

Computer Science E-I

Lecture 4: Internet

Exam I

Review Session

Feedback Form

Net Neutrality

Protocols

DHCP (again)

DHCP

- client: DHCPBROADCAST

DHCP

- client: **DHCPBROADCAST**
- server: **DHCPOFFER**

DHCP

- client: DHCPBROADCAST
- server: DHCPOFFER
- client: DHCPREQUEST

DHCP

- client: DHCPBROADCAST
- server: DHCPOFFER
- client: DHCPREQUEST
- server: DHCPACK

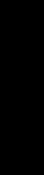
HTTP

Clients v. Servers

<http://example.com>

GET /home.php HTTP/1.1
Host: www.facebook.com

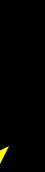
Verb



GET /home.php HTTP/1.1

Host: www.facebook.com

Path



GET /home.php HTTP/1.1

Host: www.facebook.com

Version



GET /home.php HTTP/1.1

Host: www.facebook.com

GET /home.php HTTP/1.1

Host: www.facebook.com



Header

Telnet

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server:Apache/2.2.22 (Fedora)

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server:Apache/2.2.22 (Fedora)

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

HTTP/1.1 404 Not Found

<https://github.com/404>

<http://seatgeek.com/404>

<http://bluefountainmedia.com/404>

200

OK

301

Moved Permanently

302

Found

400

Bad Request

401

Unauthorized

403

Forbidden

404

Not Found

500

Internal Server Error

1	Informational
2	Success
3	Redirection
4	Client Error
5	Server Error

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server:Apache/2.2.22 (Fedora)

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server: Microsoft-IIS/7.5

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server:Apache/2.2.22 (Fedora)

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server:Apache/2.2.22 (Fedora)

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

HTML

<h1>CSCI E-1</h1>

Start Tag
↓
<h1>CSCI E-1</h1>

End Tag

<h1>CSCI E-1</h1>

Value



<h>CSCI E- </h>

HTTP/1.1 200 OK

Date:Wed, 30 Jan 2013 21:43:11 GMT

Server:Apache/2.2.22 (Fedora)

