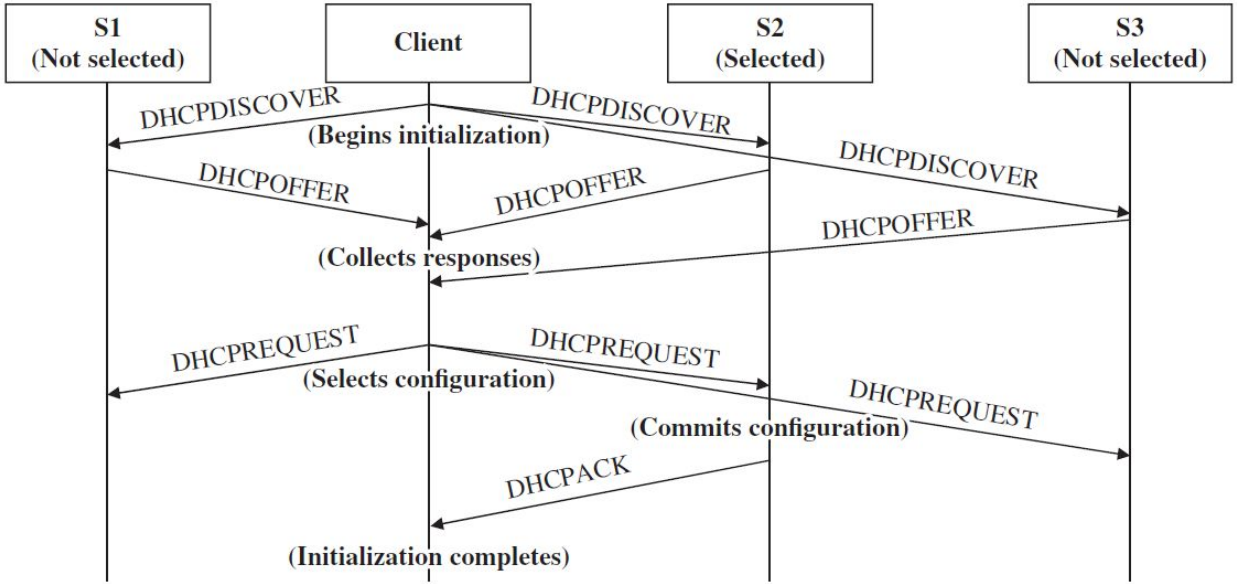
New transport protocols

Comparison table

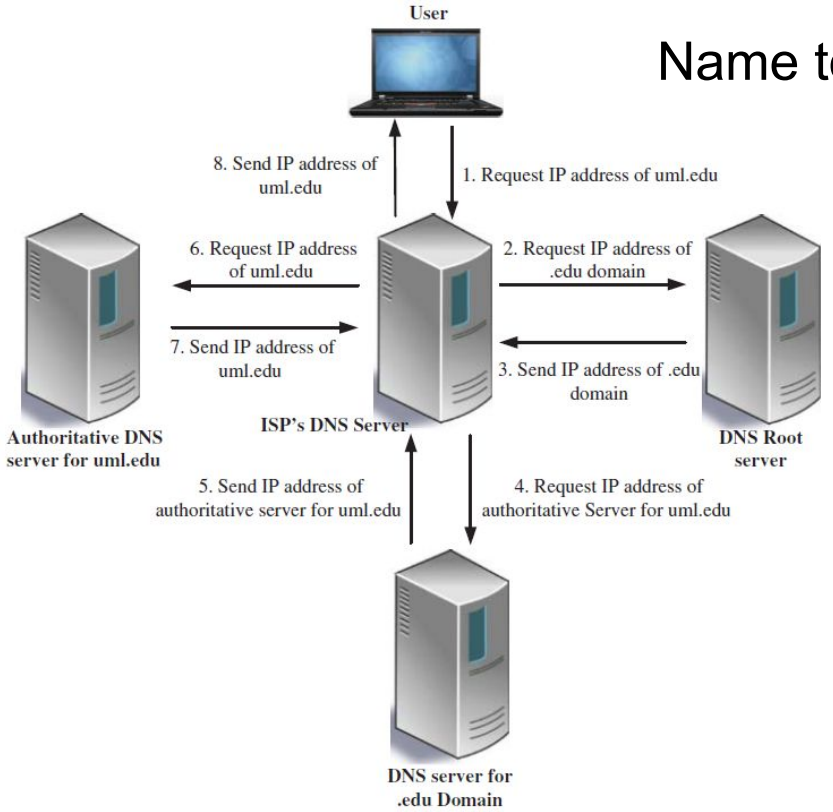
Services/features	TCP	UDP	SCTP	DCCP
Connection-oriented	Yes	No	Yes	Yes
Ordered data delivery	Yes	No	Yes	No
Unordered data delivery	No	Yes	Yes	Yes
Reliable data transfer	Yes	No	Yes	No
Congestion control	Yes	No	Yes	Yes
Flow control	Yes	No	Yes	Optional
Byte-oriented	Yes	No	Yes	No
Message-oriented	No	Yes	Yes	Yes
Multistreaming	No	No	Yes	No
Uses selective acknowledgments	Optional	No	Yes	Yes
Multihoming	No	No	Yes	No
Protection against SYN flood attack	No	No	Yes	No
Allows half-closed connections	Yes	No	No	No

