RDM#2

Research & Development Meetup

IPFS LISBON

David Dias,
P2P SE&R @ Protocol Labs
tw: @daviddias gh: @diasdavid
João Ascensão,
Data Scientist @ Uniplaces
tw: @jtascensao gh: @jtascensao
IPFS LISBON

What is RDM?

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Space to invest time in learning things that are hard to grasp
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world of possibilities
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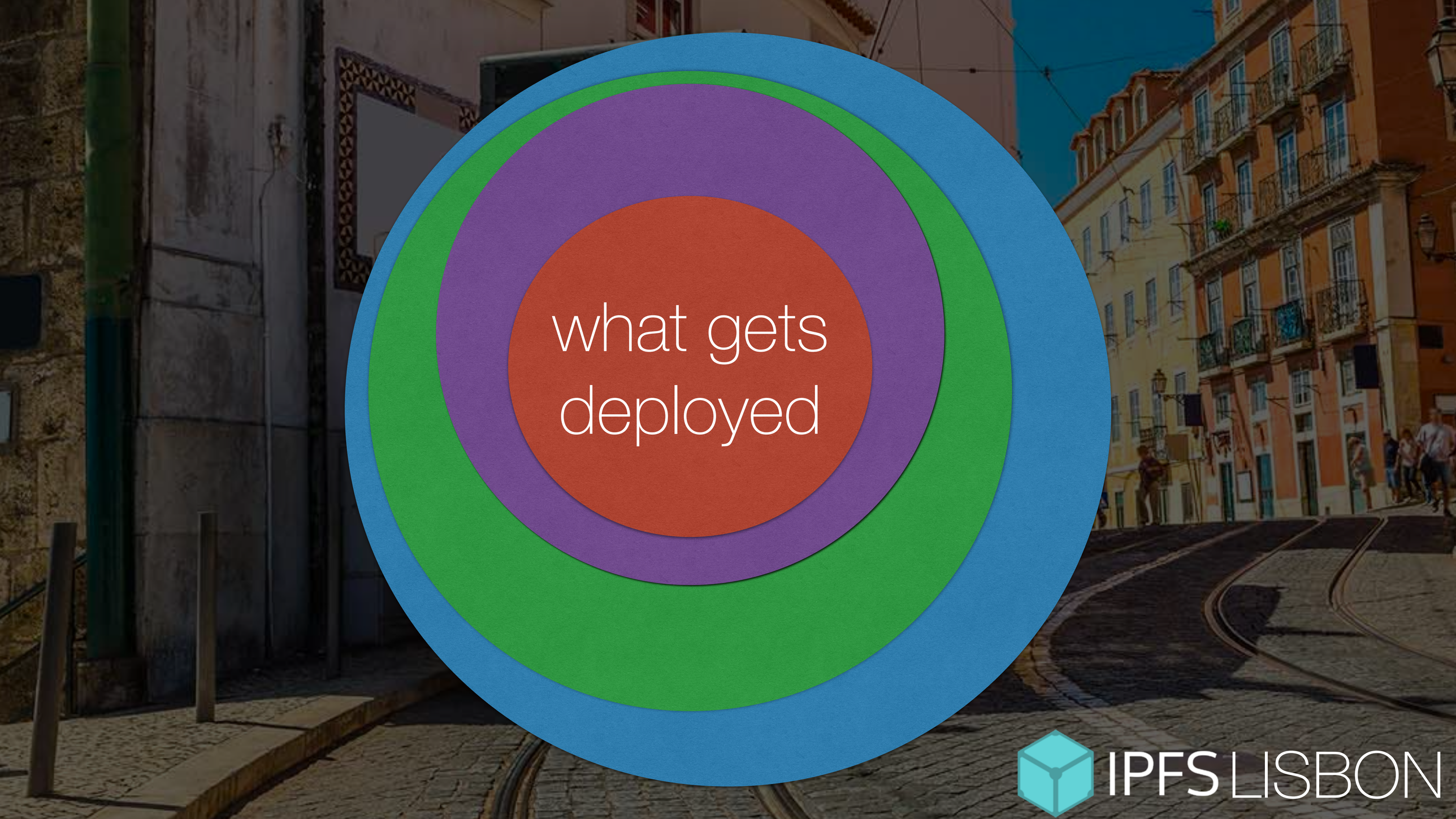
what actually gets researched

IPFS LISBON

what gets developed
IPFS LISBON


what gets
deployed
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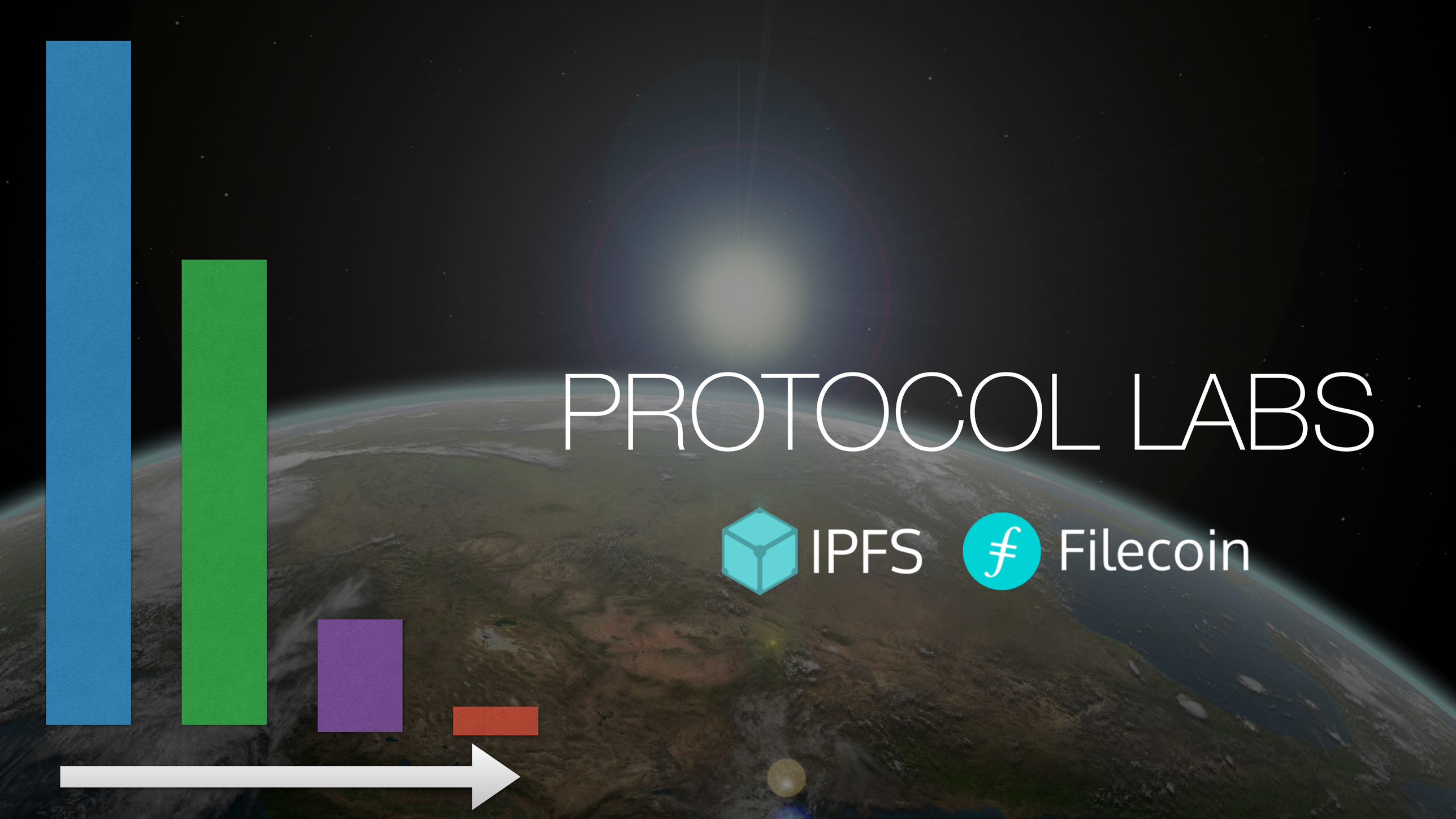
what most people are doing
IPFS LISBON


PROTOCOL LABS
IPFS
Filecoin

FORMAT

- New topics / Research
- Hacking + Digesting + Publishing

IPFS LISBON

TODAY

- The Distributed Web
- Machine Learning / AI

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The Distributed Web

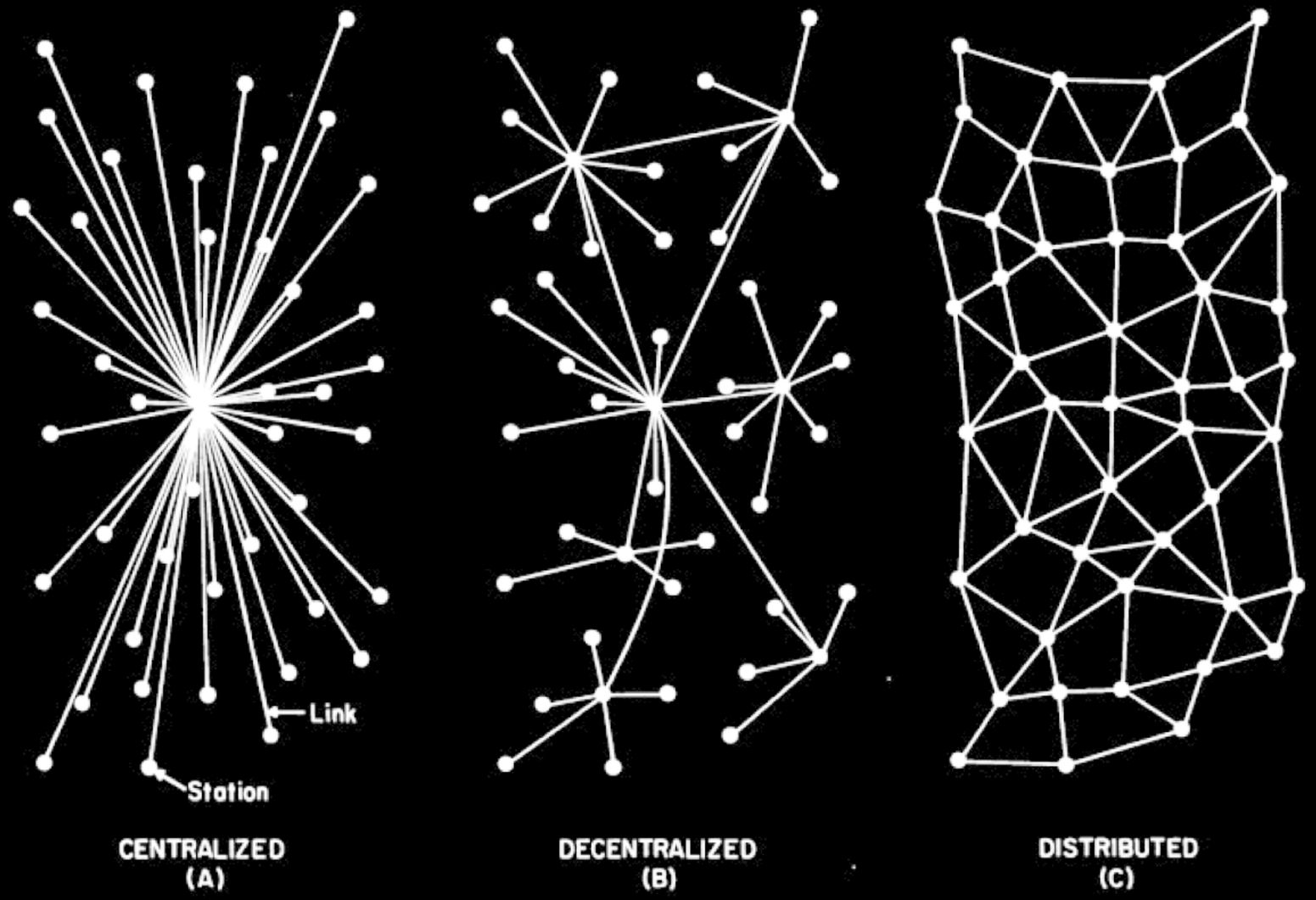
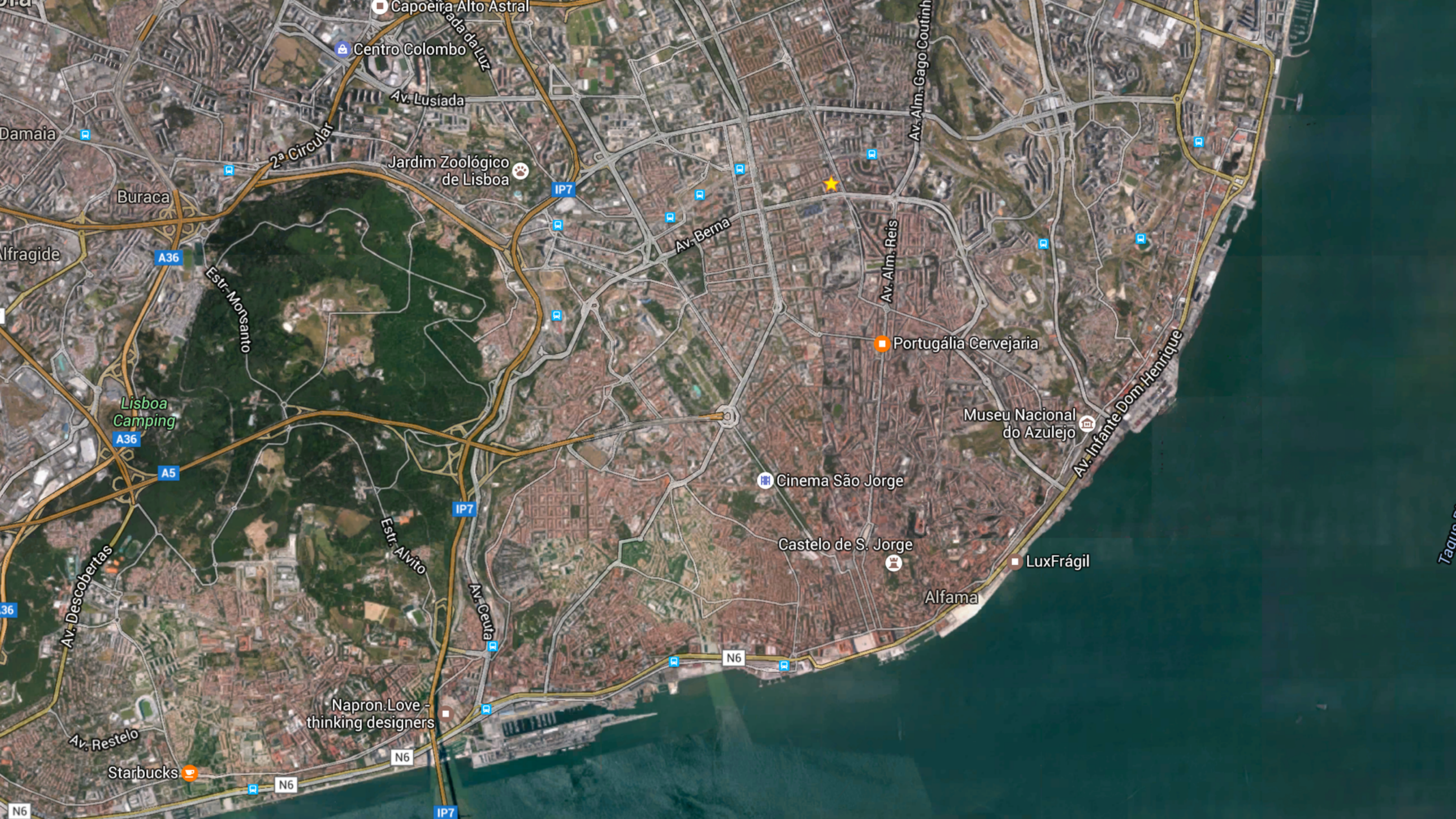
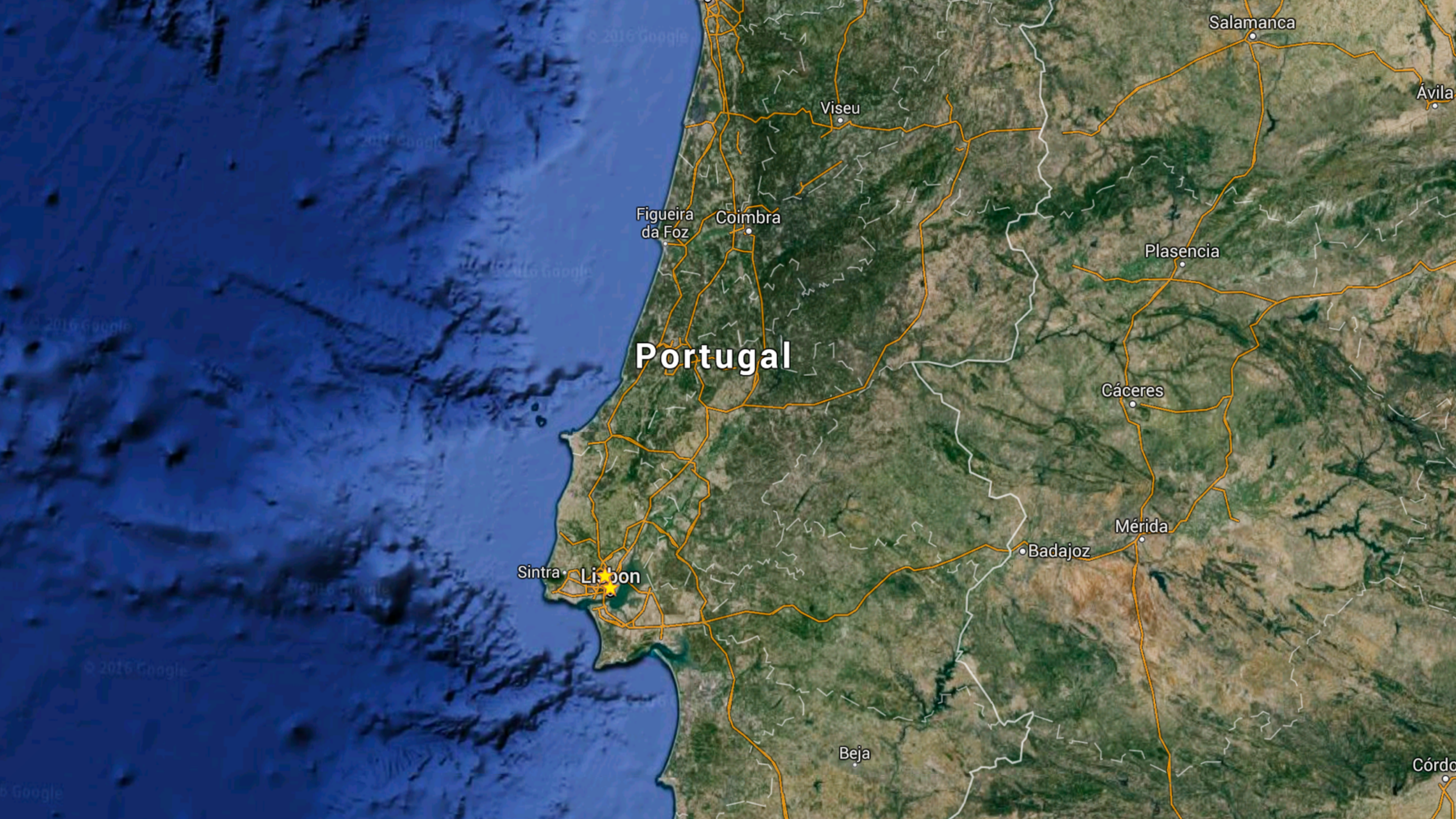