Content-Length: 2422

Content-Type: text/html; charset=UTF-8

Connection: close

GET /search?q=cats HTTP/1.1
Host: www.google.com

POST /login HTTP/1.1

Host: www.example.com

Content-Type: application/x-www-form-urlencoded

Content-Length: 35

username=tommy&password=supersecret

POST /login HTTP/1.1

Host: www.example.com

Content-Type: application/x-www-form-urlencoded

Content-Length: 35

username=tommy&password=supersecret

POST /login HTTP/1.1

Host: www.example.com

Content-Type: application/x-www-form-urlencoded

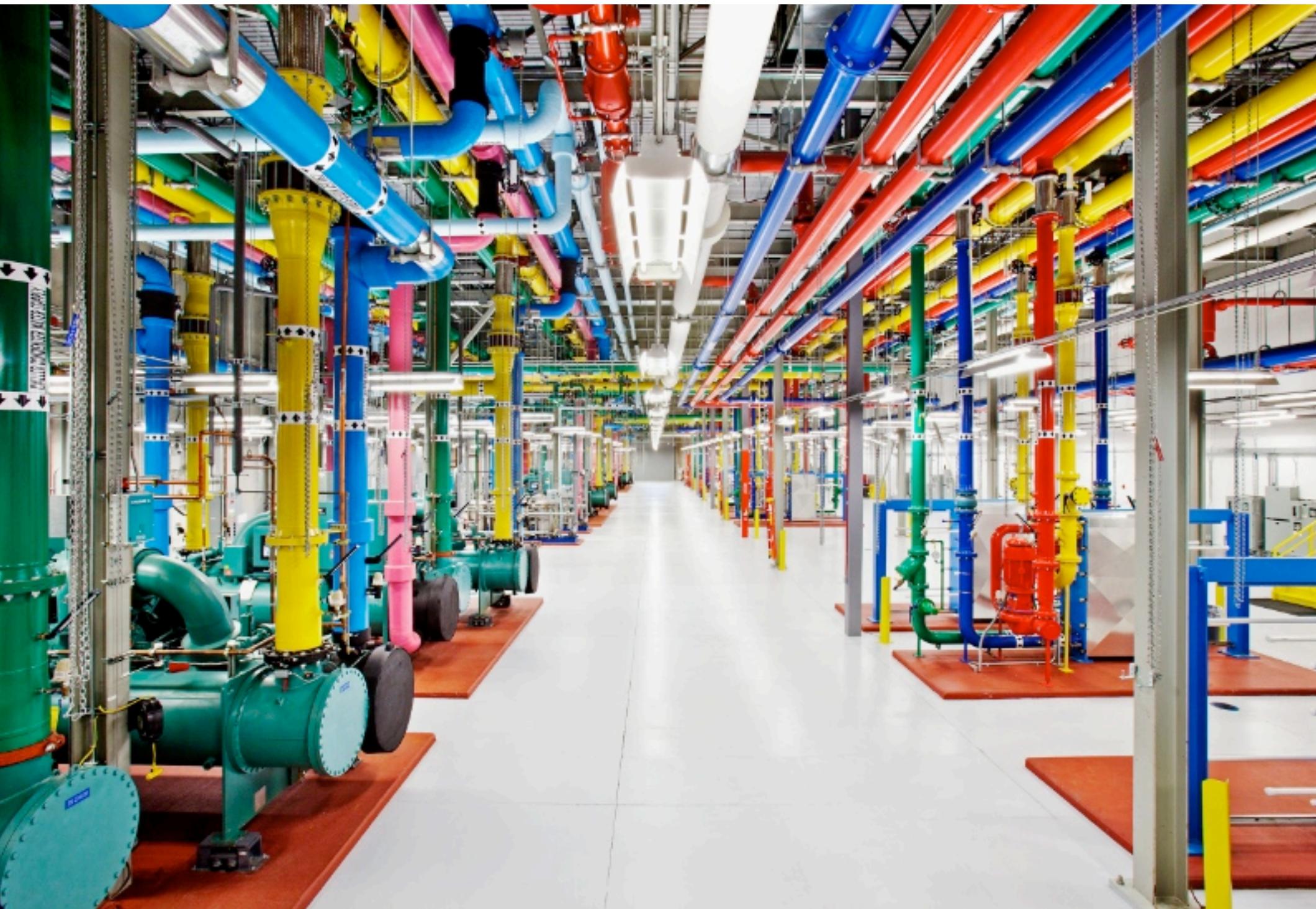
Content-Length: 35

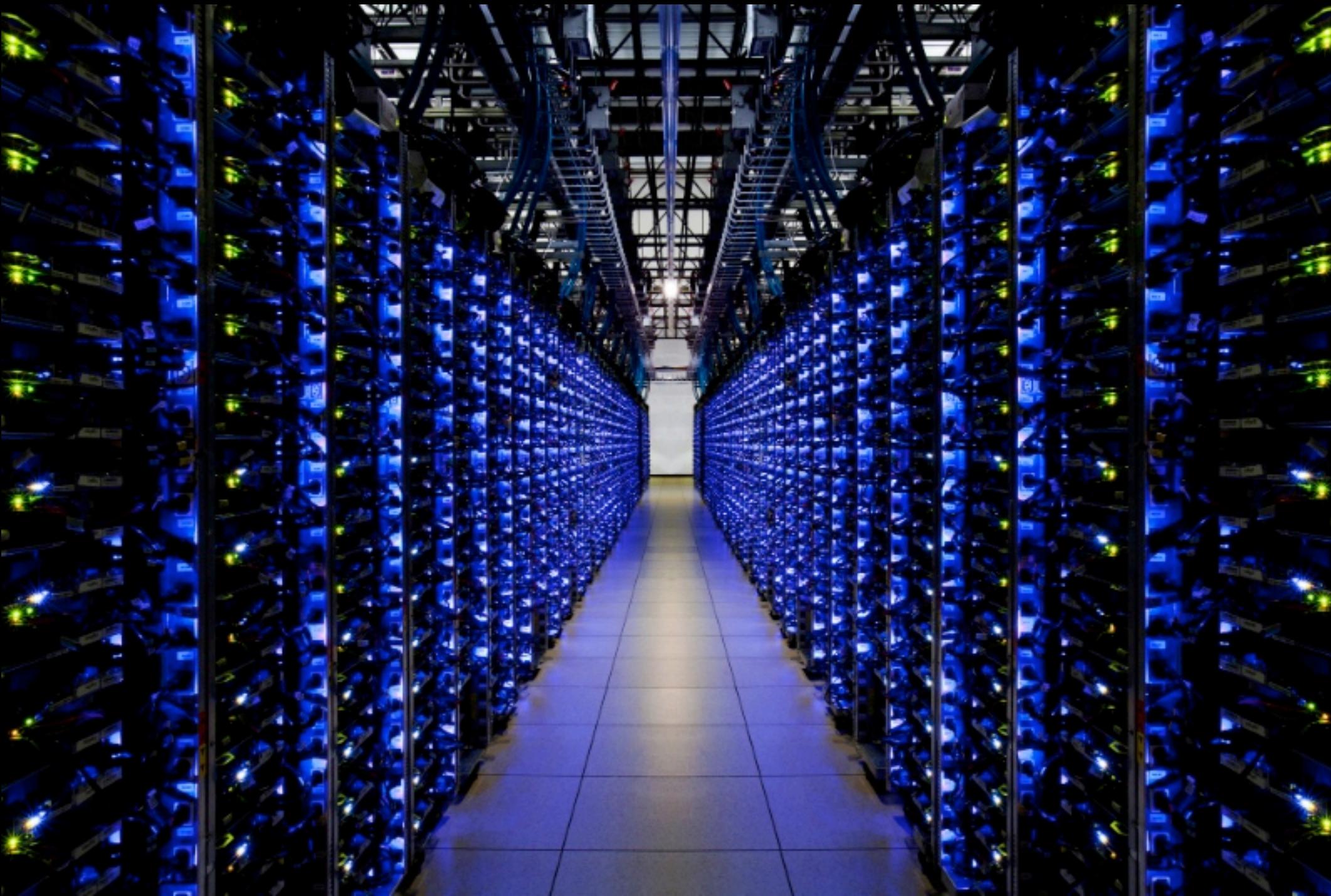
username=tommy&password=supersecret

Screenshot of the Network tab in the Chrome DevTools developer console, showing network requests for a Google search page.

The Network tab displays the following table of network requests:

Name Path	Method	Status Text	Type	Initiator	Size Content	Time Latency	Timeline
www.google.com	GET	200 OK	text/html	Other	0B 104.06KB	97ms 90ms	
k1_a31af7ac.png ssl.gstatic.com/gb/images	GET	304 Not Modified	image/png	www.google.com:78 Parser	180B 11.70KB	39ms 12ms	
blank.html	GET	200 OK	text/html	Other	(from cache)	45ms 45ms	
photo.jpg lh6.googleusercontent.com/-fPIGTPZr-II/AA/	GET	304 Not Modified	image/jpeg	www.google.com:78 Parser	191B 1.01KB	96ms 51ms	
logo3w.png /images/srpr	GET	304 Not Modified	image/png	www.google.com:78 Parser	180B 6.84KB	76ms 42ms	





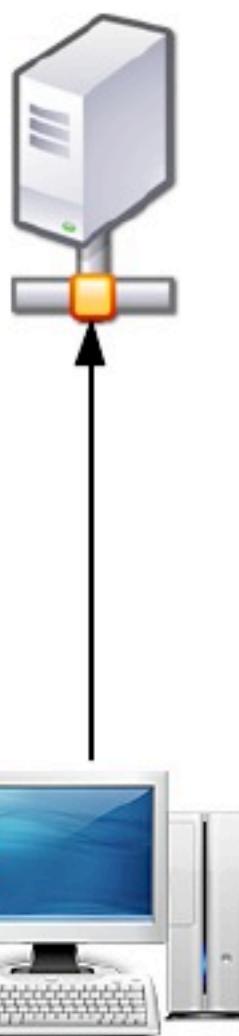
```
<!doctype html><html itemscope="itemscope" itemtype="http://schema.org/WebPage"><head><meta content="Search the world's information, including webpages, images, video, and more. Google has many special features to help you find exactly what you're looking for." name="description"><meta content="noodp" name="robots"><meta itemprop="image" content="/images/google_favicon_128.png"><meta id="mref" name="referrer" content="origin"><title>Google</title><script>(function(){
window.google={kEI:"Hjc0UZ6VC6Pb0wHui4DIAw",getEI:function(a){for(var b;a&&(!a.getAttribute()||(b=a.getAttribute("eid")));)a=a.parentNode;return b||google.kEI},https:function()
{return"https":==window.location.protocol},kEXPI:"31215,38371,39523,3300010,3300112,3300128,3300130,3300136,3300137,3300153,3310078,4000116,4001569,4001948,4001959,02562,4002734,4002855,4003053,4003385,4003386,4003575,4003638,4003917,4003944,4003982,4004065,4004083,4004152,4004180,4004213,4004222,4004256,4004298,4004308,4004355,{e:"31215,38371,39523,3300010,3300112,3300128,3300130,3300136,3300137,3300153,3310078,4000116,4001569,4001948,4001959,4001975,4002562,4002734,4002855,4003053,4003385,4003575,4003638,4003917,4003944,4003982,4004065,4004083,4004152,4004180,4004213,4004222,4004256,4004298,4004308,4004355",ei:"Hjc0UZ6VC6Pb0wHui4DIAw"},authuser:0,ml:{},pageState:"",kHL:"en",time:function(){return(new Date).getTime()},log:function(a,b,c,k){var d=new Image,f=google.lc,e=google.li,g="";d.onerror=d.onabort=function(){delete f[e]};f[e]=d;!c&&-1==b.search("&ei=")&&(g+"&ei="+google.getEI(k));c=c||"/gen_204?atyp=i&ct="+a+"&cad="+b+"&g)+"&zx="+google.time();a=/^http:/i;a.test(c)&&google.https()?(google.ml(Error("GLMM"),!1,{src:c}),f[e]):(d.src=c,google.li=e+1),lc:[],li:0,j:{en:1,l:function(){google.fl=!0},e:function(){google.fl=!0},b:!!location.hash&&!!location.hash.match("[#&((q|fp)=|tbs=simg|tbs=sbi)"),bv:21,cf:"",pm:"p",pl:[],mc:0,sc:0.5,u:"1c81eb08"},Toolbelt:{},y:{},x:function(a,b){google.y[a.id]=[a,b];return!1},load:function(a,b){google.x({id:"l"+a},function(){google.load(a,b)}),try{google.j.push([a,b])}catch(e){}},onpopstate:function(){google.j.psc=1;for(var h="ad api bc is p pa ac pc pah ph sa sifp slp spf spn xx zc zz".split(" "),l=0,m;m=h[l++]);}(function(a){google.j[a]=function(){google.j.pl.push([a,arguments])})(m);window.chrome||(window.chrome={},window.chrome.sv=2.00,window.chrome.searchBox||(window.chrome.searchBox={},window.chrome.searchBox.onSubmit=function(){google.x({id:"psyapi"},function(){var a=encodeURIComponent(window.chrome.searchBox.value);google.nav.search({q:a,sourceid:"chrome-psyapi2"}))});});(function(){var d=!1;google.sn="webhp";google.timers={};google.startTick=function(a,b){google.timers[a]={t:{start:google.time()},bfr:!!b}};google.tick=function(a,b){google.timers[a]||google.startTick(a);google.timers[a].t[b]=h||google.time();google.startTick("load",!0);try{google.pt=window.chrome&&window.chrome.csi&&Math.floor(window.chrome.csi().pageT)}catch(e){}});(function(){'use strict';var b=null,h=this;var p=function(c,m){return function(f){f||(f=window.event);return m.call(c,f)}},s="undefined"!