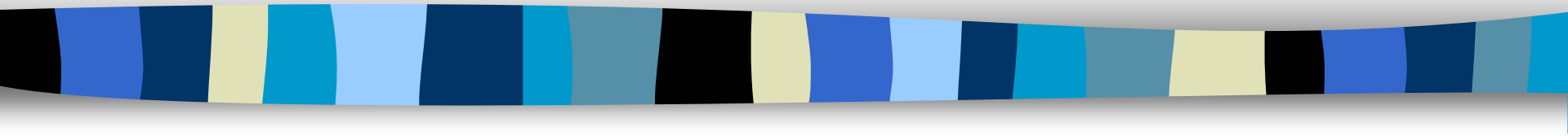
Internet Addressing

A Technical Overview



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Overview

- Background
- Internet Address History
- Internet Address Allocators
- Conclusions

Addresses -- How to get here from there

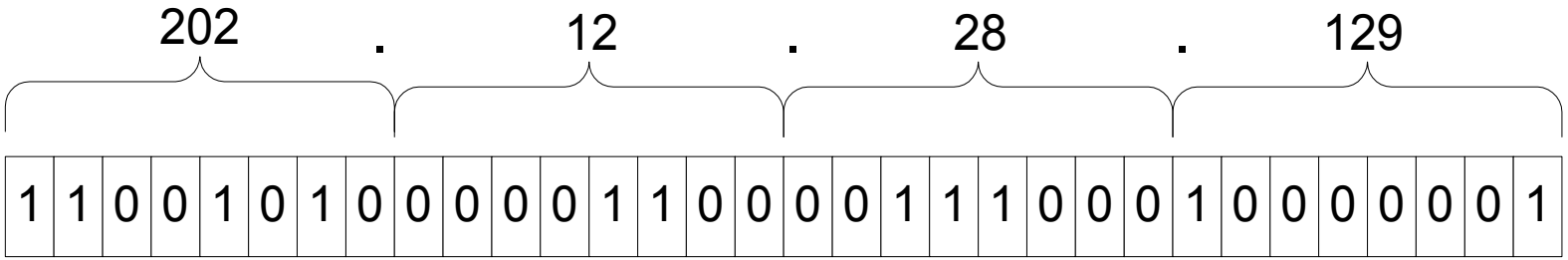
- Addresses provide information on how to locate something, e.g., what route to take from here to there.
- Internet addresses combine
  - a routing portion, known as the network part
  - a name portion known as the host part
- How to split an Internet address into the network part and the host part has changed over time…

The Beginning

- Back when the TCP/IP protocols were first being designed, there was a big argument between fixed length and variable length addresses
  - Fixed length will always be limited
    - But if you make it big enough, no one will notice
  - Variable length will always take more cycles to process
    - But there are tricks you can play to minimize the difference
- The decision was made for fixed, 32 bit addresses
  - Rumor has it, by a flip of a coin...

IP version 4 Addresses

- 32 bit unsigned integers
  - possible values 0 - 4,294,967,295
- Typically written as a “dotted quad of octets”
  - four 8 bit values with a range of 0-255 separated by “.”
  - For example, 202.12.28.129 can be written as below