FIG. 1 — Centralized, Decentralized and Distributed Networks


Capoeira Alto Astral
Centro Colombo
Av. Lusíada
Damaia
2ª Circular
Jardim Zoológico de Lisboa
IP7
Buraca
Alfragide
A36
Estr. Monsanto
Av. Berna
Av. Alm. Reis
Av. Alm. Gago Coutinho
Portugália Cervejaria
Av. Infante Dom Henrique
Museu Nacional do Azulejo
Lisboa Camping
A36
A5
Cinema São Jorge
IP7
Estr. Alvito
Castelo de S. Jorge
LuxFrágil
Alfama
Av. Descobertas
Av. Ceuta
N6
Napron.Love - thinking designers
Av. Restelo
Starbucks
N6
N6
N6
IP7


Salamanca
Ávila
Viseu
Figueira da Foz
Coimbra
Plasencia
Portugal
Cáceres
Mérida
Badajoz
Sintra
Lisbon
Beja
Córdo

Norway
Estonia
Baltic Sea
Latvia
Lithuania
North Sea
United Kingdom
Denmark
Ireland
Belarus
Poland
Netherlands
Germany
Belgium
Ukraine
Czech Rep
Slovakia
Moldova
Austria
Hungary
France
Romania
Georgia
Black Sea
Croatia
Serbia
Italy
Bulgaria
Portugal
Turkey
Spain
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Morocco
Egypt
Algeria
Libya
Western

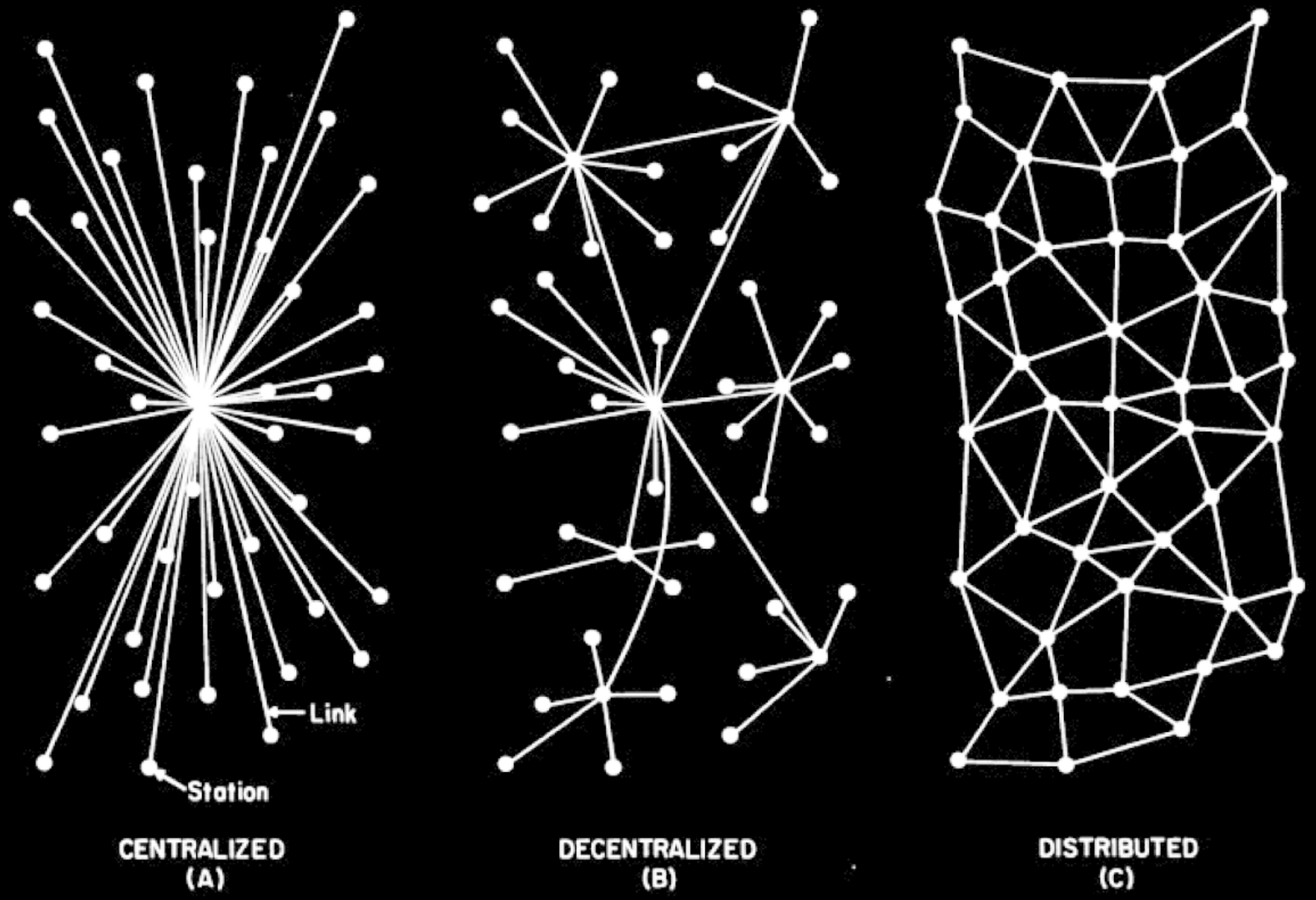


FIG. 1 — Centralized, Decentralized and Distributed Networks

Serve data to everywhere

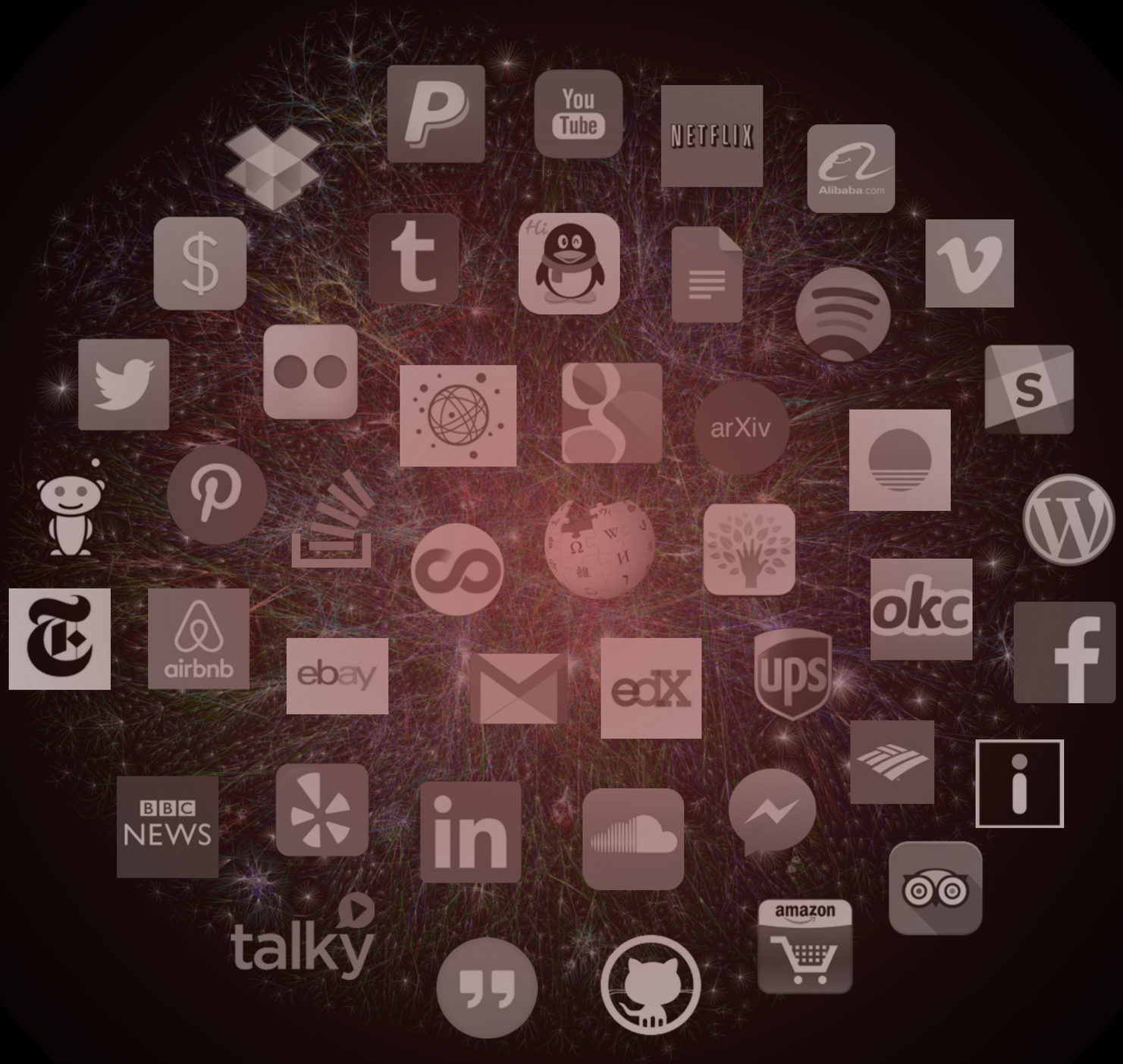
- Motivations
- IPFS, the Protocol
  - MerkleDAG (Directed Acyclic Graph)
  - DHT (Distributed Hash Table)

- Motivations
- IPFS, the Protocol, MerkleDAG, IPNS, Network
- IPFS in action
- IPFS, the project
- filecoin
- libp2p
- starship
- gx

- full IPFS JavaScript implementation
- mutable file system and the files API
- Other DHT
- Structure P2P Networks
- Unstructured P2P Networks
- NAT Traversal
- Relay/Turn

- registry-mirror
- smart chunking
- Transports
- Multiplexers
- Self Describing Data Types
- Search
- Station
- and more