=typeof navigator&&/Macintosh/.test(navigator.userAgent),u="undefined"!=typeof navigator&&!/Opera/.test(navigator.userAgent)&&/WebKit/.test(navigator.userAgent),v="undefined"!=typeof navigator&&!/Opera|WebKit/.test(navigator.userAgent)&&/Gecko/.test(navigator.product)?"keypress":"keydown";var w=function(c){this.k=!c;this.h=[];this.a=[];this.g={};this.d=b;this.c=[]},z="undefined"!=typeof navigator&&/iPhone|iPod/.test(navigator.userAgent),A=/\s*/;\s*/;,B=function(c,m,f){return function(a){var d;a:{d=m;if("click"==d&&(s&&a.metaKey||!s&&a.ctrlKey))d="clickmod";else{var n=a.which||a.keyCode||a.key;g;if(g=a.type==v){g=a.srcElement||a.target;var e=g.tagName.toUpperCase(),l;if(!l||"TEXTAREA"==e){if(e=="INPUT"==e){e.toUpperCase():void 0,e!=!(void 0)==e&&("BUTTON"==e||"CHECKBOX"==e||"IMAGE"==e||"RADIO"==e||"RANGE"==e||"RESET"==e||"SUBMIT"==e);l=e||g.isContentEditable}g!=1&&!(a.ctrlKey||a.shiftKey||a.altKey||a.metaKey)&&(13==n||32==n||u&&3==n)}g&&(d="clickkey")}for(g=n=a.srcElement||a.target;g&&g!=this;g=g.parentNode){e=g;var k=e;l=q=k.__jsaction;if(!q){q={};f&&(k.__jsaction=q);var t=b;"getAttribute"in k&&(t=k.getAttribute("jsaction"));if(k=t)for(var k=k.split(A),t=0,P=k?k.length:0;t<P;t++){var r=k[t];if(r){var y=r.indexOf(":");I=-1!=y,Q=I?r.substr(0,y).replace(/^\s+/,"").replace(/\s+$/, ""):"click",r=I?r.substr(y+1).replace(/^\s+/,"").replace(/\s+$/, ""):r;q[Q]=r}}k=void 0;"clickkey"==l?l="click":"click"==l&&(k=q.click||q.clickonly);l=(k=k||q[1])?{i:1,action:k}:void 0;d={eventType:l,i:event:a,targetElement:n,action:l.action,actionElement:e};break a}d=b}if(d){if(a.stopPropagation)a.stopPropagation():a.cancelBubble=!0,"A"==d.actionElement.tagName&&"click"==m&&(a.preventDefault?a.preventDefault():a.returnValue=!1),c.d)c.d(d);else{var n=d,x;if((g=h.document)&&!g.createEvent&&g.createEventObject)try{x=g.createEventObject(a)}catch(U){x=a}else x=a;n.event=x;c.c.push(d)}},C=function(c,m){return function(a,d){var e=c,d=m,n=1;if(f.addEventListener){if("focus"==a||"blur"==a)n=!0;f.addEventListener(a,d,n)}else f.attachEvent&&("focus"==a?a="focusin":"blur"==a&&(a="focusout"),d=p(f,d),f.attachEvent("on"+a,d));return{i:a,m:d,capture:n}}},D=function(c,m){if(!c.g.hasOwnProperty(m)){var f=B(c,m,c.k),a=C(m,f);c.g[m]=f;c.h.push(a);for(f=0;f<c.a.length;++f){var d=c.a[f];d.c.push(a.call(b,d.a))}"click"==m&&D(c,v)}},w.prototype.m=function(c){return this.F=function(){this.a=E;this.c=[]};var G=new w,E=window.document.documentElement,H;a:{for(var J=0;J<G.a.length;J++){var K=G.a[J].a,L=E;K!=L&&L.parentNode;if(K==L){H=!0;break a}}H!=1}if(!H){z&&(E.style.cursor="pointer");for(var M=new F,N=0;N<G.h.length;++N)M.c.push(G.h[N].call(b,M.a));G.a.push(M)}D(G,"click");D(G,"focus");D(G,"focusin");D(G,"blur");D(G,"focusout");D(G,"change");D(G,"keydown");D(G,"keyup");D(G,"mousedown");D(G,"mouseout");D(G,"mouseover");D(G,"mouseup");D(G,"touchstart");D(G,"touchmove");D(G,"touchend");var O=function(c){G.d=c;G.c&&(0<G.c.length&&c(G.c),G.c=b)},R=["google","jsad"],S=h;!({0:0}in S)&&S.execScript&&S.execScript("var "+R[0]);for(var T;R.length&&(T=R.shift());)!R.length&&void 0==O;S[T]=0:S=S[T]?S[T]:{};}.call(window);google.arwt=function(a){a.href=document.getElementById(a.id.substring(1)).href;return!0};google.arwt2=function(a){a.href=document.getElementById("h"+a.id).href;return!0};</script><style>#gbz{font:13px/27px Arial,sans-serif;height:102px}#gbg{position:absolute;white-space:nowrap;top:0;height:30px;z-index:1000}#gbz{left:0;padding-left:4px}#gbg{right:0;padding-right:5px}#gbs{background:transparent;position: absolute; top:-999px; visibility:hidden; z-index:998} .gbto #gbs{background:#fff}#gbx3,#gbx4{background-color:#2d2d2d;bad
```



