Network Address Translation

How your computer and router get around a really BIG internet problem

How Your Computer Gets to the site you're looking for

- You start off by entering a name of a website you want to visit
  - Computers don't do well with names so...
- Your computer and router convert that name to an number – an IP address
  - Which is kind of like a phone number in that it's unique
- The present commonly used numbering (addressing) scheme is called Internet Protocol v4 (IPv4)

IPv4 – The Problem

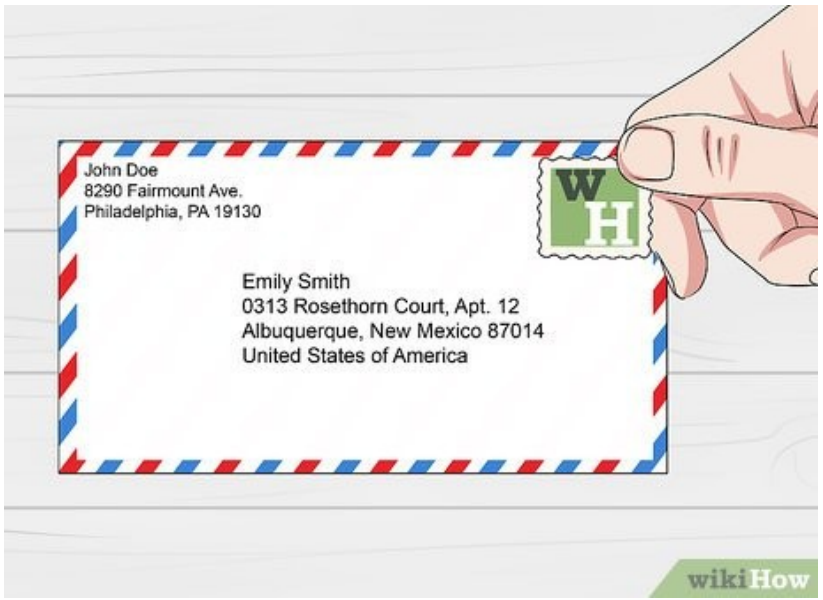
- IPv4 address (adopted in 1981) is made up of four numbers separated by decimal points
  - X.X.X.X where X can be any number up to 255
- Ex – 192.168.10.5 or 63.45.107.5
- There are “only” ~4.3 billion possible addresses in this scheme
  - Which was initially thought to be “way more than enough”
- *Except* it’s estimated that there are now around 20 billion devices with access to the internet
- With that many devices, it’s not possible to uniquely identify each with the present scheme

The Solution (for now) - NAT

- There are 3 groups of IP addresses set aside for use on private networks
  - 10.0.0.0 – 10.255.255.255
  - 172.16.0.0 – 172.31.255.255
  - 192.168.0.0 – 192.168.255.255
- Your network (or you) will be set up your devices within one of these ranges
- These addresses are for private use only and will NOT work on the general internet

The Solution - (for now) NAT

- Every communication on the internet includes the recipients IP address and the senders IP address
  - Similar to a first class letter you might mail