You Tube
NETFLIX
Alibaba.com
arXiv
airbnb
ebay
edX
ups
okc
BBC NEWS
talky
amazon


You Tube
NETFLIX
Alibaba.com
arXiv
airbnb
ebay
edX
ups
okc
BBC NEWS
talky
amazon

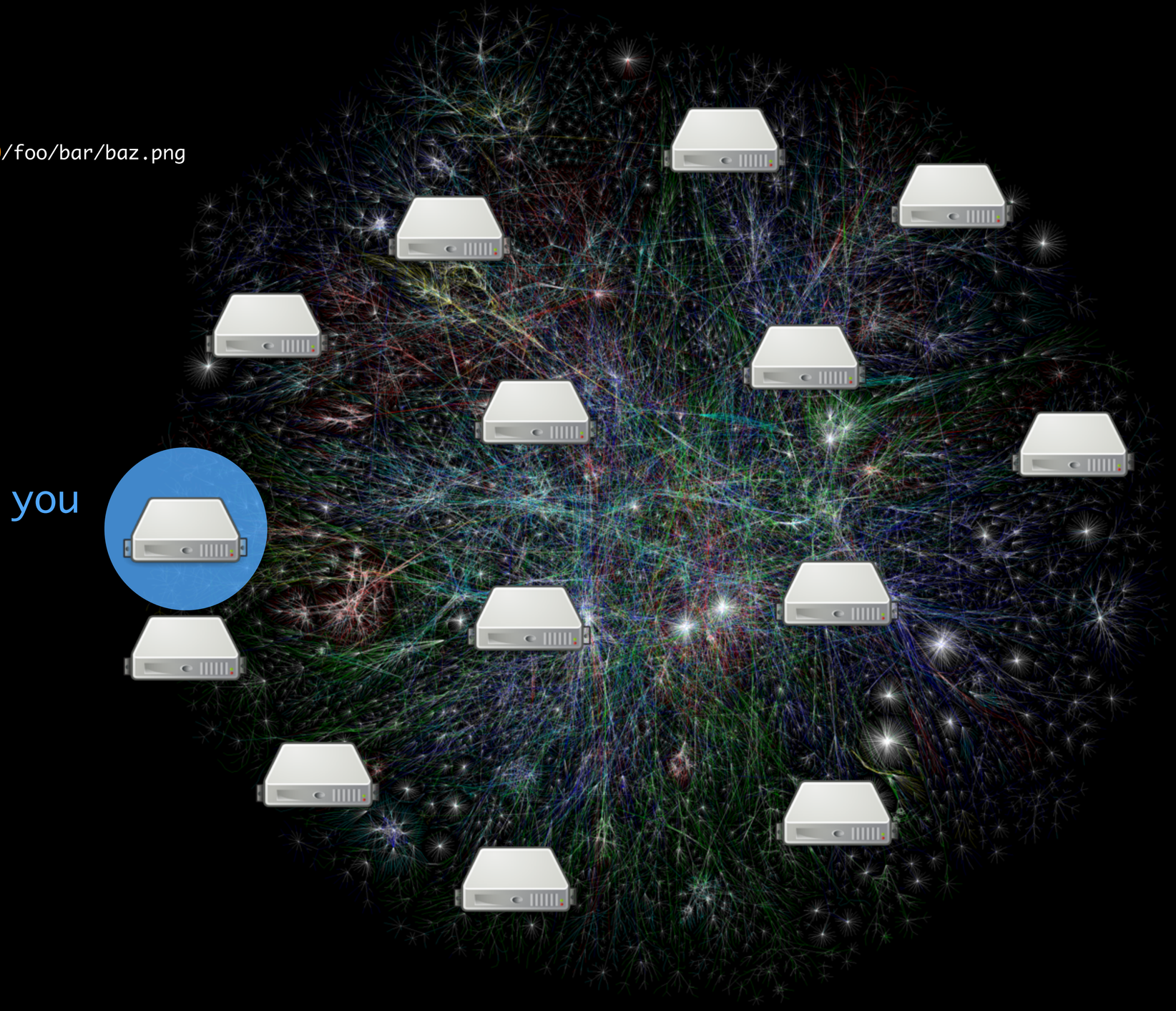
Location Addressing

http://example.com/foo/bar/baz.png

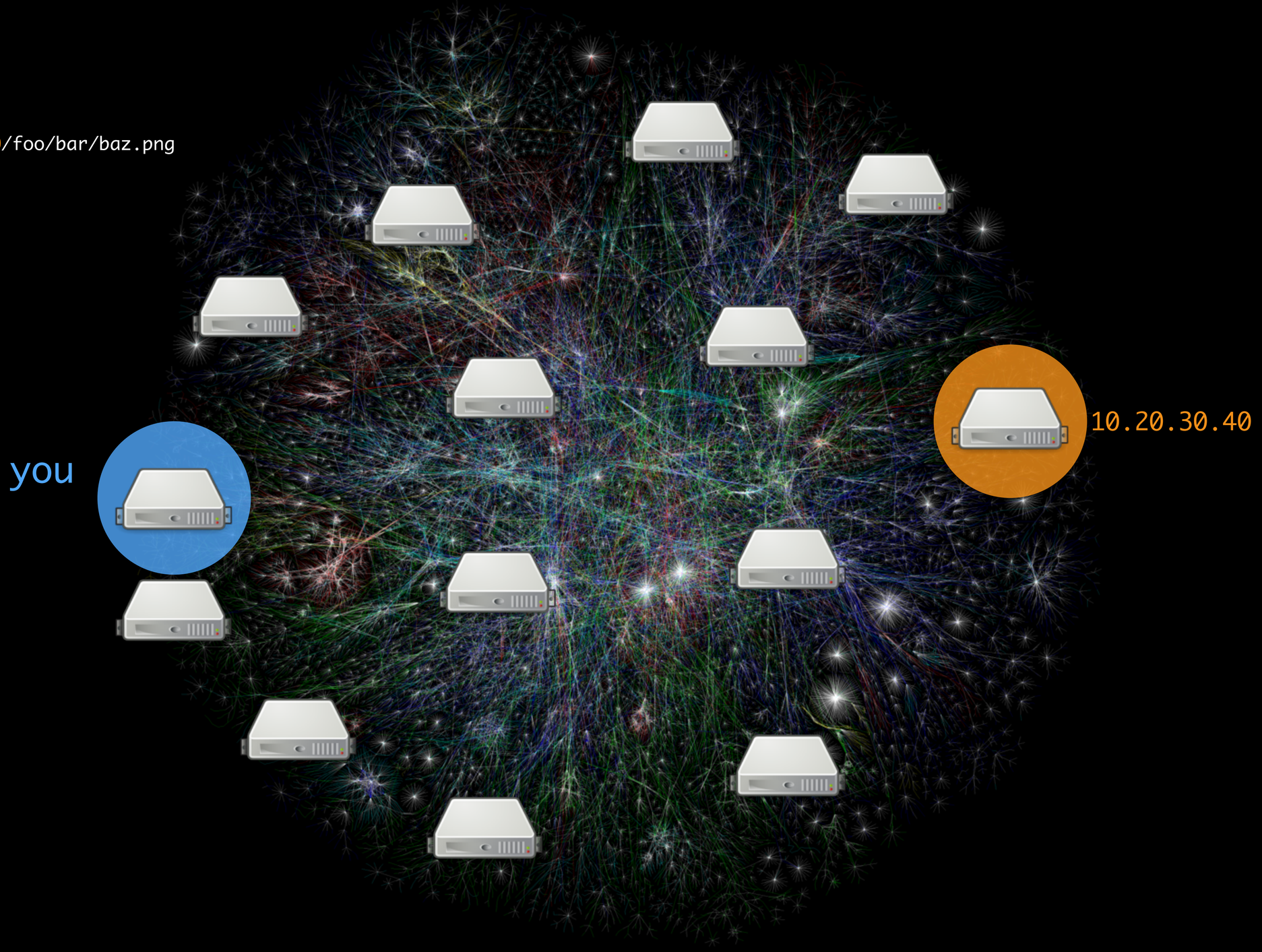
http://10.20.30.40/foo/bar/baz.png

location path

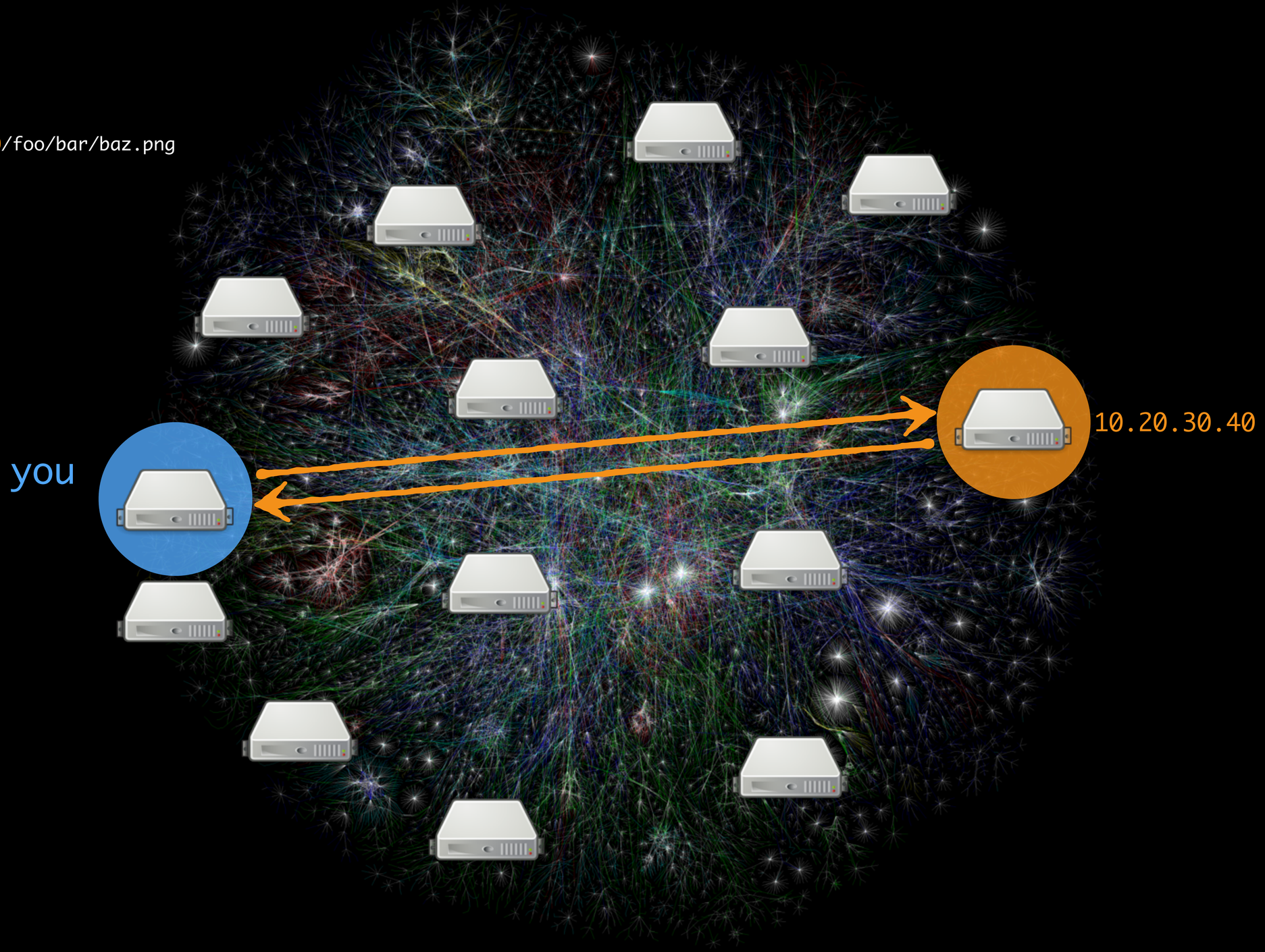
http://10.20.30.40/foo/bar/baz.png

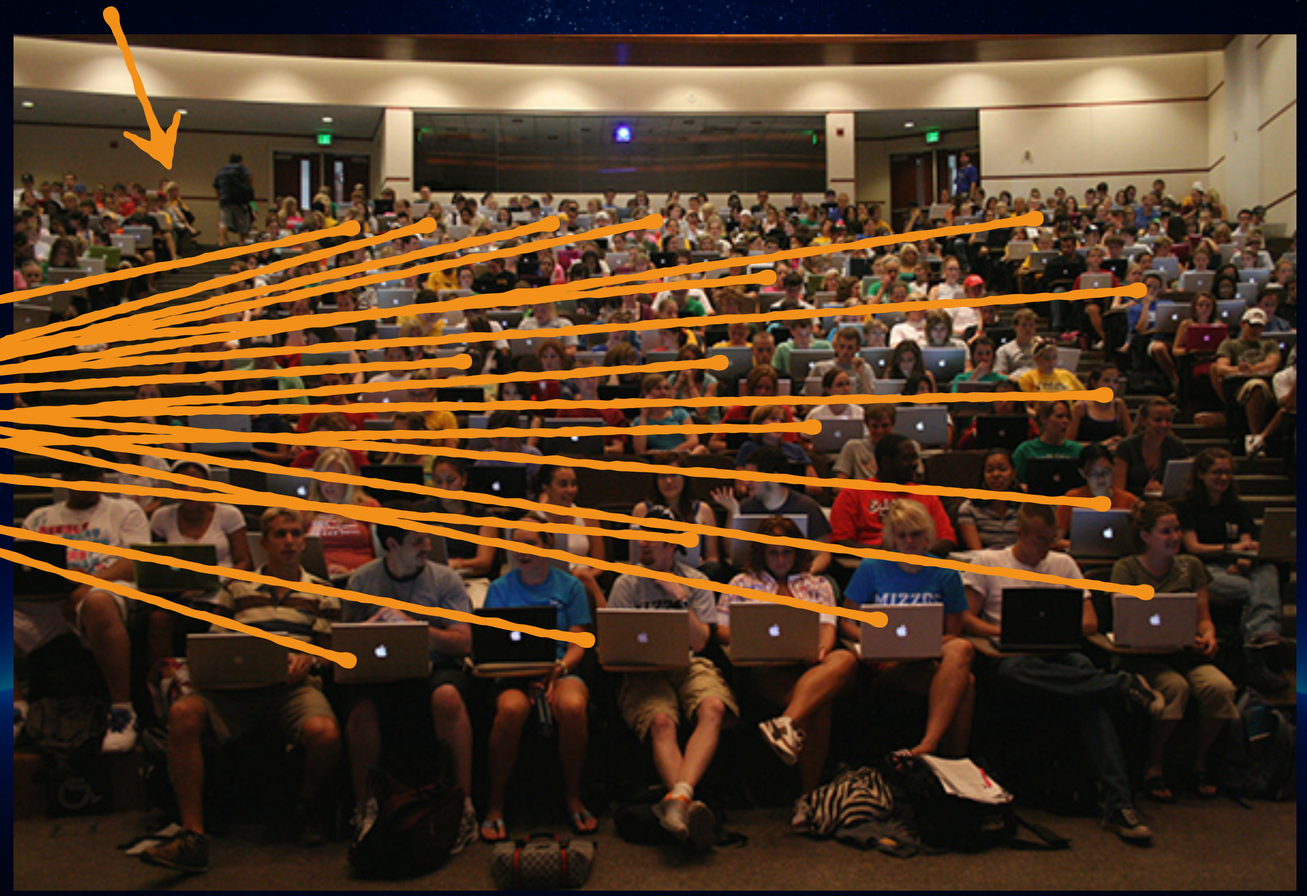


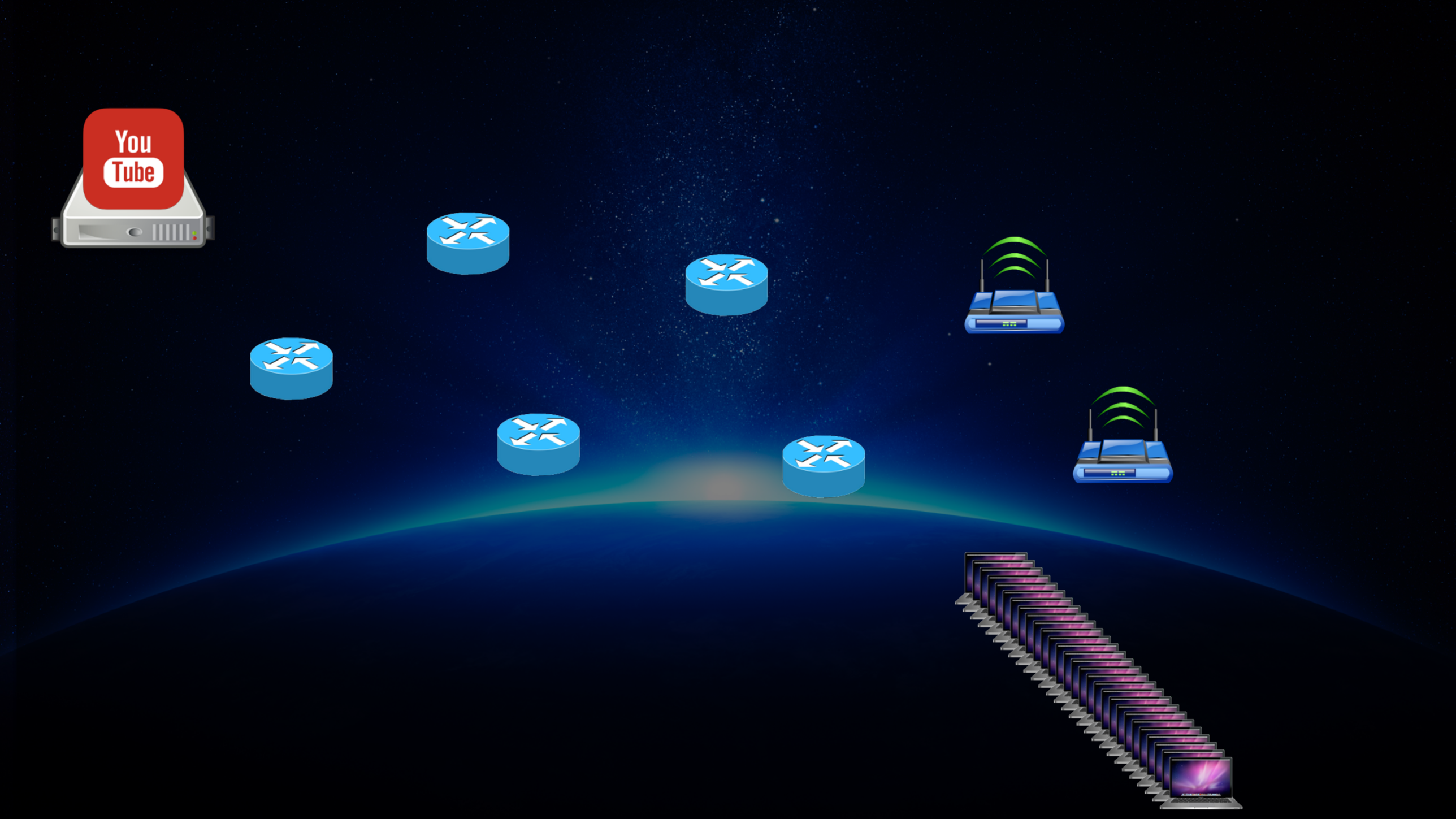
http://10.20.30.40/foo/bar/baz.png



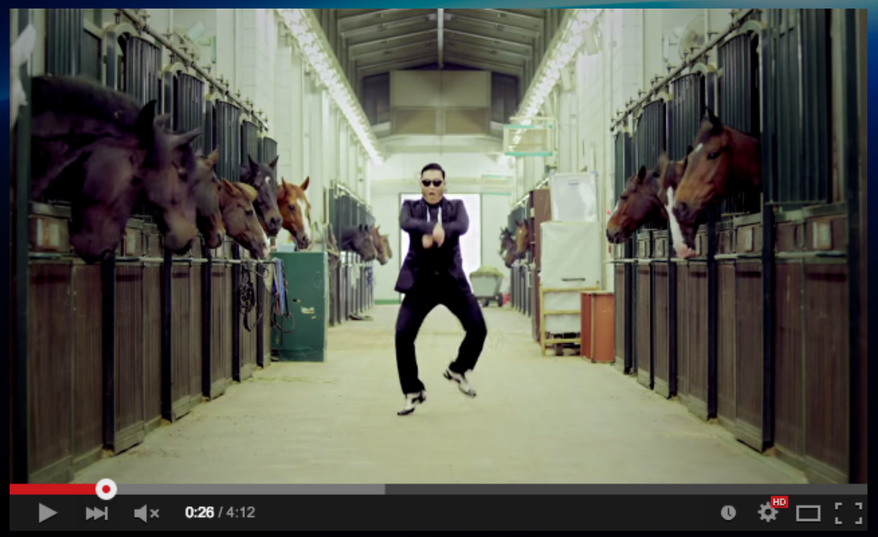
http://10.20.30.40/foo/bar/baz.png