Email

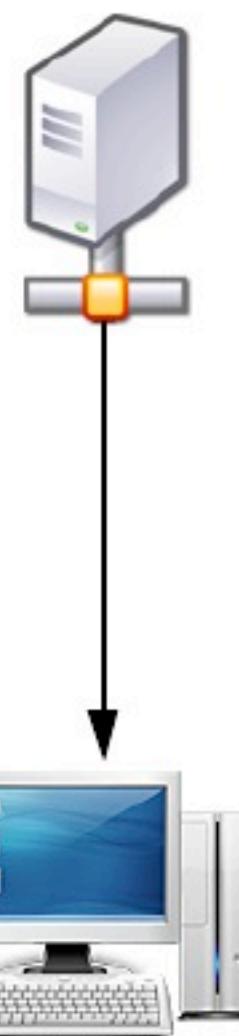
SMTP

SMTP server (sender)



Client (sender)

SMTP server (receiver)



Client (receiver)

Queue



Rockin' Roller Coaster
Starring: AEROSMITH

Hanes

Tommy R.J. Ben

Tommy R.J.

Tommy

Stack

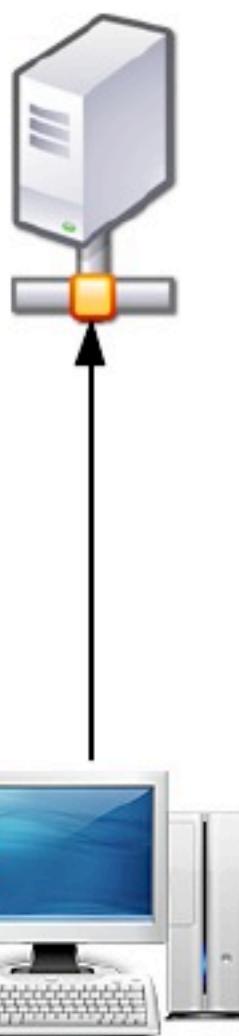
Tommy R.J. Ben

R.J. Ben

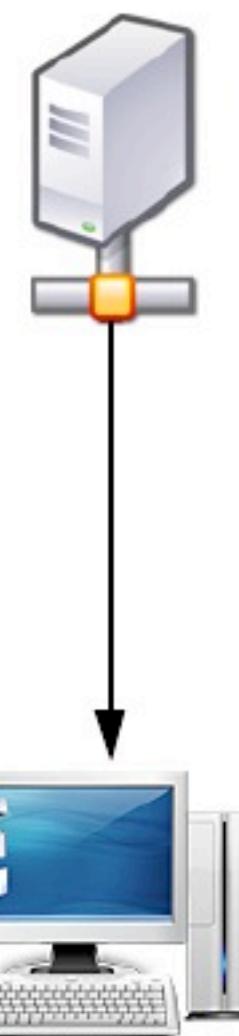
Ben

name@website.com

SMTP server (sender)



SMTP server (receiver)



Client (sender)



Client (receiver)



Delivered-To: macwilliamt@gmail.com

Received: by 10.223.64.143 with SMTP id e15csp17700fai; Sat, 2 Mar 2013
09:46:00 -0800 (PST)

Return-Path: <tmacwilliam@live.com>

Received: from col0-omcl-s9.col0.hotmail.com (col0-omcl-
s9.col0.hotmail.com. [65.55.34.19]) by mx.google.com with ESMTP id
hc10sill831922qab.44.2013.03.02.09.45.57; Sat, 02 Mar 2013 09:45:58
-0800 (PST)

Received: from COL002-W67 ([65.55.34.7]) by col0-omcl-
s9.col0.hotmail.com

Return-Path: tmacwilliam@live.com

Content-Type: multipart/alternative; boundary="abc_"