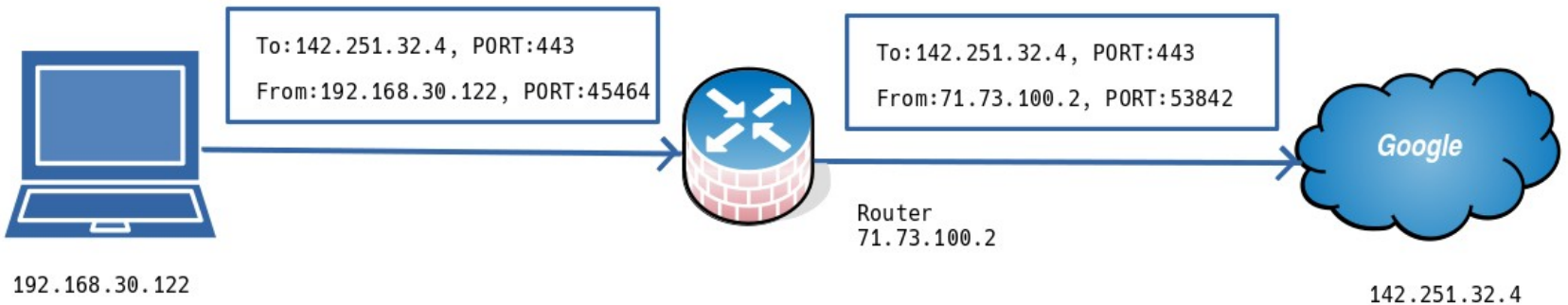
The Solution - (for now) NAT

- When you send out a request to the internet, say to Google for a search request
  - The request goes out to Google pretty easily
    - You computer/router look up to number associated with www.google.com and sends out the request
  - Google then needs to send you back it’s search results
    - But if it the ‘sent from’ address that Google sees is your private computer IP address, the response would never reach you – since it’s private!

The Solution - (for now) NAT

- NAT allows your router to act as an agent between your private network and the public internet
- Using it allows all your devices to connect to the internet thru your router without your ISP having to give each of your devices a separate IP address
  - Which would use up more of the ~ 4.3B address
- It acts something like a mail forwarding service
  - You send your mail out and that forwarding service changes out the envelop
  - Substituting their return address for your
  - When the receiver sends a reply, it goes back to the forwarding service who changes out the envelop again and then sends your mail on to you

Example



NAT Table	
Internal	External
192.138.30.122, Port 45464	73.71.100.2, Port 53842

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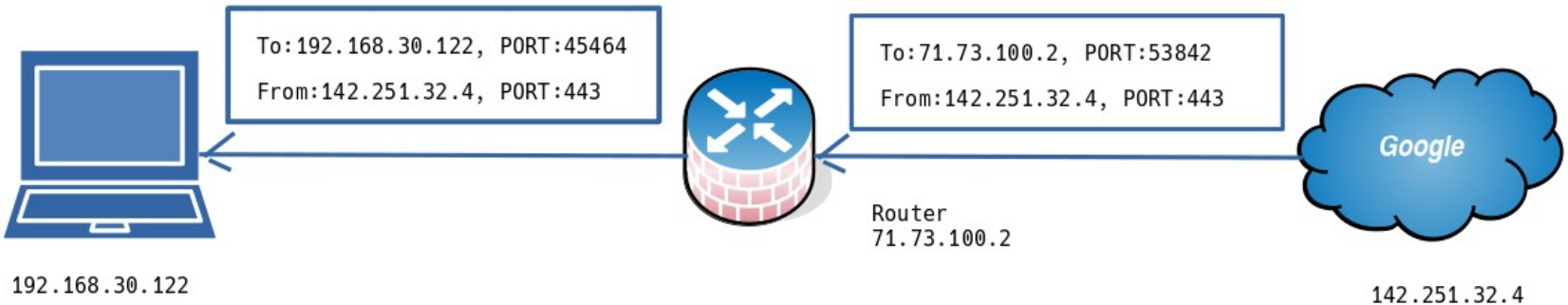

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The Solution - (for now) NAT

- One very cool feature of NAT is that, no external website can access your computer *UNLESS* it's going to an address that is in the NAT table
  - But the NAT table is purged after each communication is finished
  - For example, if someone tried to snoop on your computer from and just addressed your router address with no port #

NAT Table	
Internal	External
192.138.30.122, Port 45464	73.71.100.2, Port 53842

  - They would not get thru
    - Since it's not in the NAT list

The Solution - (for now) NAT

- It’s a bit like calling an office that still has someone answering phones and directing calls
  - If you’re not on somebody’s approved list, you’re not getting thru

IPv6 – The Intended Solution

- IPv6 is an entirely different numbering scheme made up of eight 16 bit numbers separated by colons
  - e.g. - 2001:0db8:85a3:0000:0000:8a2e:0370:7334
- With this scheme, there are ~ 3.4 trillion, trillion, trillion possible addresses
- IPv6 was ratified in 2017 and the intent is to transition the internet to this new format over some (indeterminate) period of time
- It will be a big effort since a good chunk of the existing hardware will need to be changed out

IPv6 – The Intended Solution

- The cell phone companies are well on their way to converting to IPv6
  - Which seems to be pretty transparent to users
- It’s unclear to me what the average home user will need to do to convert to IPv6 and when he’ll have to do it
  - Topic for a future discussion?