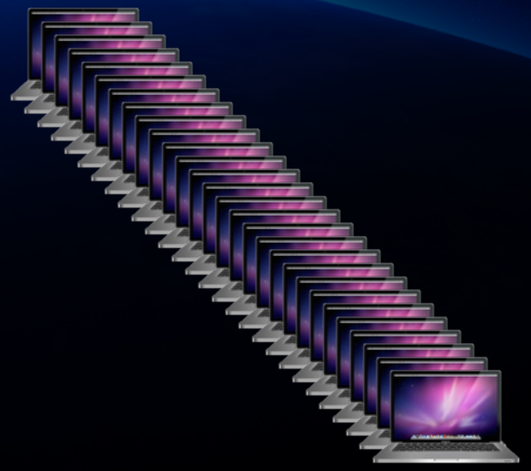





You
Tube

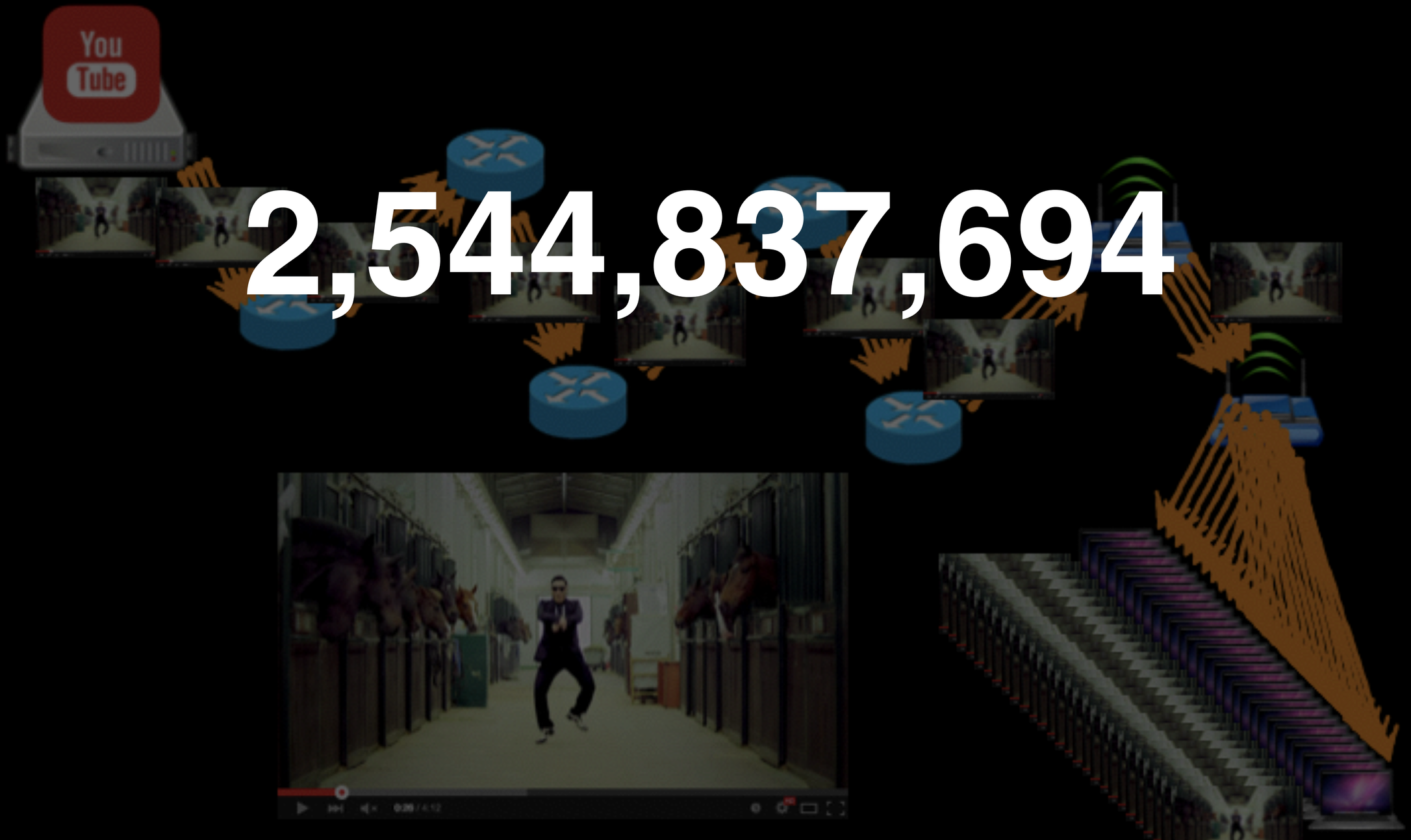
200 MB





200 MB x 30 x 8 = 48 GB

200 MB x 30 x 8 = 48 GB



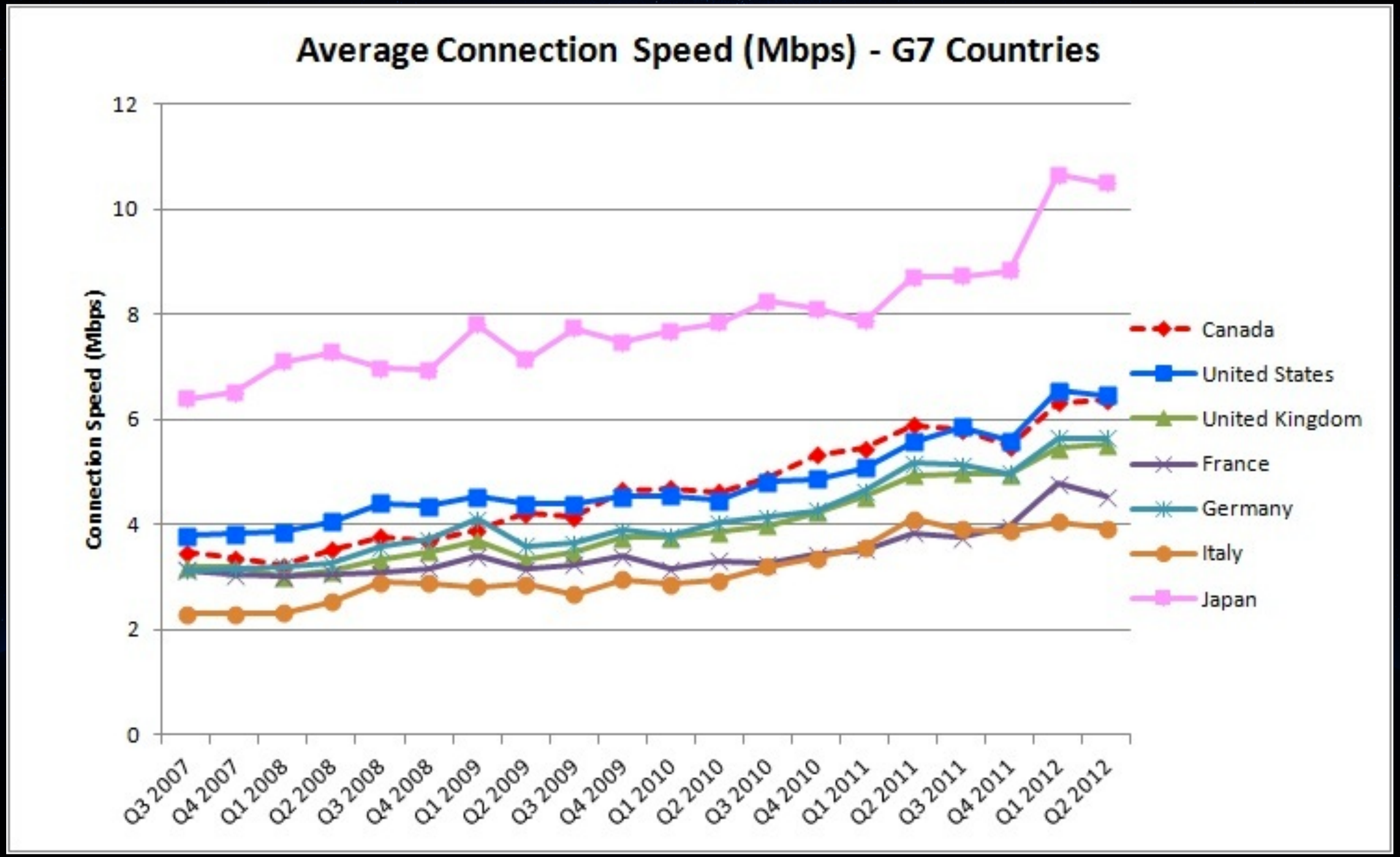
2,544,837,694

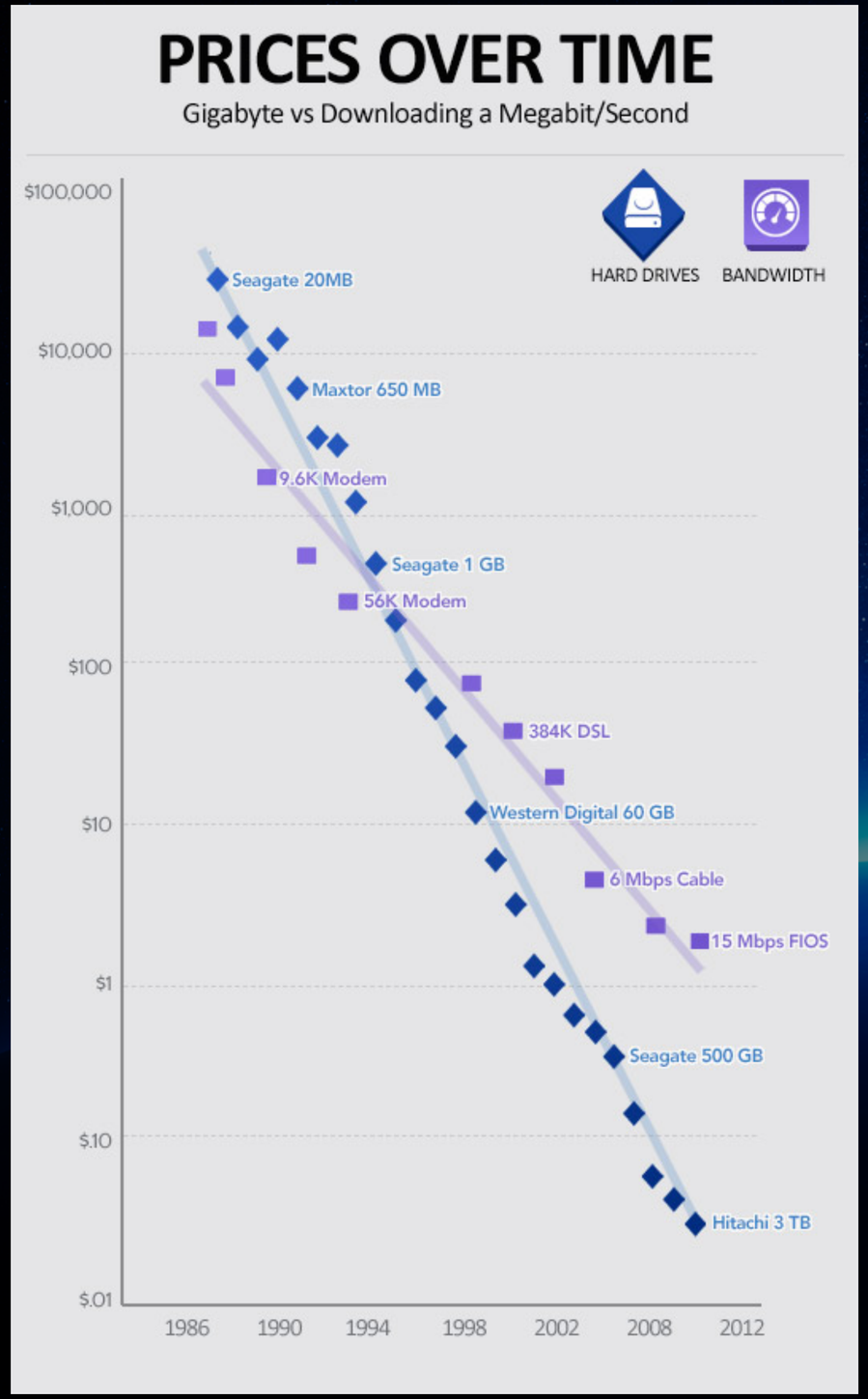
200 MB x 30 x 8 = 48 GB

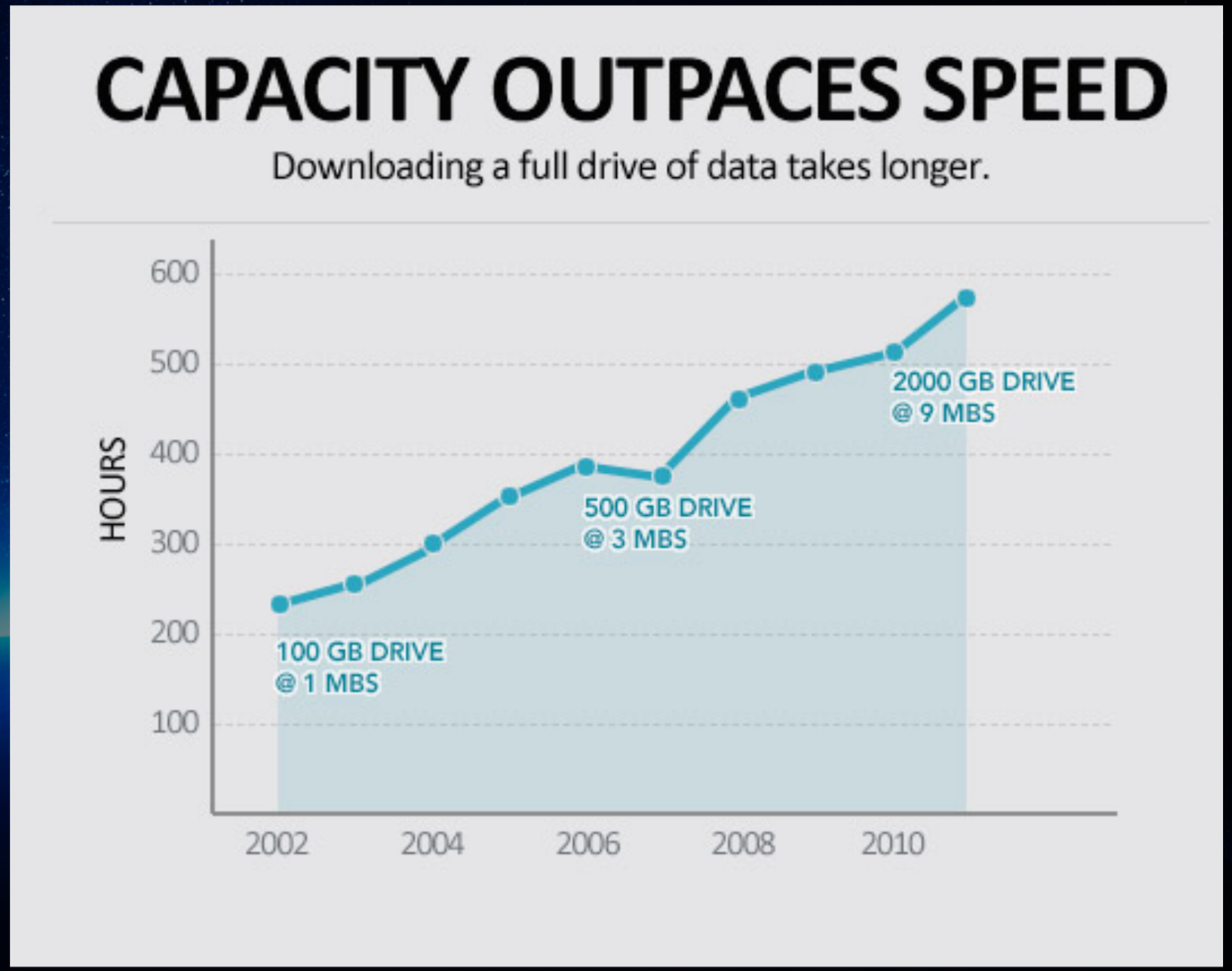
2,387,990,609

508.968 PB

Bandwidth


Average Connection Speed (Mbps) - G7 Countries
Connection Speed (Mbps)
0
2
4
6
8
10
12
Q3 2007
Q4 2007
Q1 2008
Q2 2008
Q3 2008
Q4 2008
Q1 2009
Q2 2009
Q3 2009
Q4 2009
Q1 2010
Q2 2010
Q3 2010
Q4 2010
Q1 2011
Q2 2011
Q3 2011
Q4 2011
Q1 2012
Q2 2012
Canada
United States
United Kingdom
France
Germany
Italy
Japan