From: Tommy MacWilliam <tmacwilliam@live.com>

To: "macwilliamt@gmail.com" <macwilliamt@gmail.com>

Subject: I love cats

Date: Sat, 2 Mar 2013 12:45:41 -0500

Delivered-To: macwilliamt@gmail.com

Received: by 10.223.64.143 with SMTP id e15csp17700fai; Sat, 2 Mar 2013
09:46:00 -0800 (PST)

Return-Path: <tmacwilliam@live.com>

Received: from col0-omcl-s9.col0.hotmail.com (col0-omcl-
s9.col0.hotmail.com. [65.55.34.19]) by mx.google.com with ESMTP id
hc10sill831922qab.44.2013.03.02.09.45.57; Sat, 02 Mar 2013 09:45:58
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09:46:00 -0800 (PST)

Return-Path: <tmacwilliam@live.com>

Received: from col0-omcl-s9.col0.hotmail.com (col0-omcl-
s9.col0.hotmail.com. [65.55.34.19]) by mx.google.com with ESMTP id
hc10sill1831922qab.44.2013.03.02.09.45.57; Sat, 02 Mar 2013 09:45:58
-0800 (PST)

Received: from COL002-W67 ([65.55.34.7]) by col0-omcl-
s9.col0.hotmail.com

Return-Path: tmacwilliam@live.com

Content-Type: multipart/alternative; boundary="__abc__"

From: Tommy MacWilliam <tmacwilliam@live.com>

To: "macwilliamt@gmail.com" <macwilliamt@gmail.com>

Subject: I love cats

Date: Sat, 2 Mar 2013 12:45:41 -0500

Delivered-To: macwilliamt@gmail.com

Received: by 10.223.64.143 with SMTP id e15csp17700fai; Sat, 2 Mar 2013
09:46:00 -0800 (PST)

Return-Path: <tmacwilliam@live.com>

Received: from col0-omcl-s9.col0.hotmail.com (col0-omcl-
s9.col0.hotmail.com. [65.55.34.19]) by mx.google.com with ESMTP id
hc10sill831922qab.44.2013.03.02.09.45.57; Sat, 02 Mar 2013 09:45:58
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s9.col0.hotmail.com

Return-Path: tmacwilliam@live.com

Content-Type: multipart/alternative; boundary="abc_"

From: Tommy MacWilliam <tmacwilliam@live.com>

To: "macwilliamt@gmail.com" <macwilliamt@gmail.com>

Subject: I love cats

Date: Sat, 2 Mar 2013 12:45:41 -0500

he
lo

250 mx.google.com at your service

auth login

334 VXNlcm5hbWU6

Base64

dXNlcmlhbWVAZ2lhaWwuY29t
334 UGFzc3dvcmQ6

cGFzc3dvcmQ=

235 2.7.0 Accepted

mail from:<username@gmail.com>

250 2.1.0 OK

rcpt to:<someone@example.com>

250 2.1.5 OK

data

354 Go ahead

POP3

user username@gmail.com

+OK send PASS

pass password

+OK Welcome.

list

+OK 334 messages (3179 bytes)

| 3000

2 179

retr |

dele |

IMAP

al login user@gmail.com password

al OK user@gmail.com

Tommy MacWilliam authenticated
(Success)

a2 select inbox

* 11 EXISTS

* 0 RECENT

a2 OK [READ-WRITE] inbox

selected (Success)

a3 select “[Gmail]/Sent Mail”

* 8833 EXISTS

* 0 RECENT

a3 OK [READ-WRITE] inbox

selected (Success)

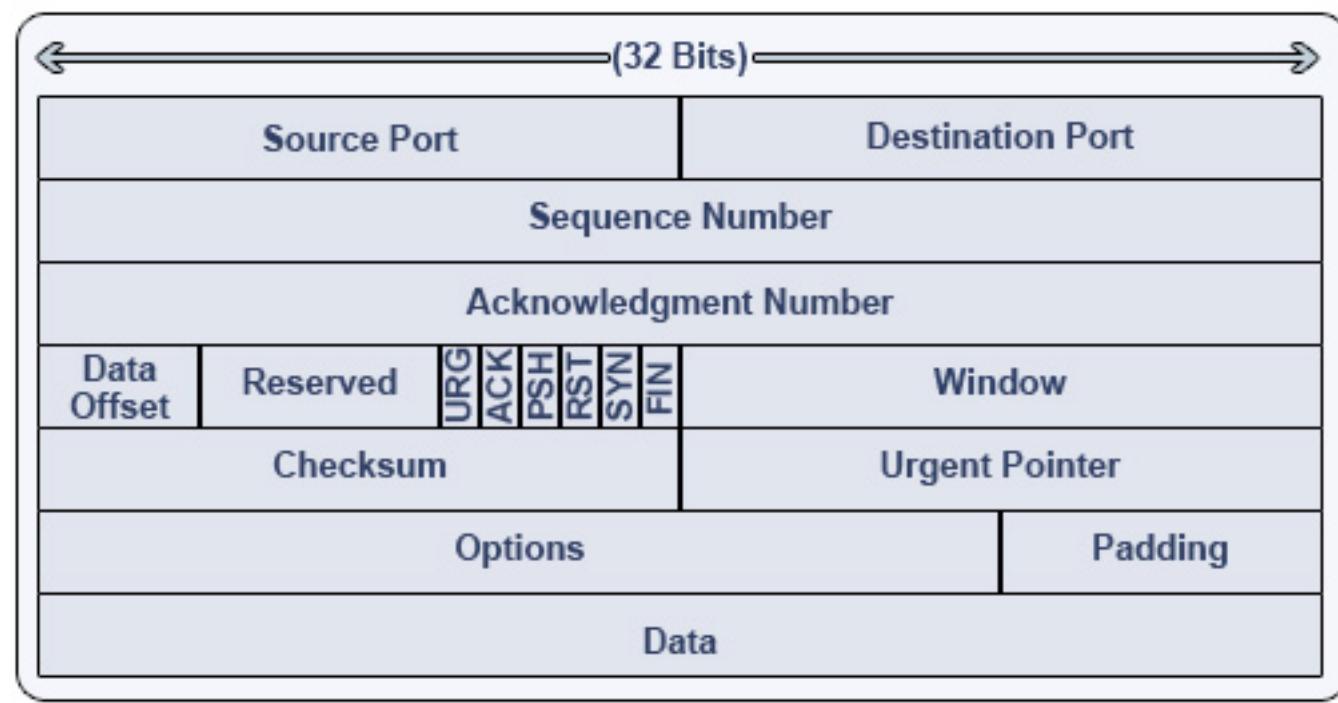
a4 fetch | body[header]

a5 fetch | body[text]