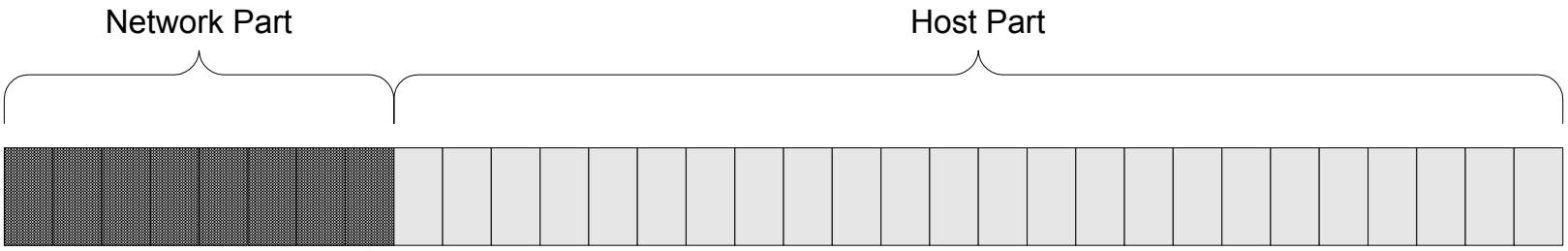


Internet Addresses

- A subset of IPv4 addresses
  - One of an infinite number
- Guaranteed globally unique by the IANA
  - Generally allocated by delegated authorities such as Internet service providers or regional registries
  - Assumed to be routable
    - Bad assumption
- Partitioned into two parts
  - A host part that identifies a particular machine on a local or wide area network
  - A network part that gives routers information how to get to the local or wide area network via the Internet

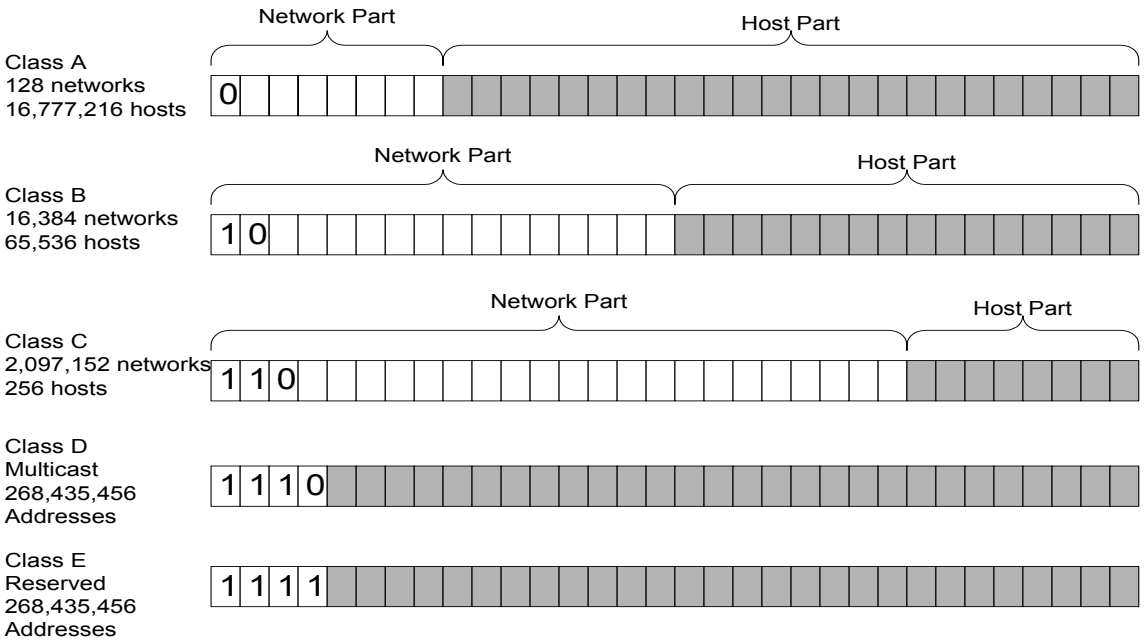
Internet Address Structure

- Originally, the architects of the Internet thought 256 networks would be more than enough
  - Assumed a few very large (16,777,216 hosts) networks
  - They were wrong (in case you were wondering)
- Addresses were partitioned as below
  - 8 bit network part, 24 bit host part



Classfull Addressing

- Original addressing plan too limiting
  - More than 256 networks with many fewer hosts than 2^{24}
- Solution was to create address classes