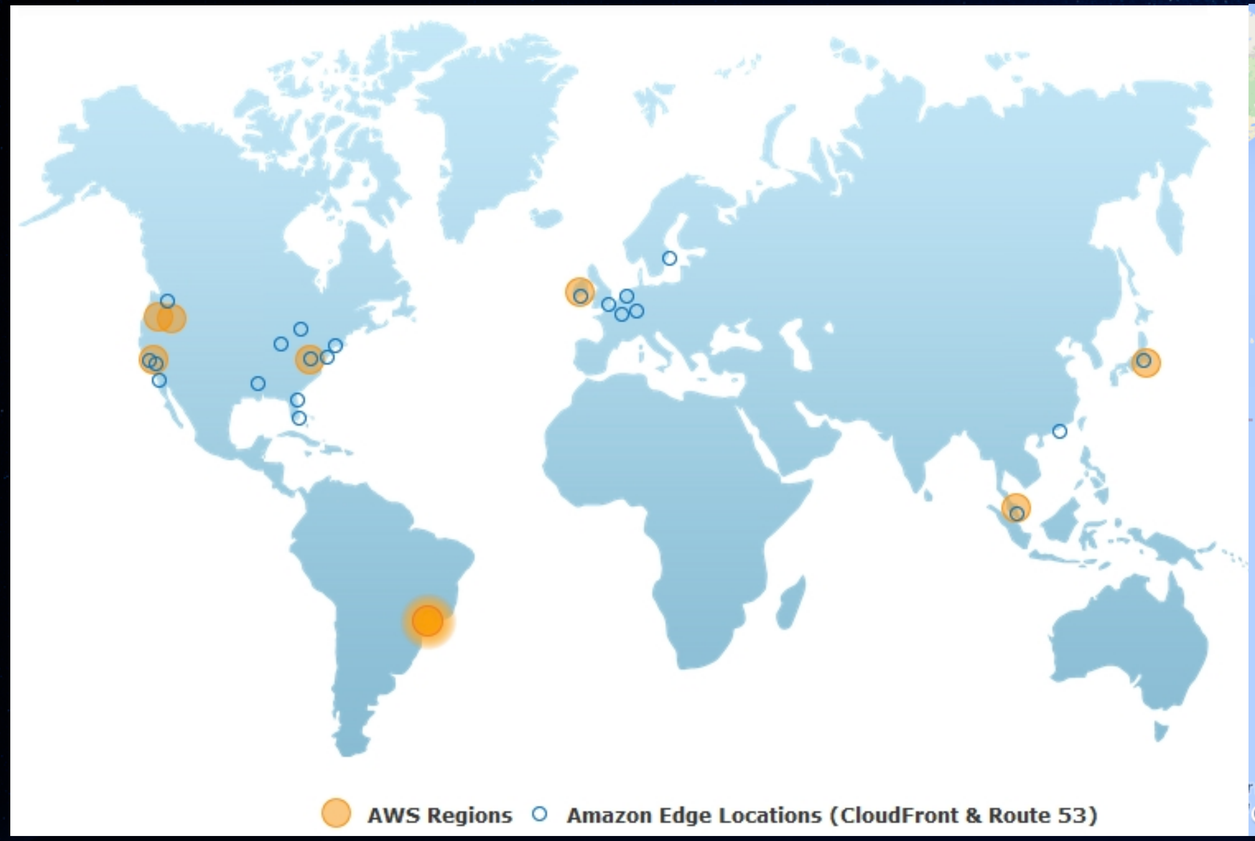


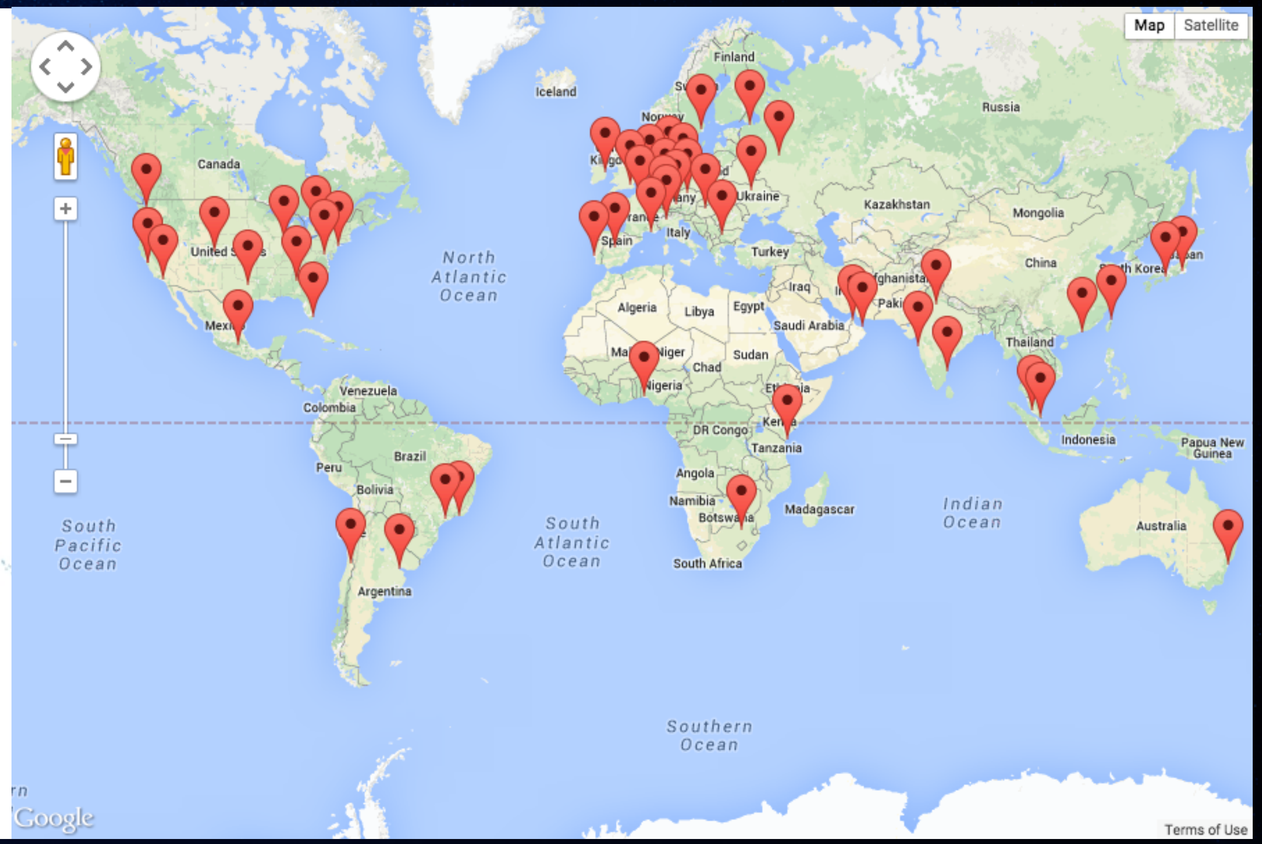


https://www.backblaze.com/blog/price-gap-storage-vs-bandwidth/

Latency

DataCenters

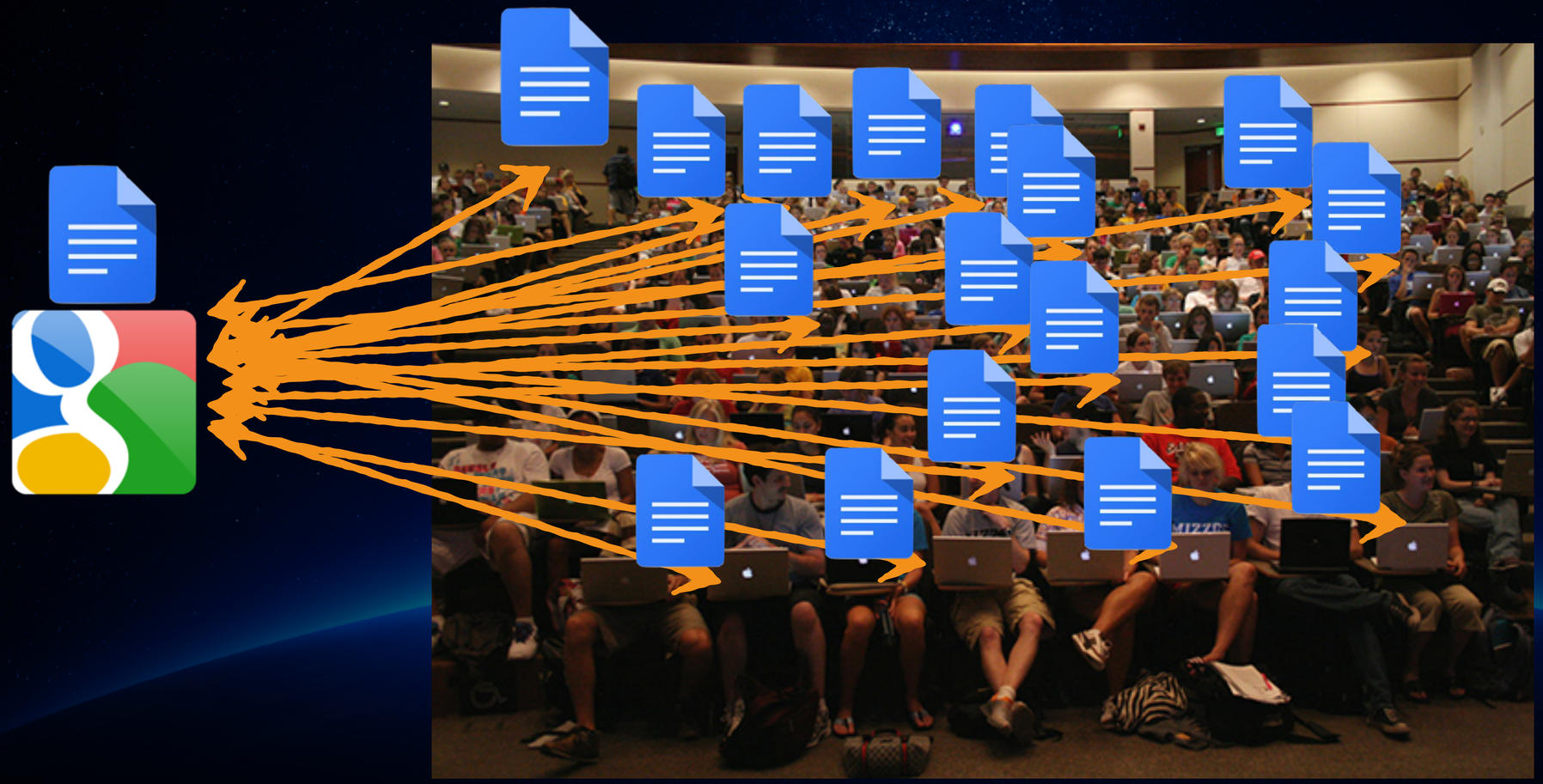


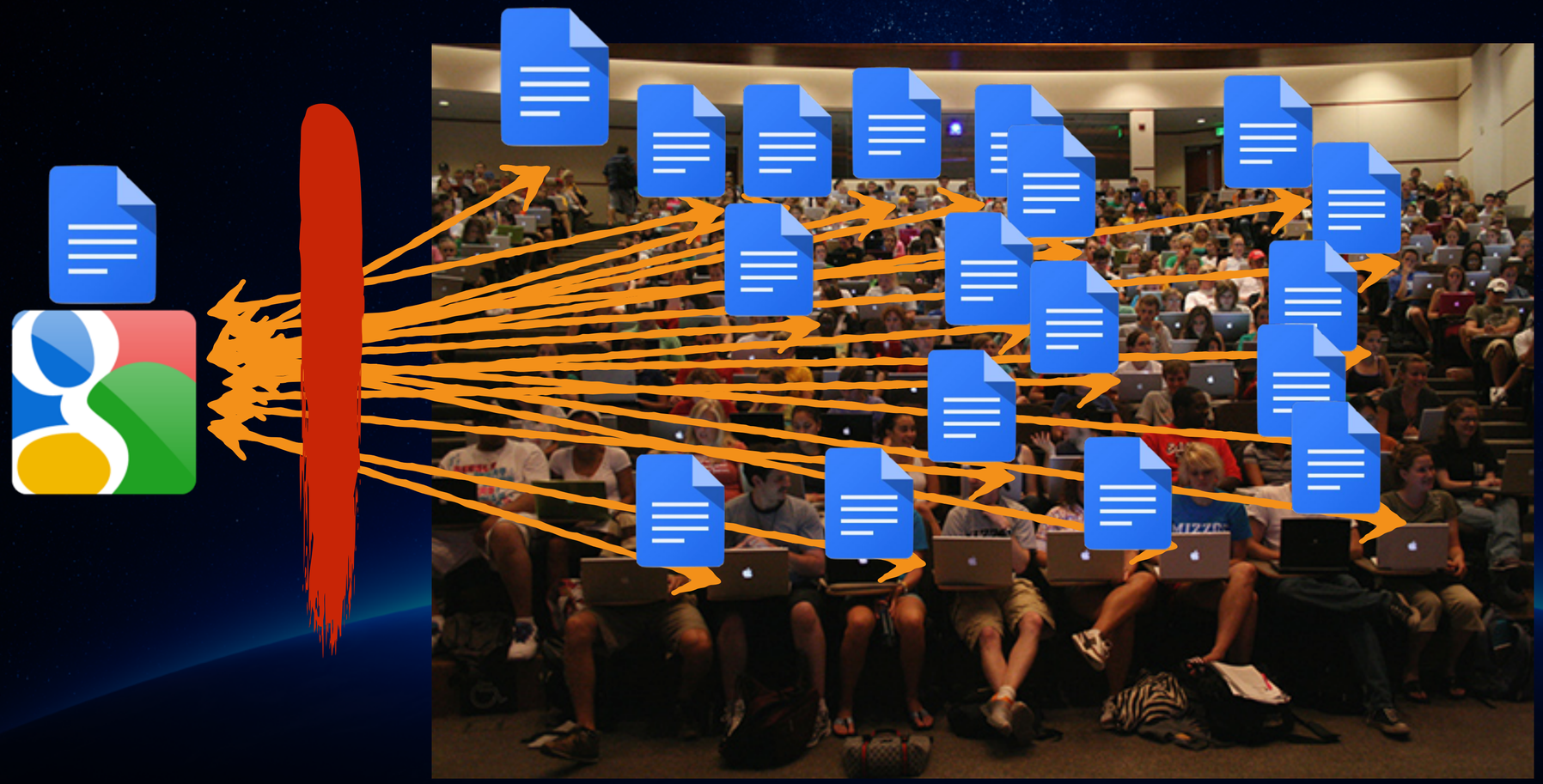


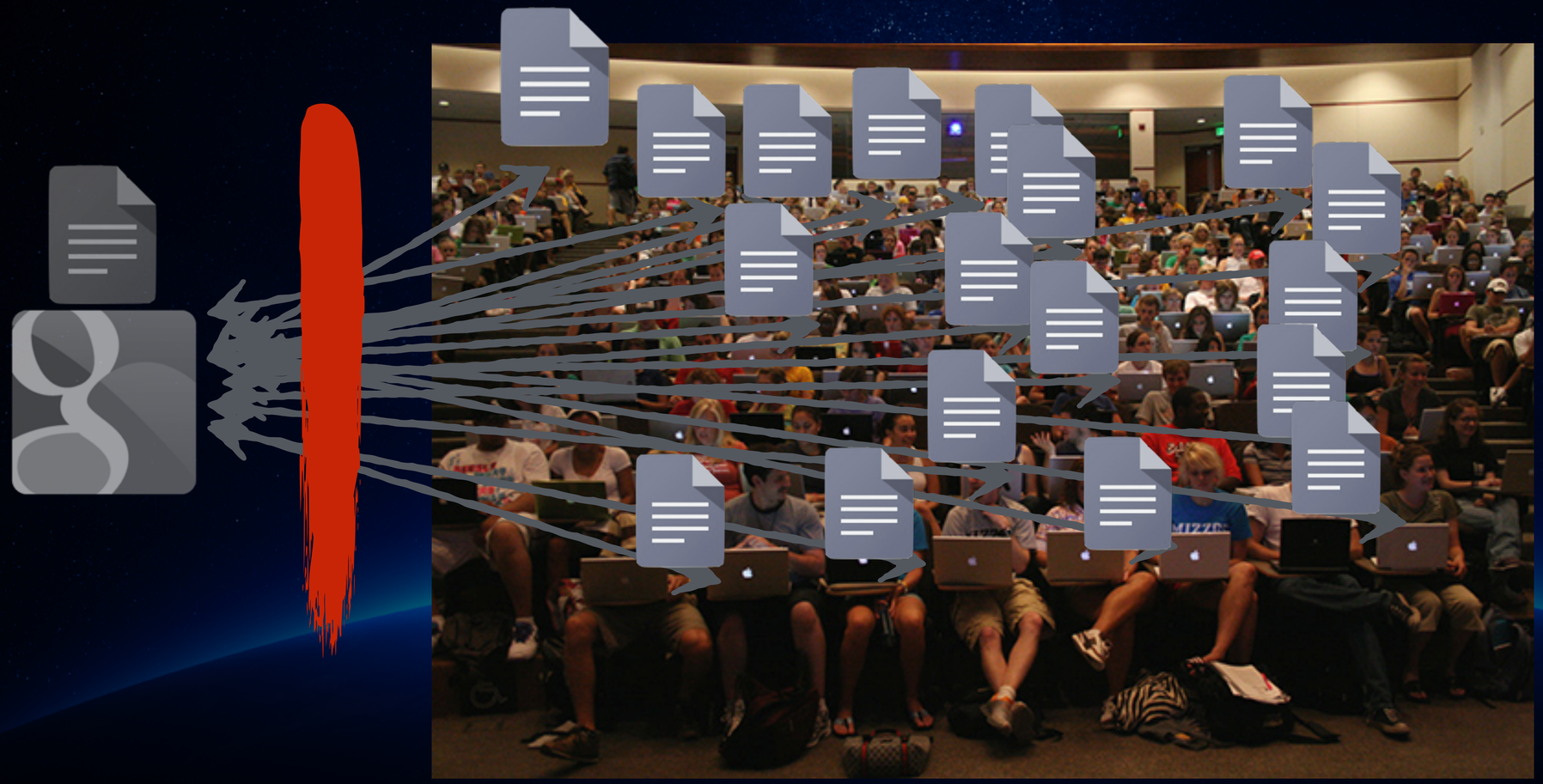
Amazon

Google

Disconnected / Offline

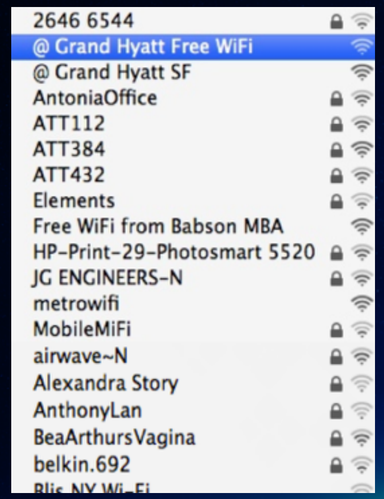






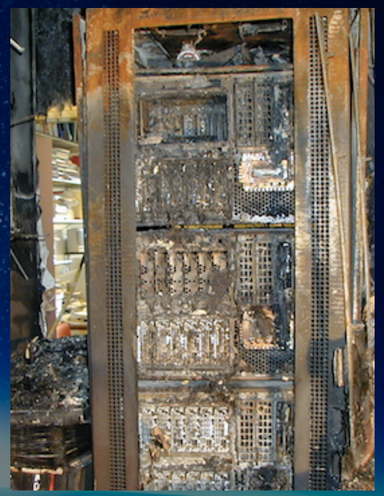
amazon

low bw

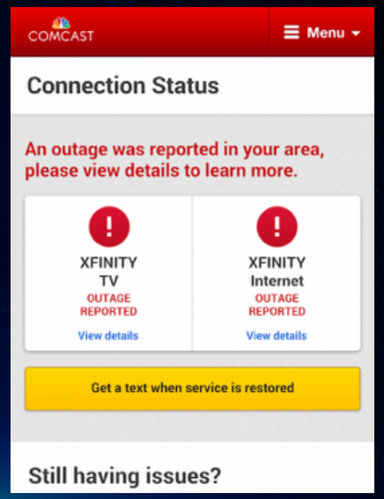


interference

congestion



datacenter



isp outage

travel

Disconnected

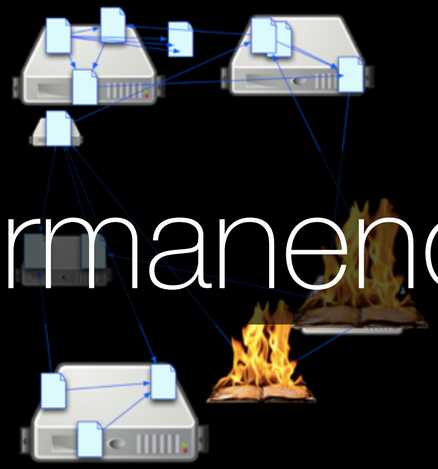
Control

200 MB x 30 x 8 = 48 GB

Bandwidth