Phishing

TCP/IP

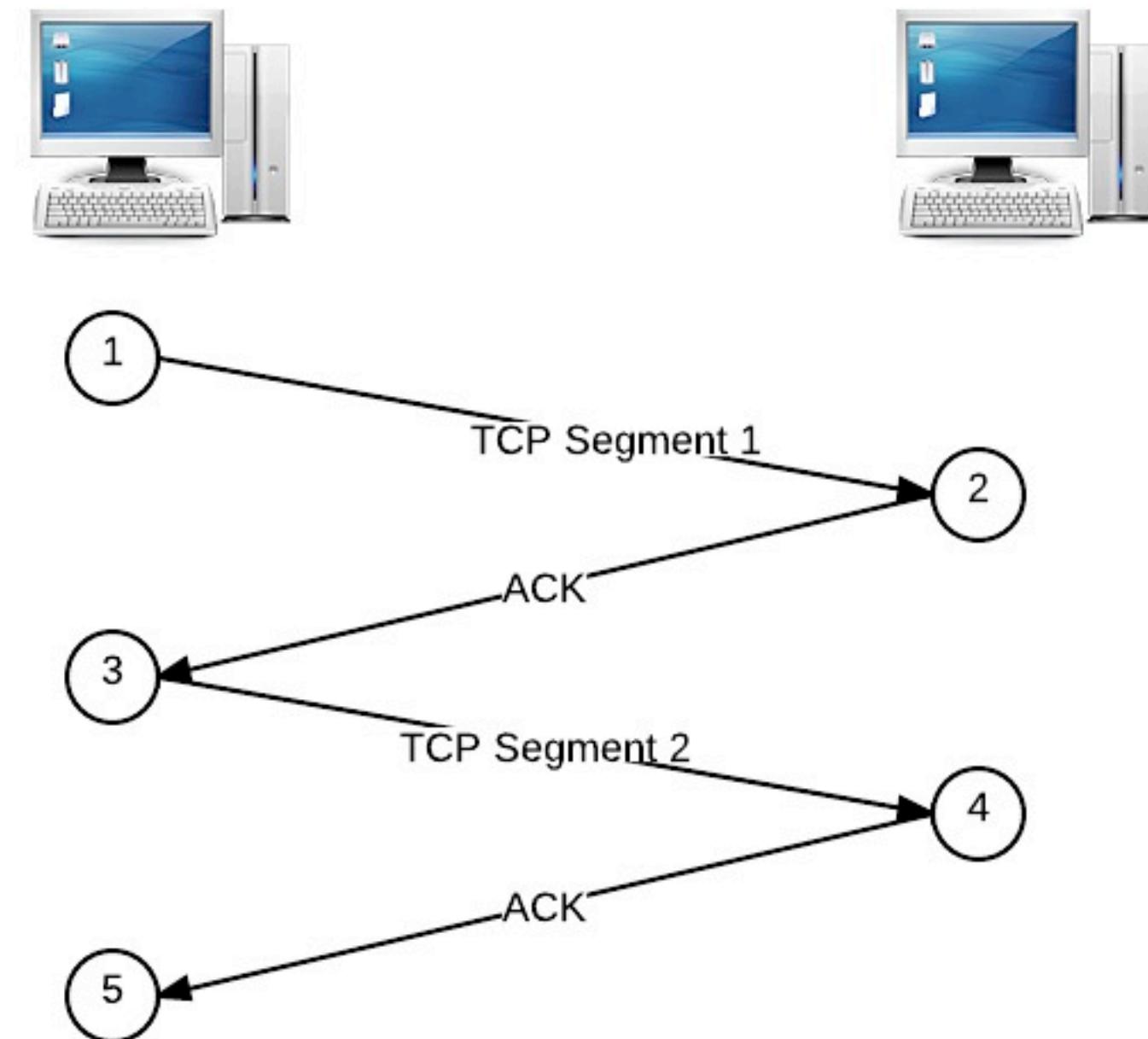
TCP



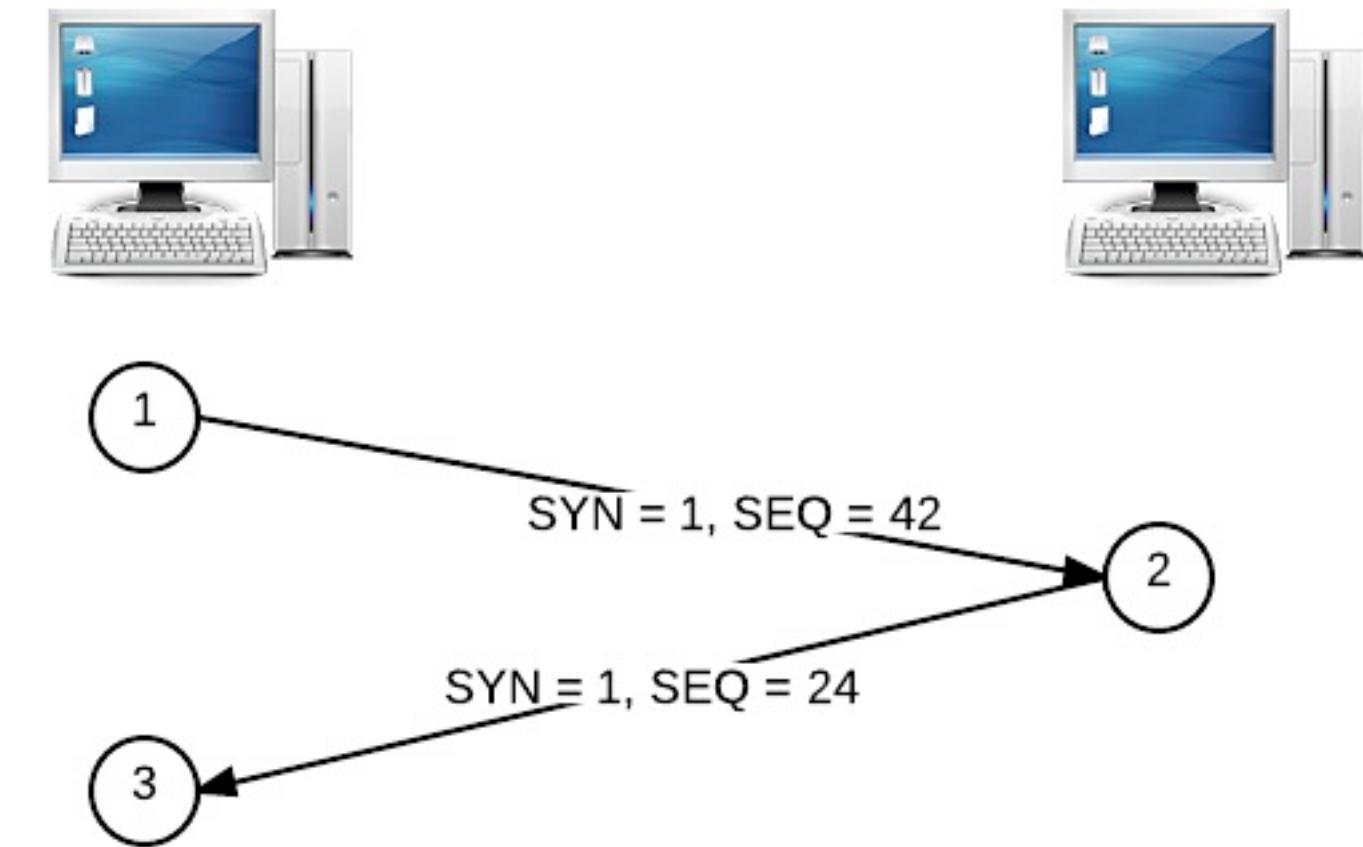
Reliable Data Transfer

Sequence Numbers

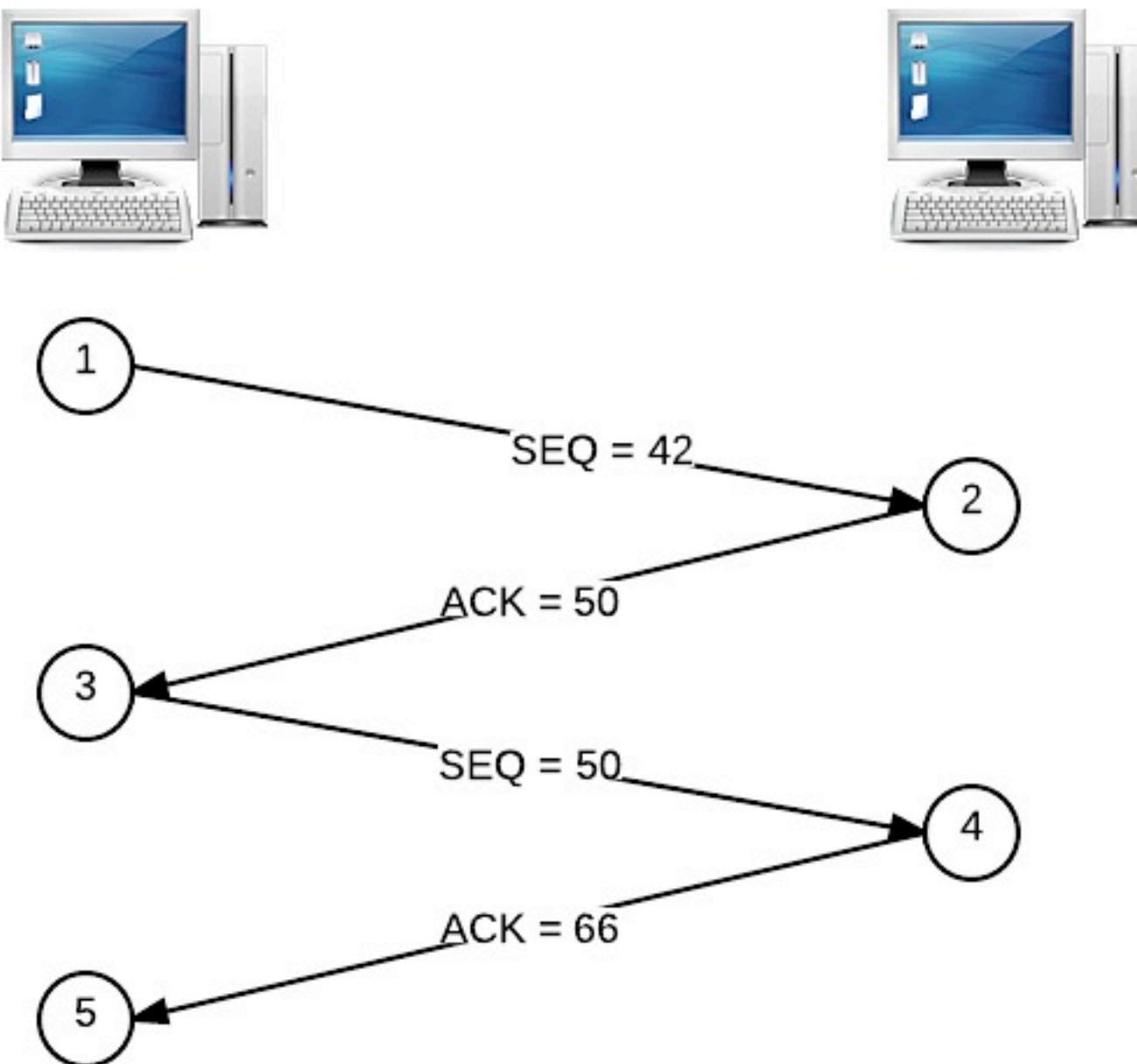
ACK



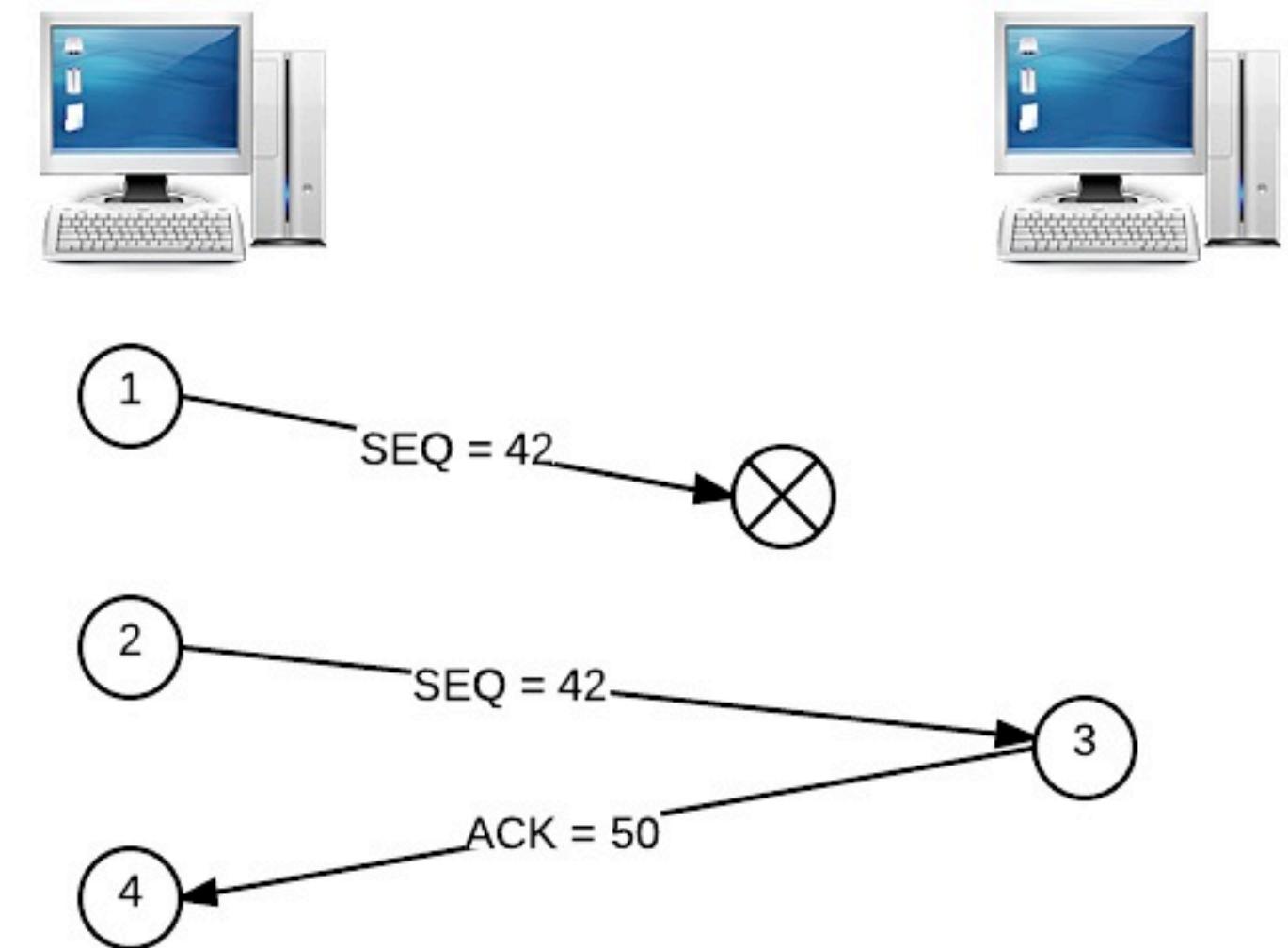