DHCP

DHCP DORA process (Discovery, Offer, Request, Acknowledgment)

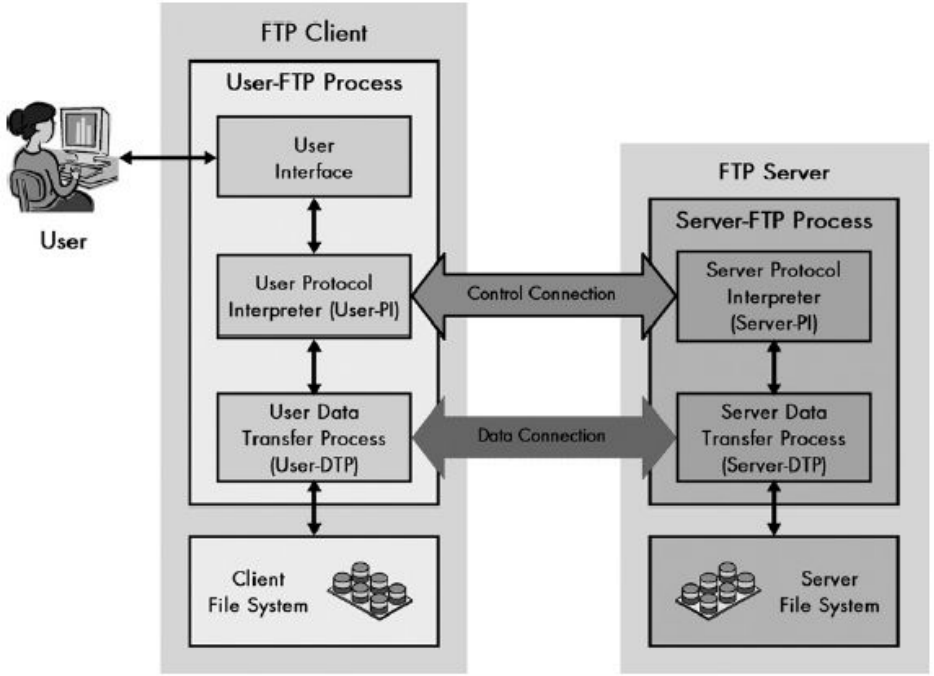


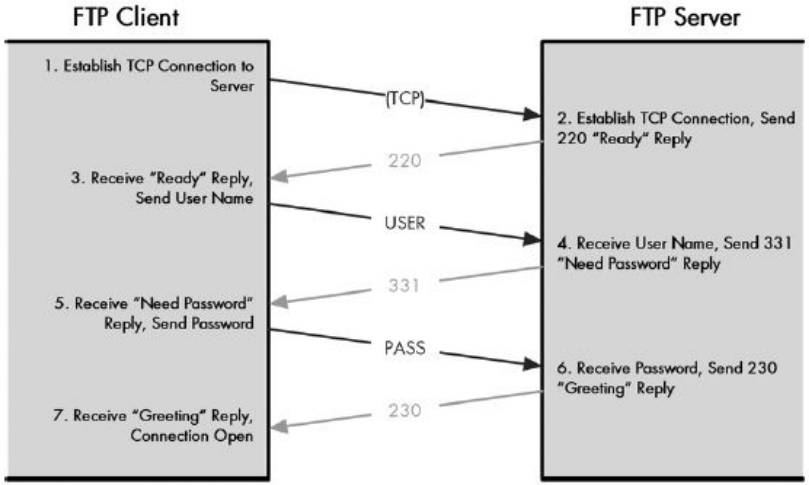
DNS



Name to ip resolution process

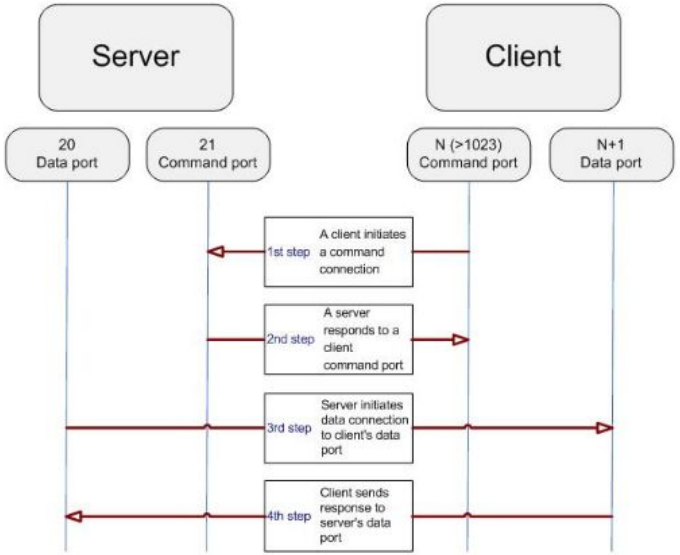
FTP



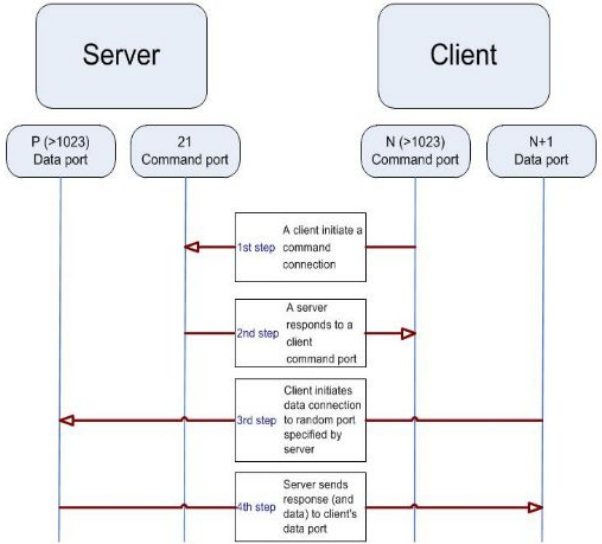


FTP

Active FTP Mode



Passive FTP Mode



HTTP

Request

<method> <path> <protocol version>
<headers>

<body>

Response

<protocol version><status code>
<headers>

<body>

HTTP

Methods

HTTP Method	RFC	Request Has Body	Response Has Body	Safe	Idempotent	Cacheable
GET	RFC 7231	Optional	Yes	Yes	Yes	Yes
HEAD	RFC 7231	No	No	Yes	Yes	Yes
POST	RFC 7231	Yes	Yes	No	No	Yes
PUT	RFC 7231	Yes	Yes	No	Yes	No
DELETE	RFC 7231	No	Yes	No	Yes	No
CONNECT	RFC 7231	Yes	Yes	No	No	No
OPTIONS	RFC 7231	Optional	Yes	Yes	Yes	No
TRACE	RFC 7231	No	Yes	Yes	Yes	No
PATCH	RFC 5789	Yes	Yes	No	No	No

HTTP

Status Codes

1xx Informational

100 Continue
101 Switching Protocols
102 Processing (WebDAV)

2xx Success

★ 200 OK
★ 201 Created
202 Accepted
203 Non-Authoritative Information
★ 204 No Content
205 Reset Content
206 Partial Content
207 Multi-Status (WebDAV)
208 Already Reported (WebDAV)
226 IM Used

3xx Redirection

300 Multiple Choices
301 Moved Permanently
302 Found
303 See Other
★ 304 Not Modified
305 Use Proxy
306 (Unused)
307 Temporary Redirect