IoT

Offline



Permanence

Security

IPFS

InterPlanetary FileSystem

IPFS

a protocol to upgrade the web

IPFS

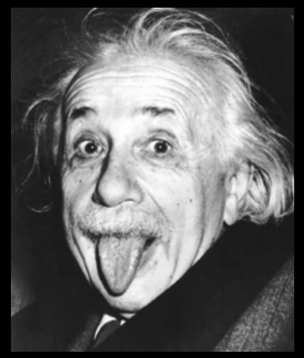
InterPlanetary FileSystem

IPFS

InterPlanetary FileSystem

THE DISTRIBUTED PERMANENT WEB MERKLE

Offline



Smarter

IPFS

Distributed

Permanent

Safer

Faster

web
SFS
git
BitTorrent
+
DHT
IPFS

The IPFS Stack

The IPFS Stack

applications

Using the Data

IPNS

IPLD

naming

merkledag

Defining the Data

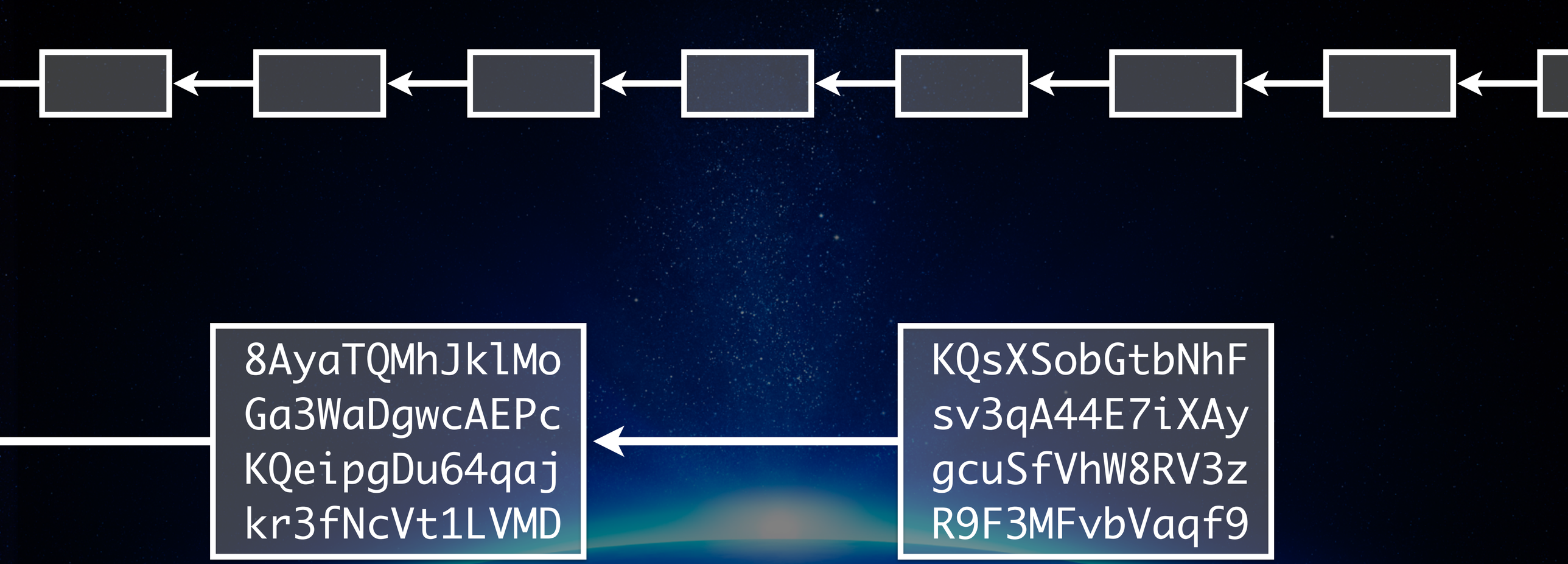
exchange

libp2p

routing

network

Moving the Data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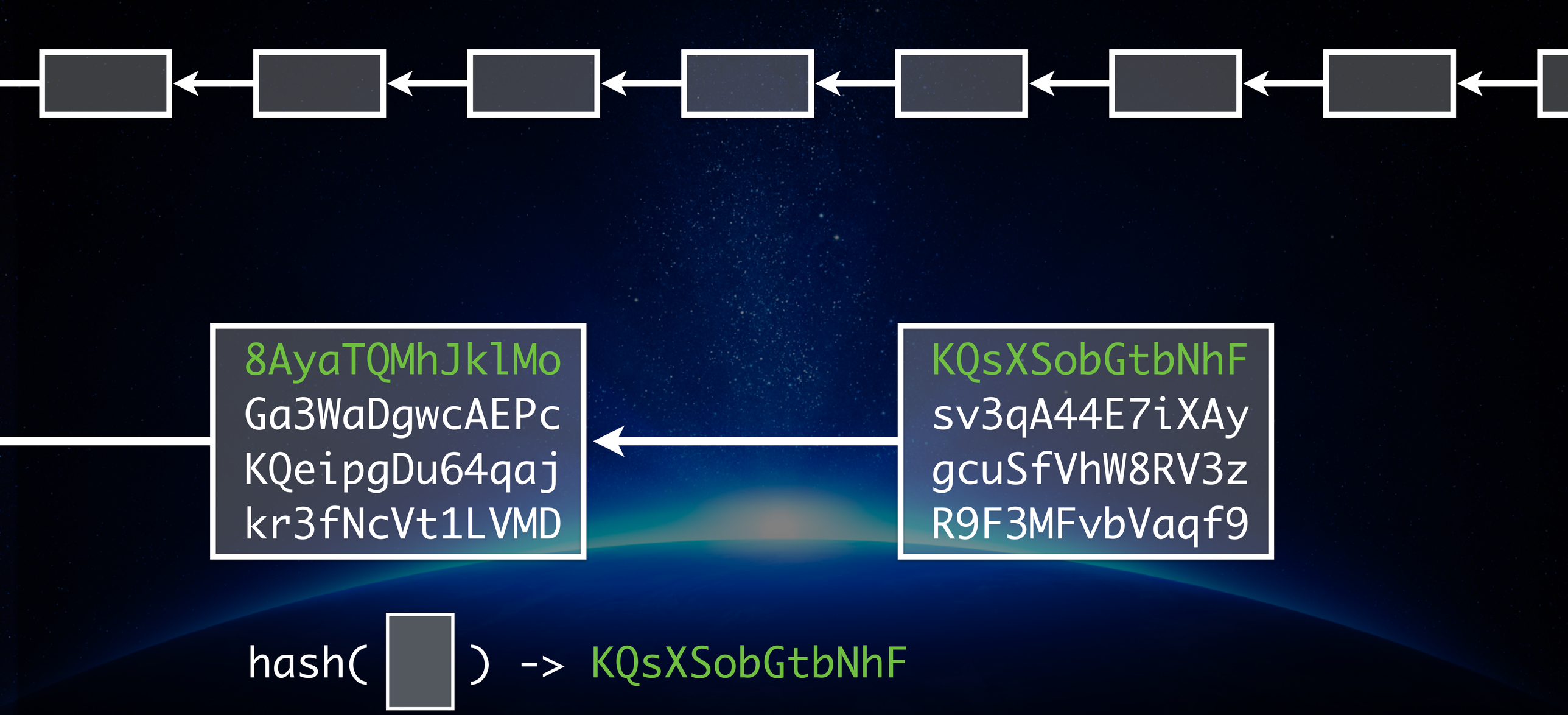