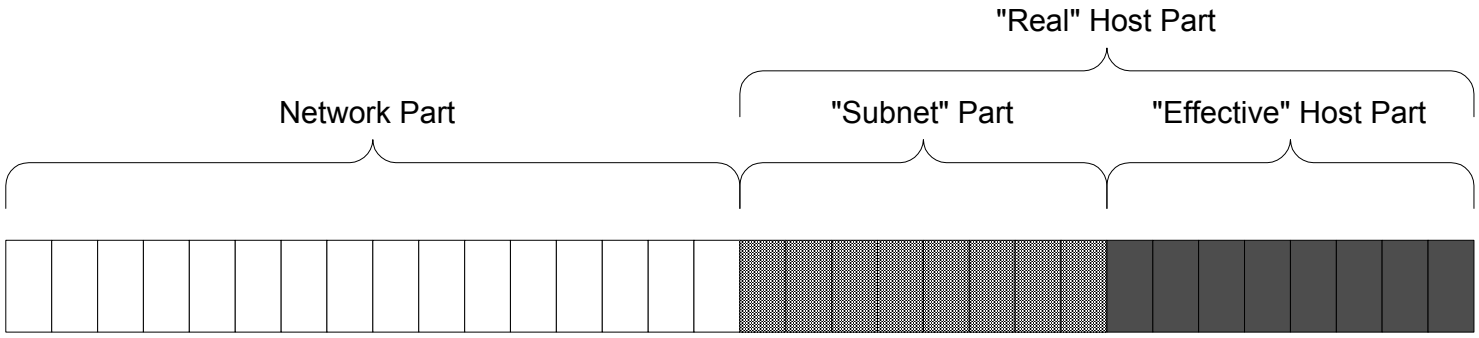


The Problem

- Class A way too big
  - 16 million hosts in a flat network is unthinkable
- Class B too big
  - Even 65536 host addresses is too many in most cases
    - Imagine 65534 hosts all responding to a broadcast
- Class C too small
  - Most sites initially connecting to the Internet were large Universities, 256 was too small for them
- Need more flexibility!

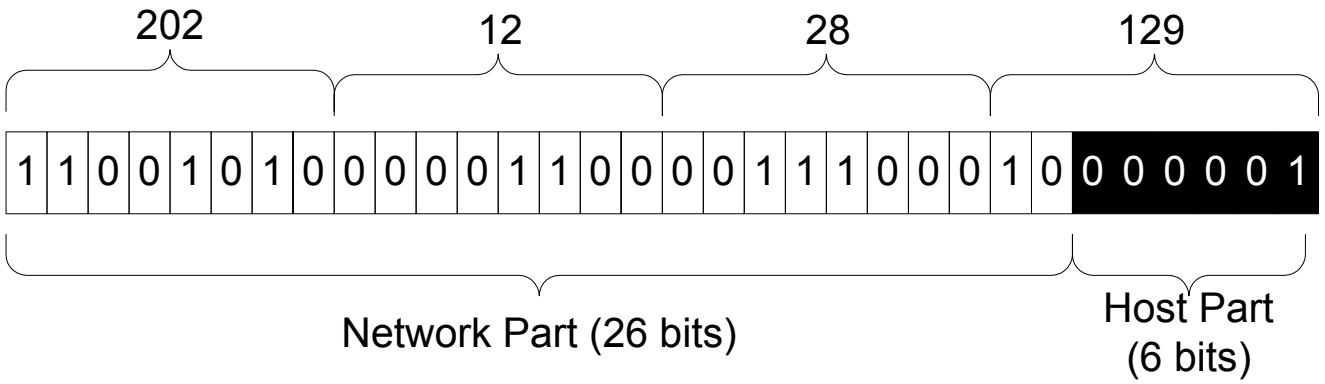
Subnetting

- Classfull addressing was a better fit than original
  - but class A and B networks impossible to manage
- Solution was to partition large networks internally into sub-networks (subnets)
  - Typically “class C” (8 bit host part) sized subnets although variable length subnets used too