308 Permanent Redirect (experimental)

4xx Client Error

★ 400 Bad Request
★ 401 Unauthorized
402 Payment Required
★ 403 Forbidden
★ 404 Not Found
405 Method Not Allowed
406 Not Acceptable
407 Proxy Authentication Required
408 Request Timeout
★ 409 Conflict
410 Gone
411 Length Required
412 Precondition Failed
413 Request Entity Too Large
414 Request-URI Too Long
415 Unsupported Media Type
416 Requested Range Not Satisfiable
417 Expectation Failed
418 I'm a teapot (RFC 2324)
420 Enhance Your Calm (Twitter)
422 Unprocessable Entity (WebDAV)
423 Locked (WebDAV)
424 Failed Dependency (WebDAV)
425 Reserved for WebDAV
426 Upgrade Required
428 Precondition Required
429 Too Many Requests
431 Request Header Fields Too Large
444 No Response (Nginx)
449 Retry With (Microsoft)
450 Blocked by Windows Parental Controls (Microsoft)
451 Unavailable For Legal Reasons
499 Client Closed Request (Nginx)

5xx Server Error

★ 500 Internal Server Error
501 Not Implemented
502 Bad Gateway
503 Service Unavailable
504 Gateway Timeout
505 HTTP Version Not Supported
506 Variant Also Negotiates (Experimental)
507 Insufficient Storage (WebDAV)
508 Loop Detected (WebDAV)
509 Bandwidth Limit Exceeded (Apache)
510 Not Extended
511 Network Authentication Required
598 Network read timeout error
599 Network connect timeout error

Demo