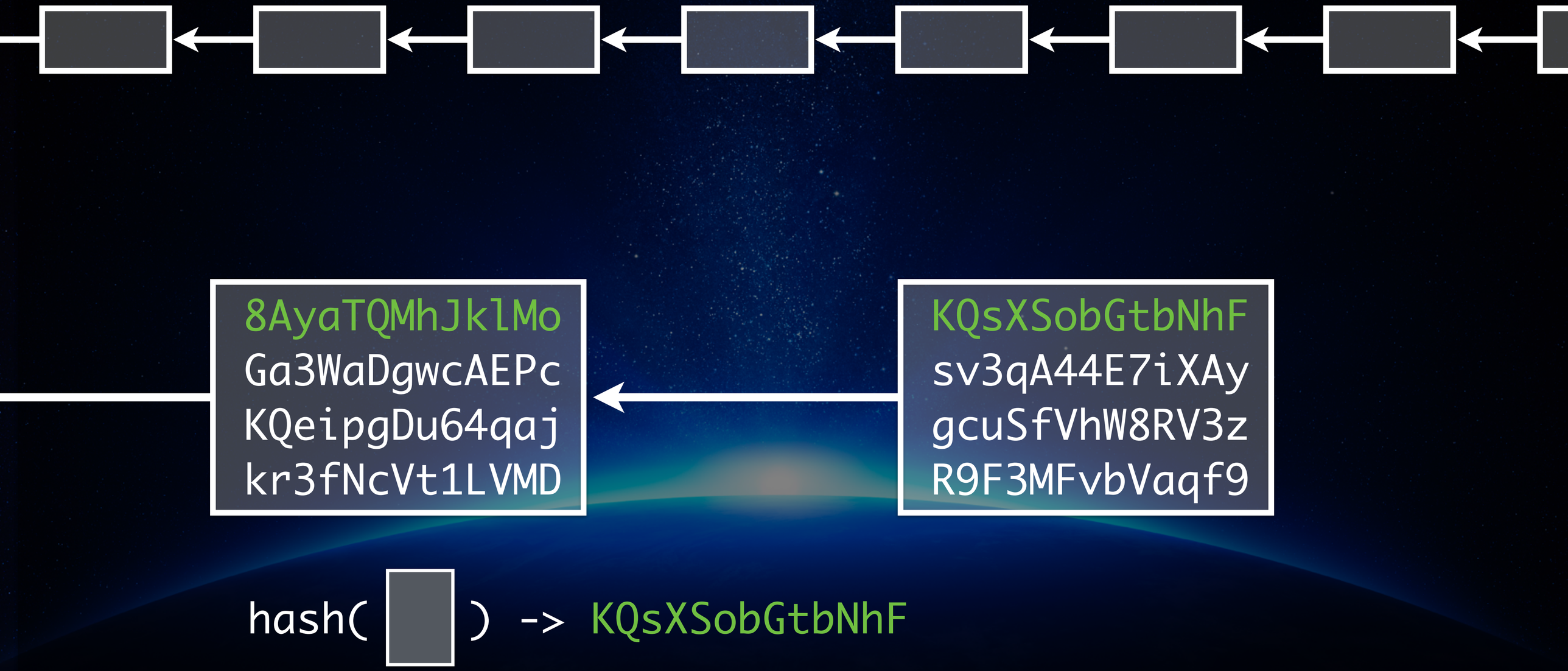
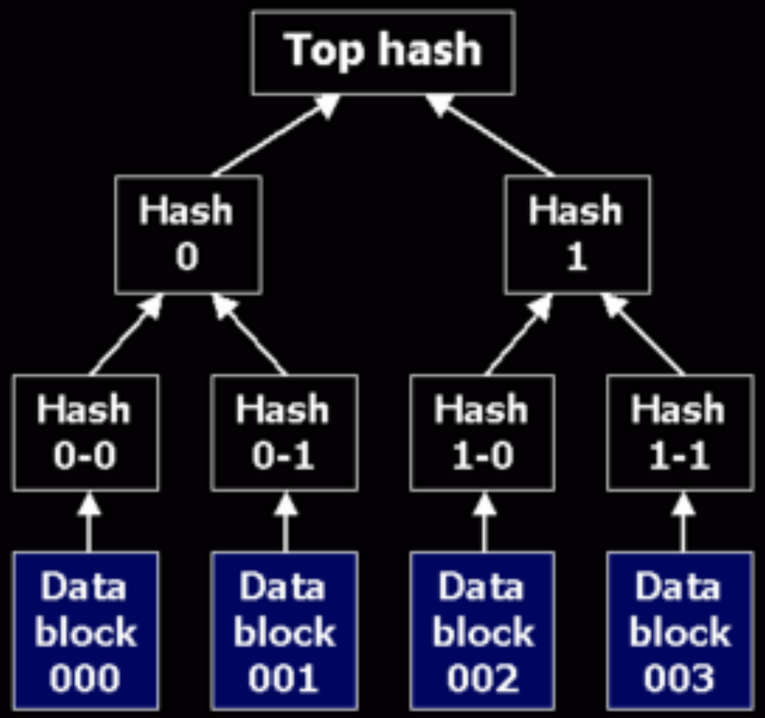
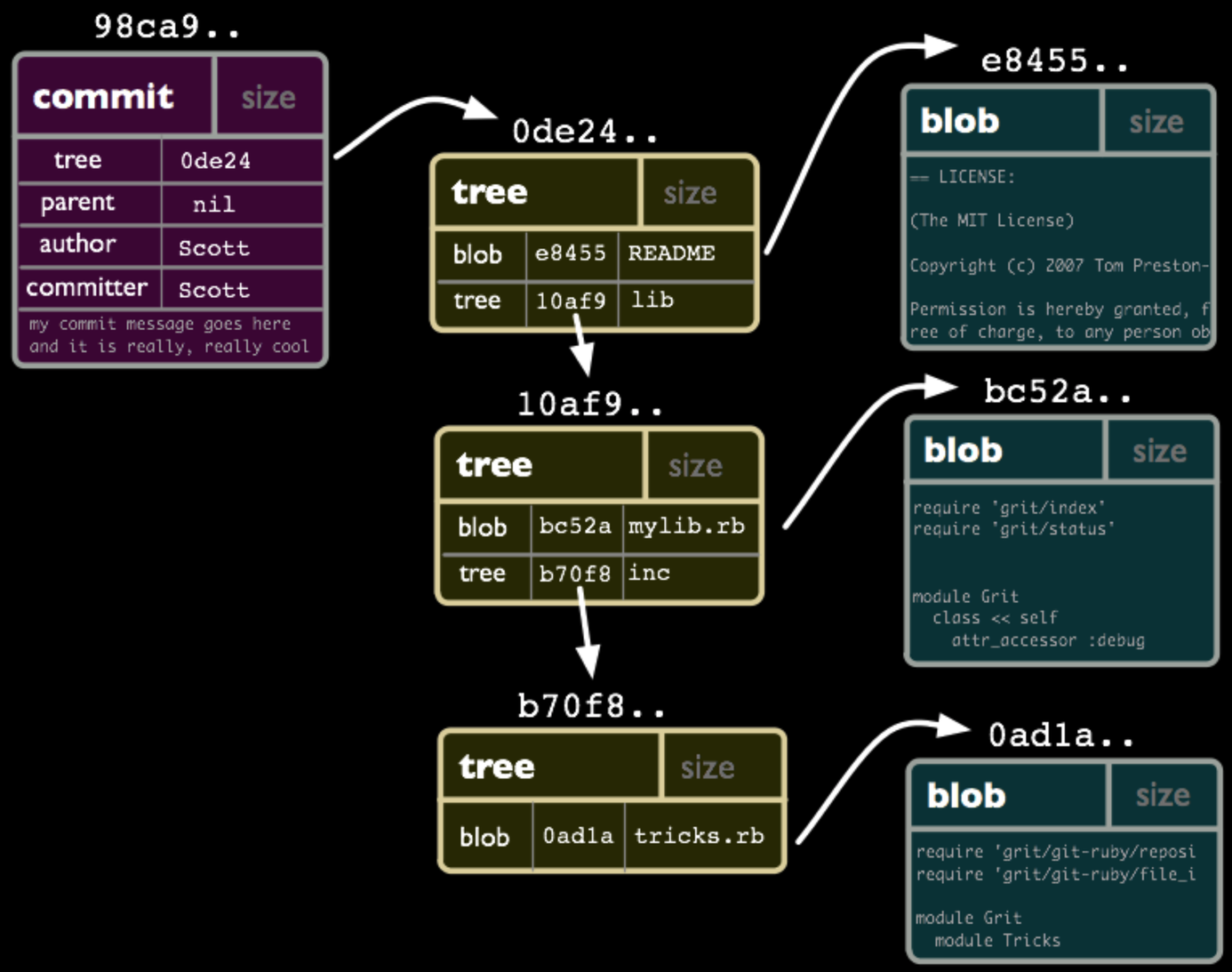
gcuSfVhW8RV3z
R9F3MFvbVaqf9


8AyaTQMhJklMo
Ga3WaDgwcAEPc
KQeipgDu64qaj
kr3fNcVt1LVMD
KQsXSobGtbNhF
sv3qA44E7iXAy
gcuSfVhW8RV3z
R9F3MFvbVaqf9
hash( ) -> KQsXSobGtbNhF

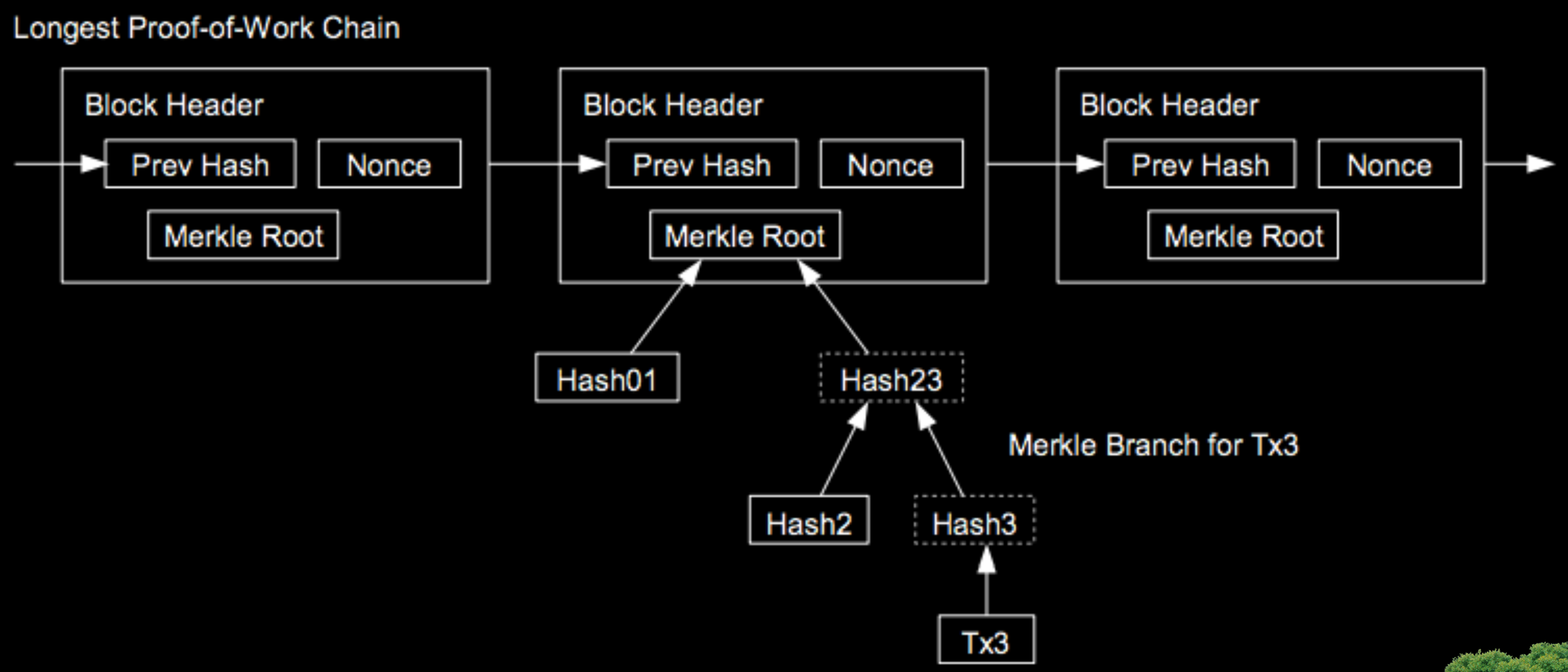

8AyaTQMhJklMo
Ga3WaDgwcAEPc
KQeipgDu64qaj
kr3fNcVt1LVMD
KQsXSobGtbNhF
sv3qA44E7iXAy
gcuSfVhW8RV3z
R9F3MFvbVaqf9
hash( ) -> KQsXSobGtbNhF

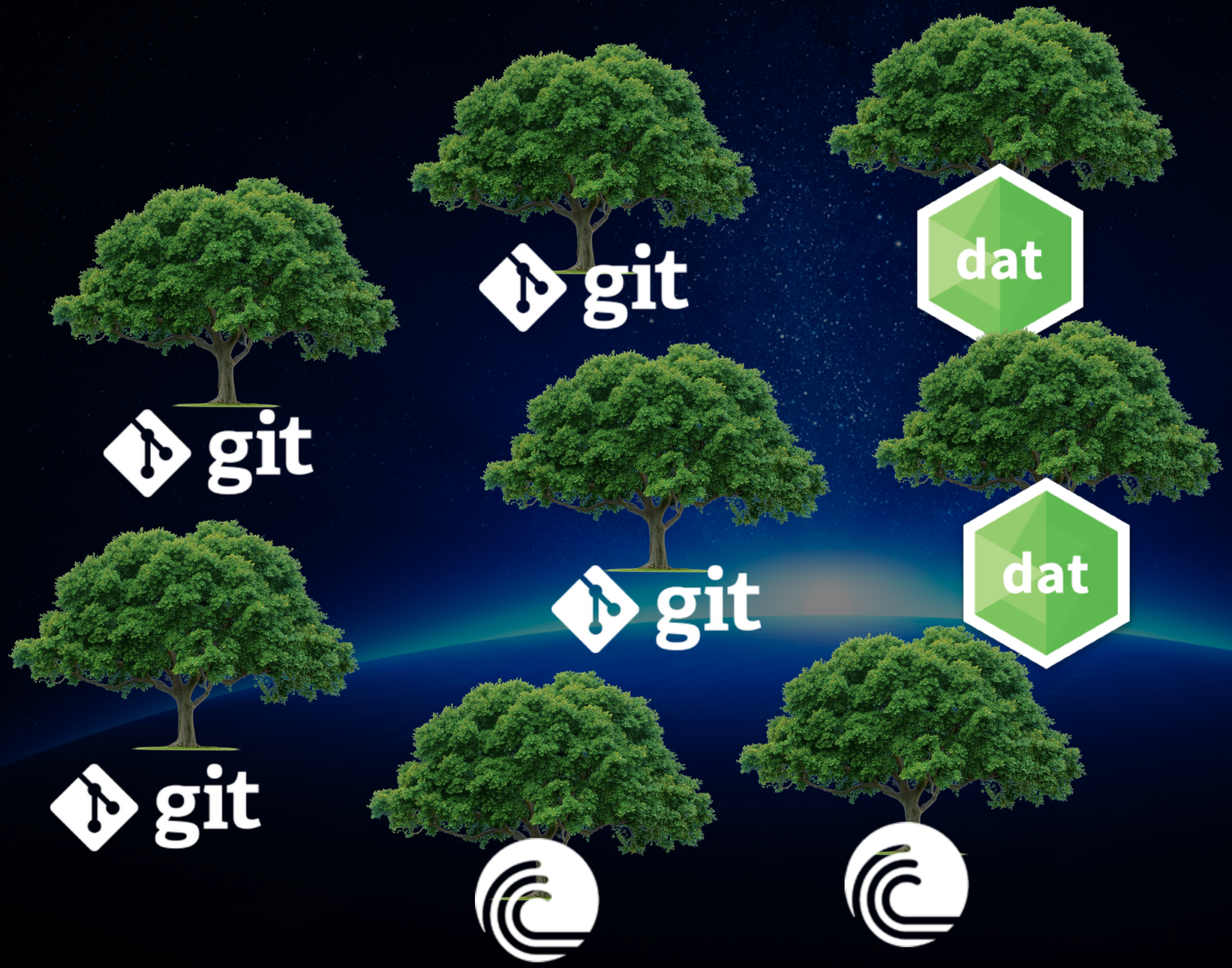
MERKLE LINK


Top hash
Hash 0
Hash 1
Hash 0-0
Hash 0-1
Hash 1-0
Hash 1-1
Data block 000
Data block 001
Data block 002
Data block 003