Handshake

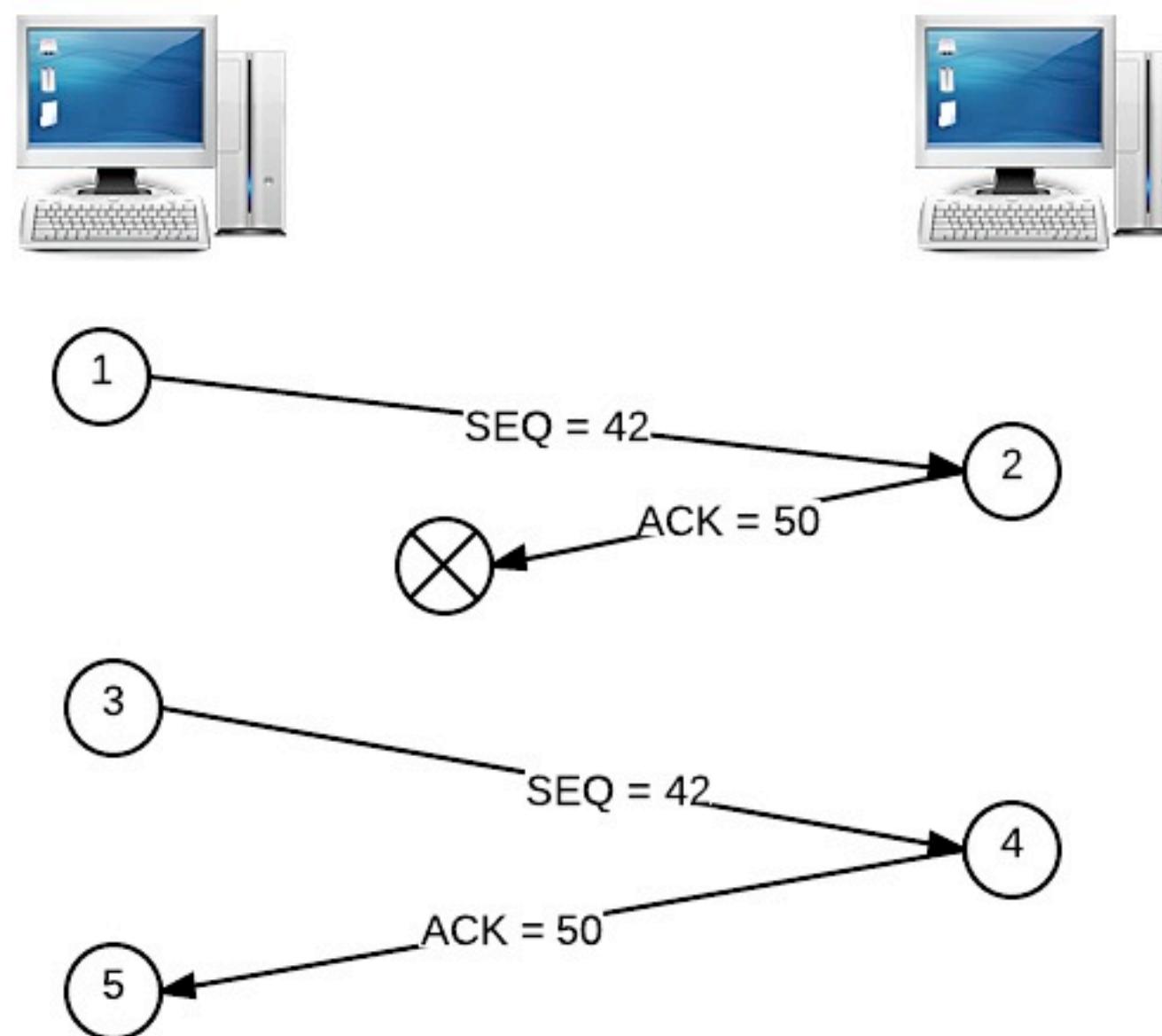


Sequence Numbers + ACKs

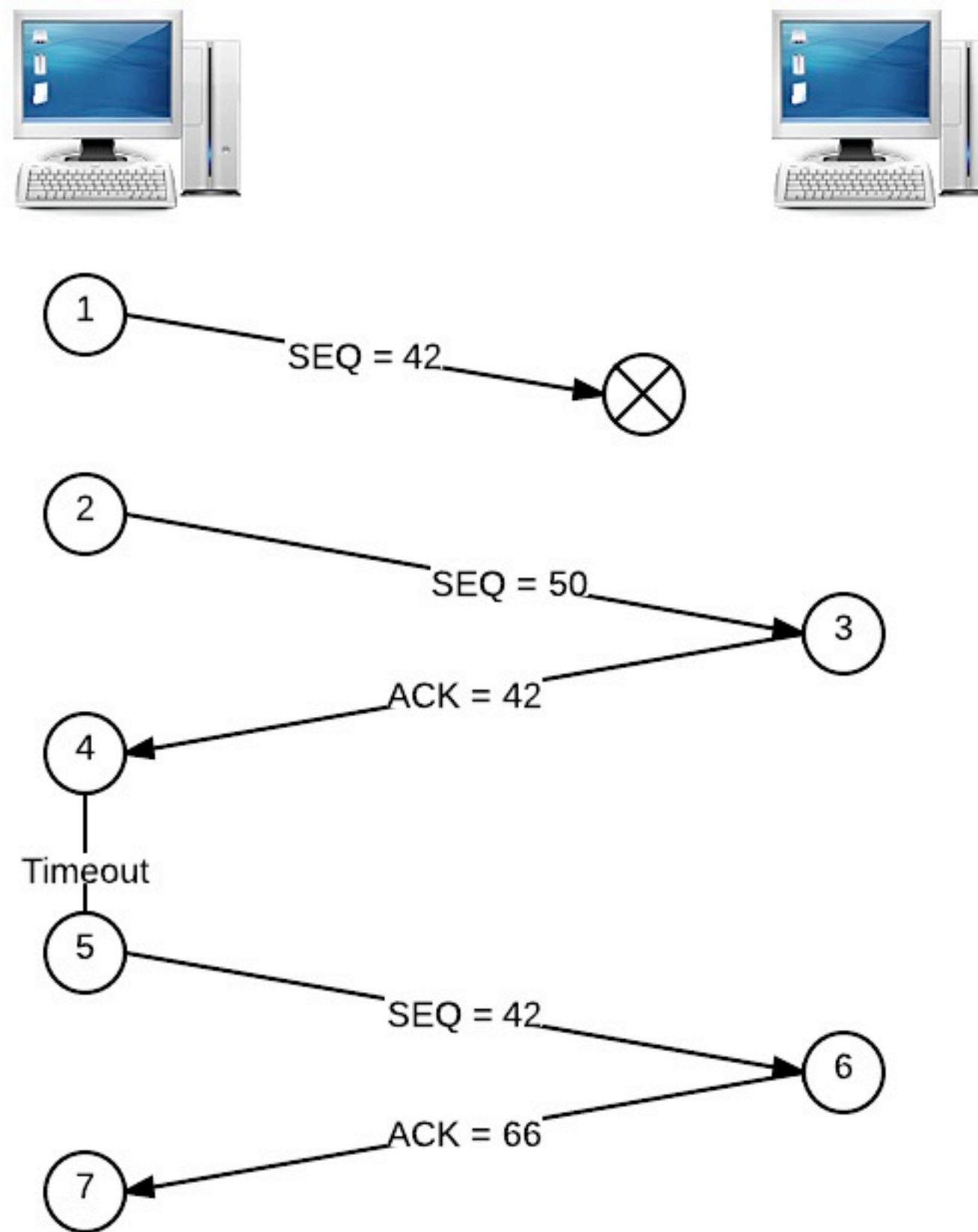


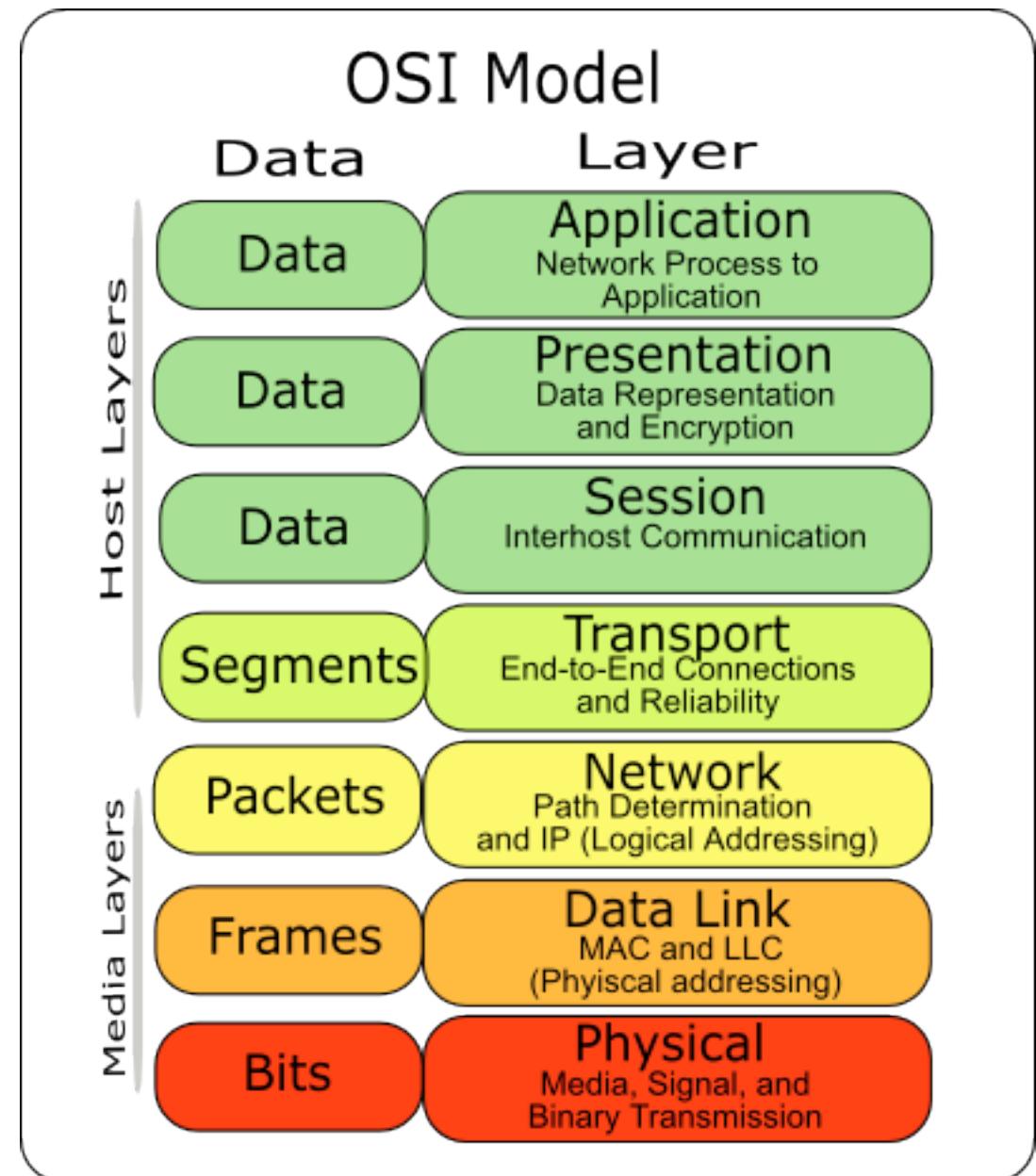
Dropped Segments