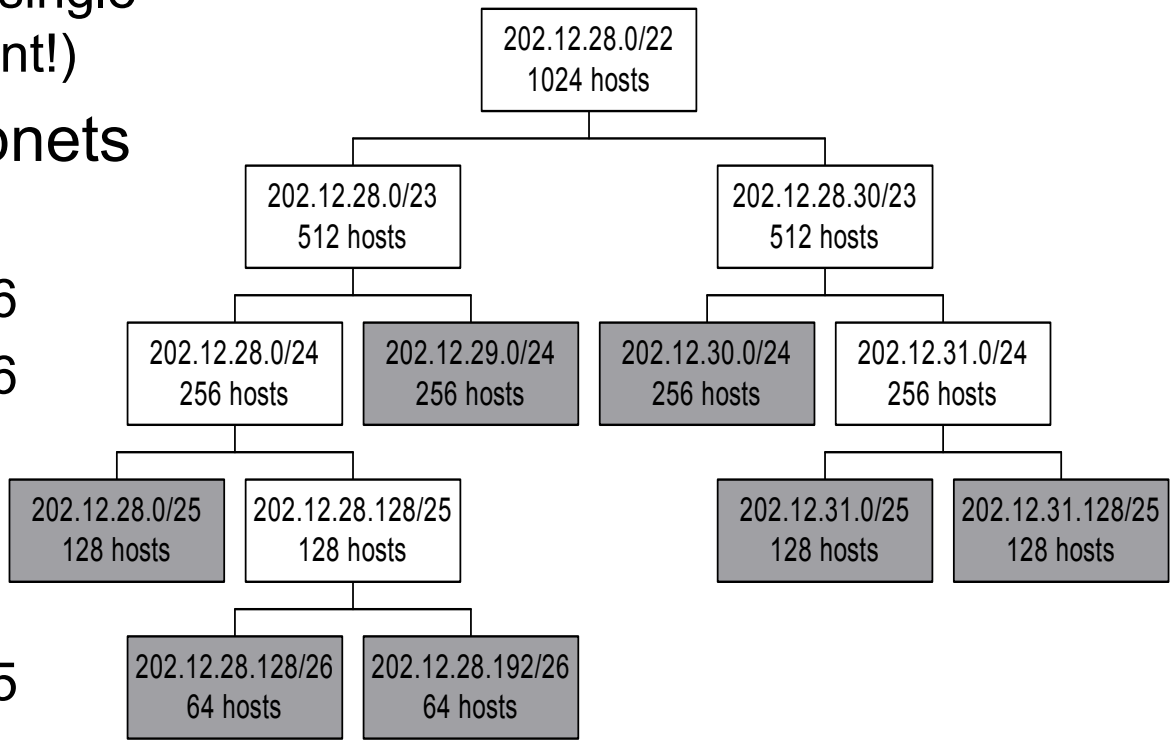
Classless Addressing

- Forget what I just told you
  - Classfull addressing is officially “Bad”™
    - 3 sizes just don’t fit all -- very wasteful
- Better solution is to use variable length partitioning between the host and network parts
  - Actual partitioning for a site provided by routing protocol
  - notation is dotted quad followed by a “/” and the network part length, e.g., 202.12.28.129/26 → First host on 64 host network starting at 202.12.28.128
- No need for subnets



Example of Classless Addressing

- Prefix 202.12.28.0/22
  - 1024 host addresses
  - announced as a single network (important!)
- Consists of 7 subnets
  - 202.12.28.0/25
  - 202.12.28.128/26
  - 202.12.28.192/26
  - 202.12.29.0/24
  - 202.12.30.0/24
  - 202.12.31.0/25
  - 202.12.31.128/25



Summary

- Internet addresses are 32 bit fixed length globally unique numbers
  - One subset of all IPv4 address spaces
- Internet addresses have evolved over time to be more flexible and to include hierarchy
- Currently, classless addressing is in use providing arbitrary host and network part lengths.