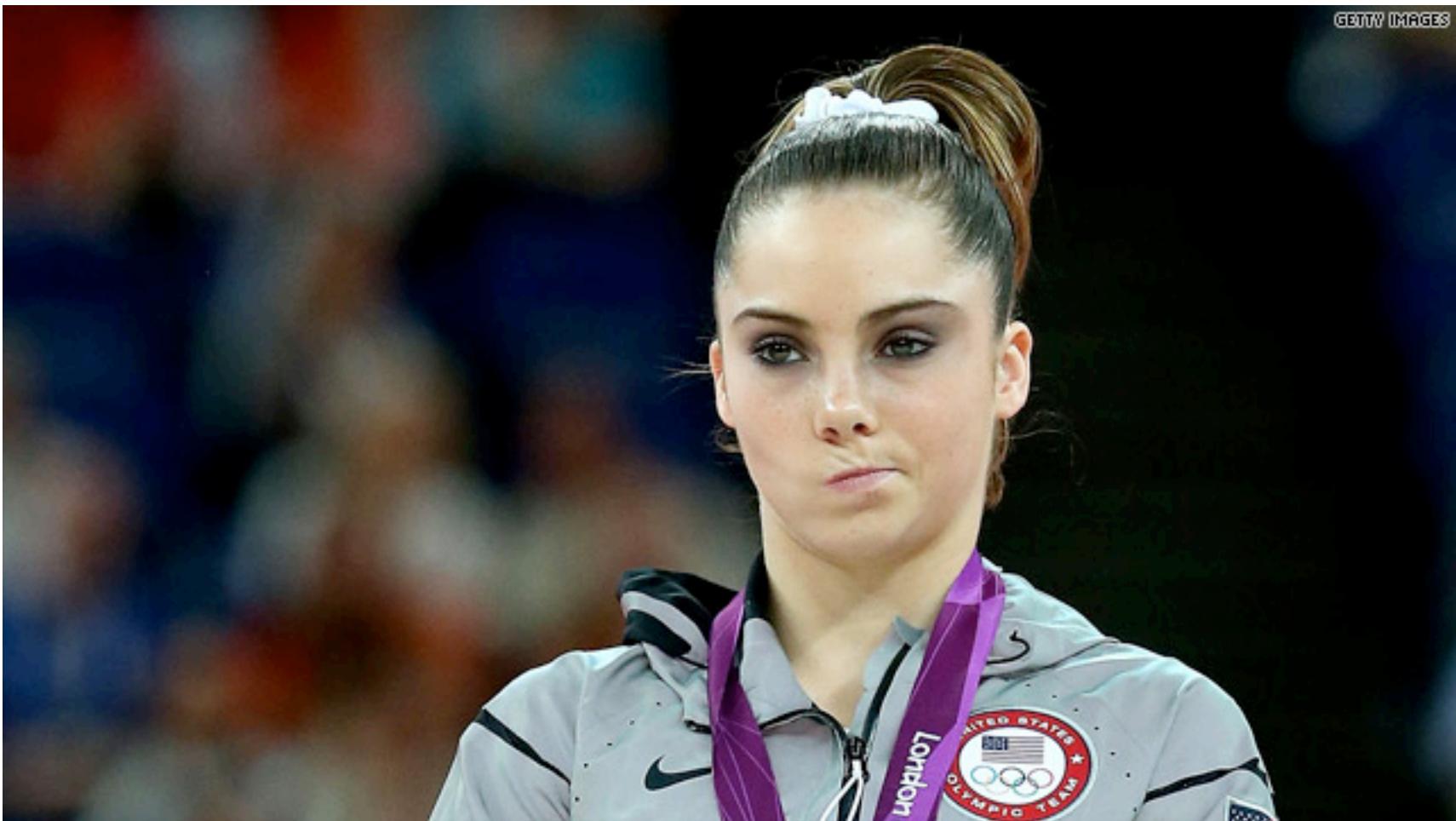
Parallelism





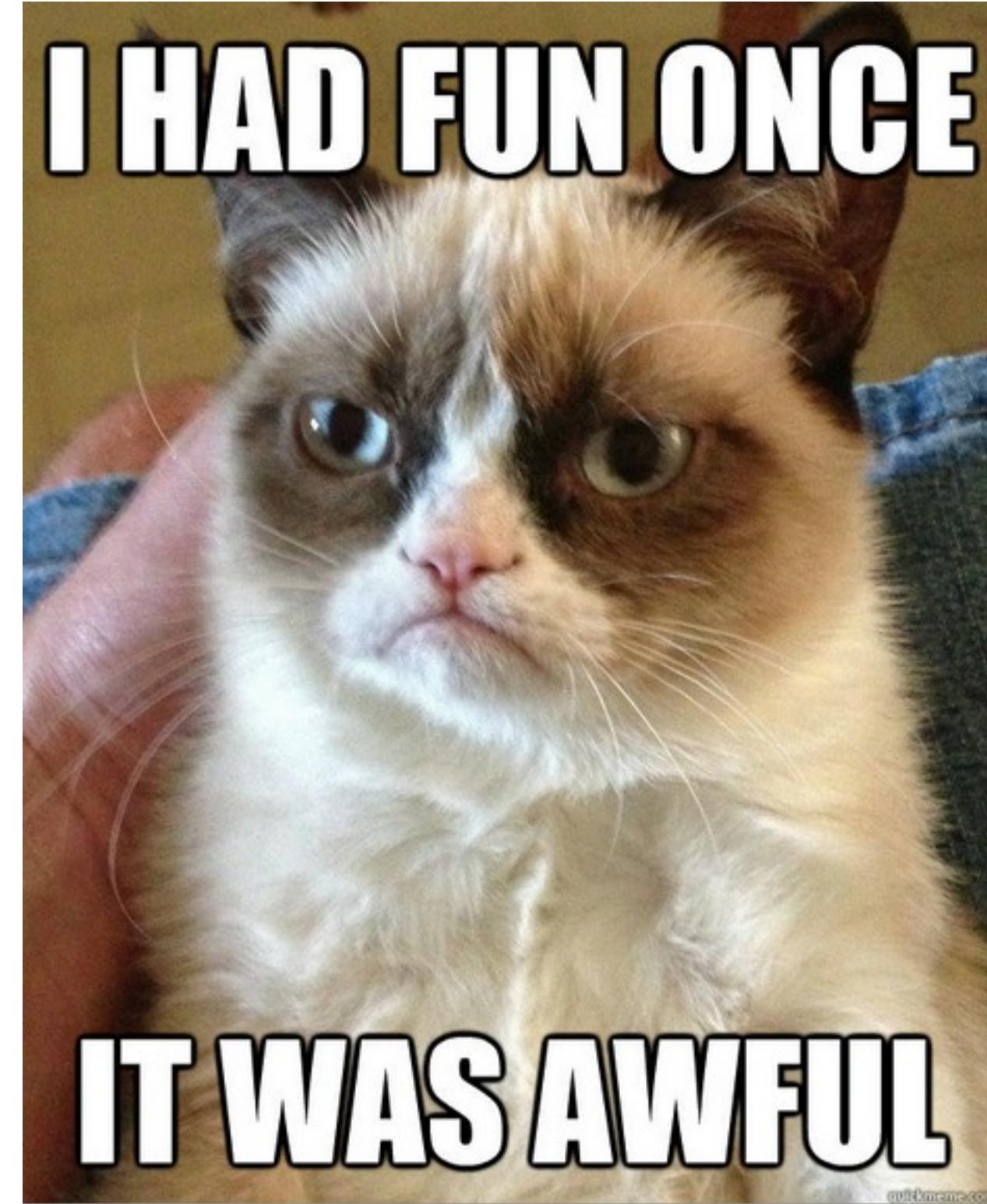
Memes

GETTY IMAGES









DASHING THROUGH THE

NO

quickmeme.com

http://youtu.be/Ve7_4ot-Dzs

Computer Science E-I

Lecture 4: Internet