98ca9..
commit
size
tree
0de24
parent
nil
author
Scott
committer
Scott
my commit message goes here
and it is really, really cool
0de24..
tree
size
blob
e8455
README
tree
10af9
lib
e8455..
blob
size
== LICENSE:
(The MIT License)
Copyright (c) 2007 Tom Preston-
Permission is hereby granted, f
ree of charge, to any person ob
10af9..
tree
size
blob
bc52a
mylib.rb
tree
b70f8
inc
bc52a..
blob
size
require 'grit/index'
require 'grit/status'
module Grit
class << self
attr_accessor :debug
b70f8..
tree
size
blob
0ad1a
tricks.rb
0ad1a..
blob
size
require 'grit/git-ruby/reposi
require 'grit/git-ruby/file_i
module Grit
module Tricks

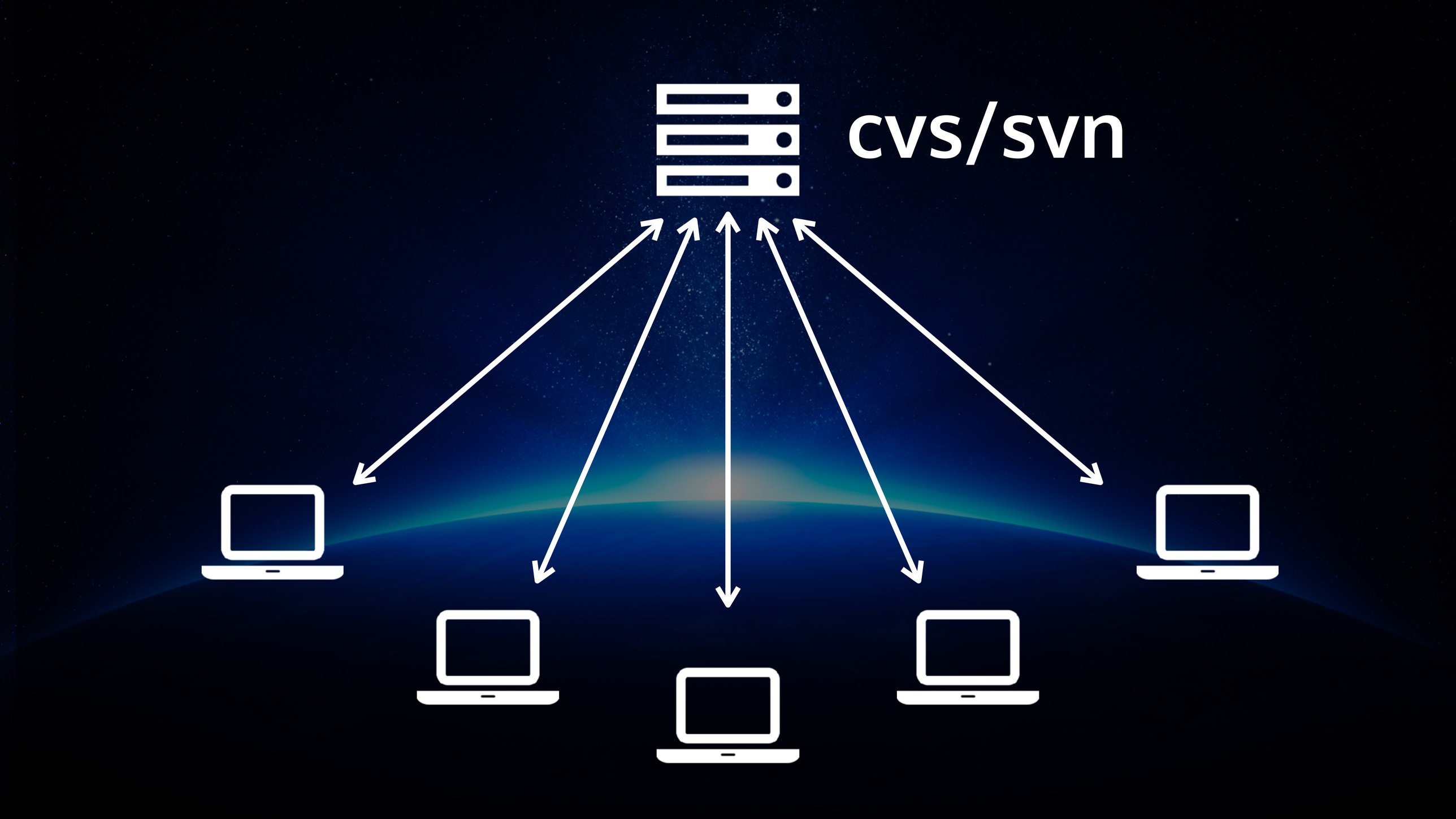
git

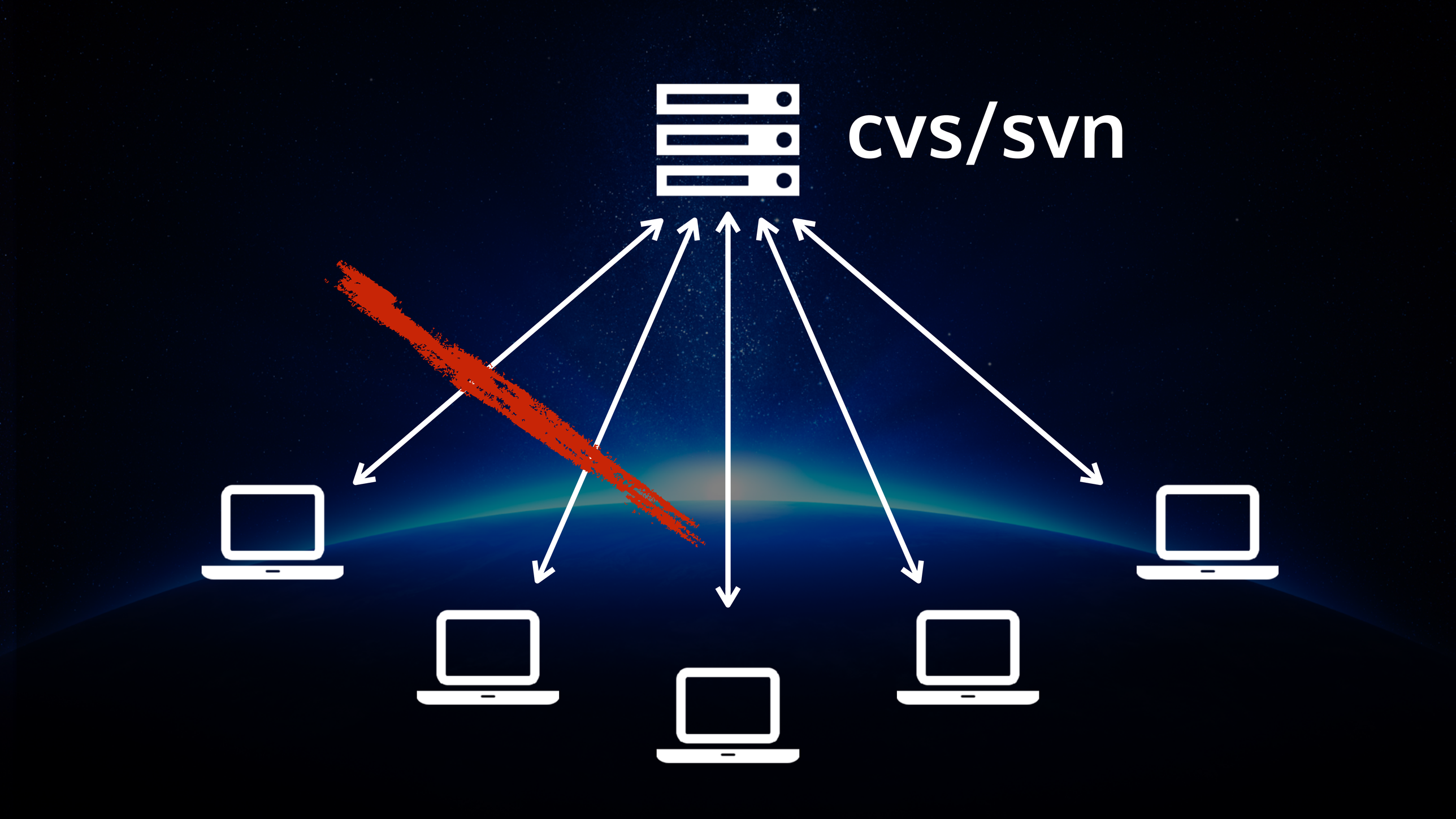

Longest Proof-of-Work Chain
Block Header
Prev Hash
Nonce
Merkle Root
Block Header
Prev Hash
Nonce
Merkle Root
Block Header
Prev Hash
Nonce
Merkle Root
Hash01
Hash23
Merkle Branch for Tx3
Hash2
Hash3
Tx3

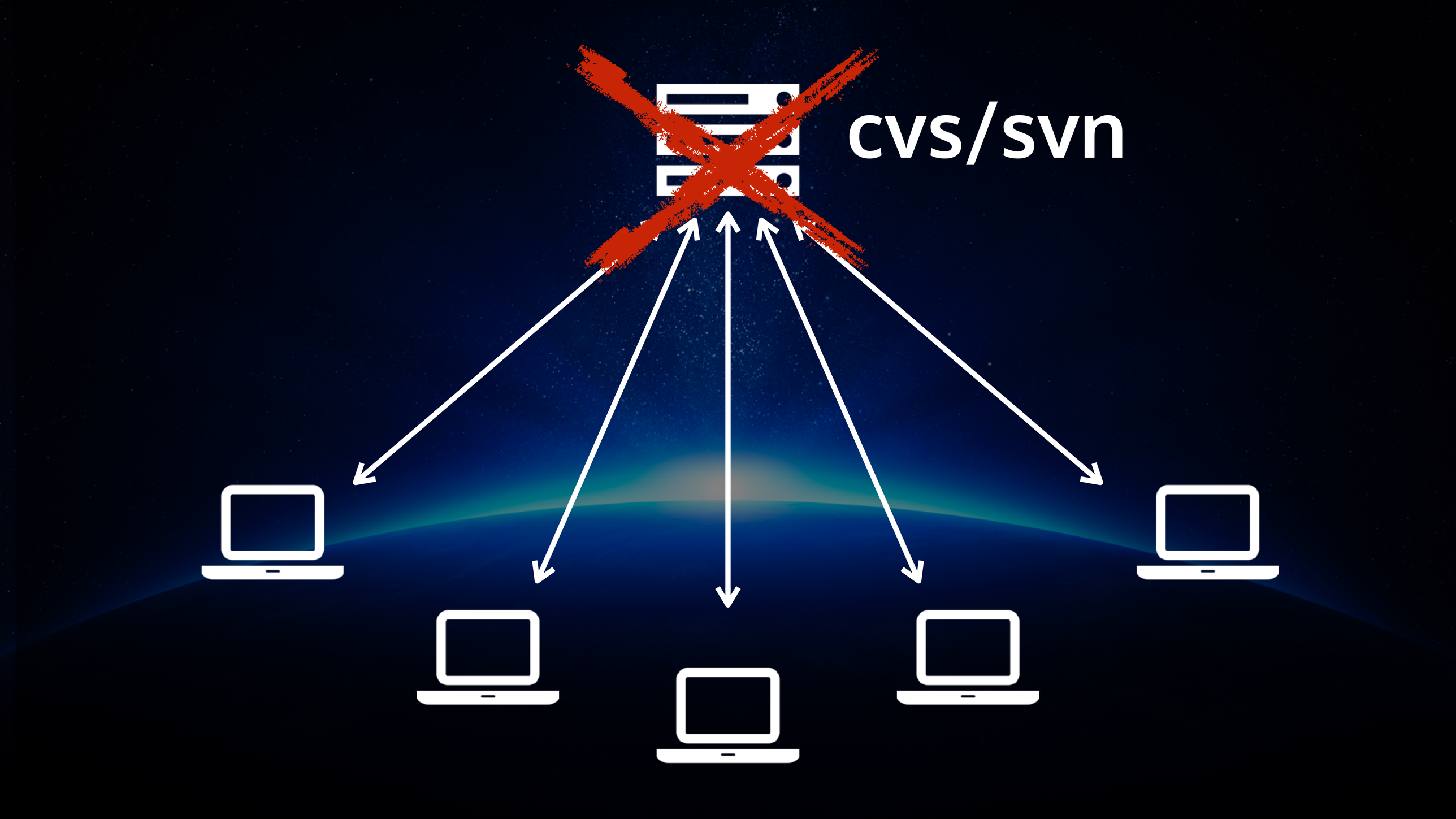

git
git
dat
git
dat
git
git

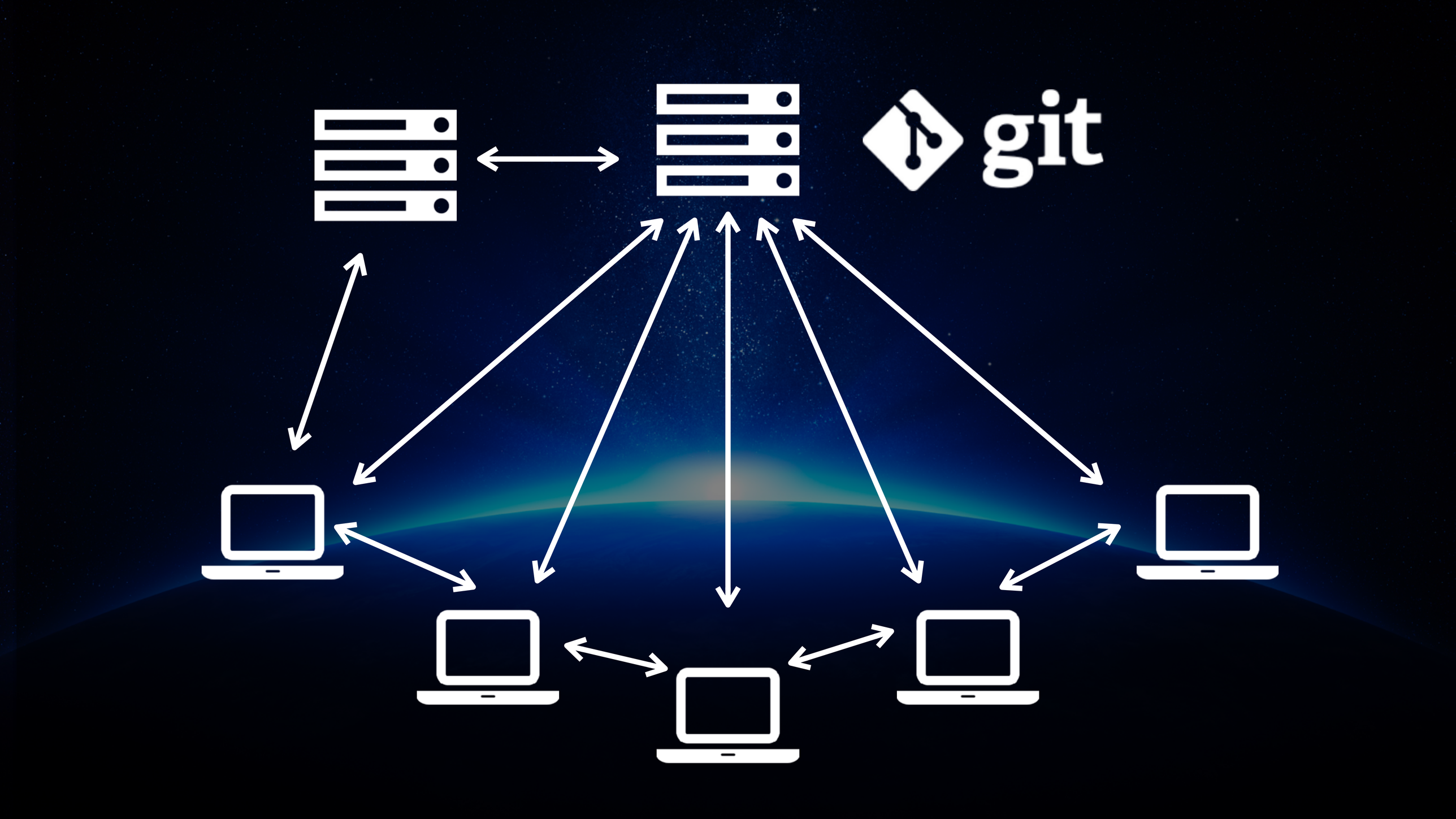
git
git
git
git
git

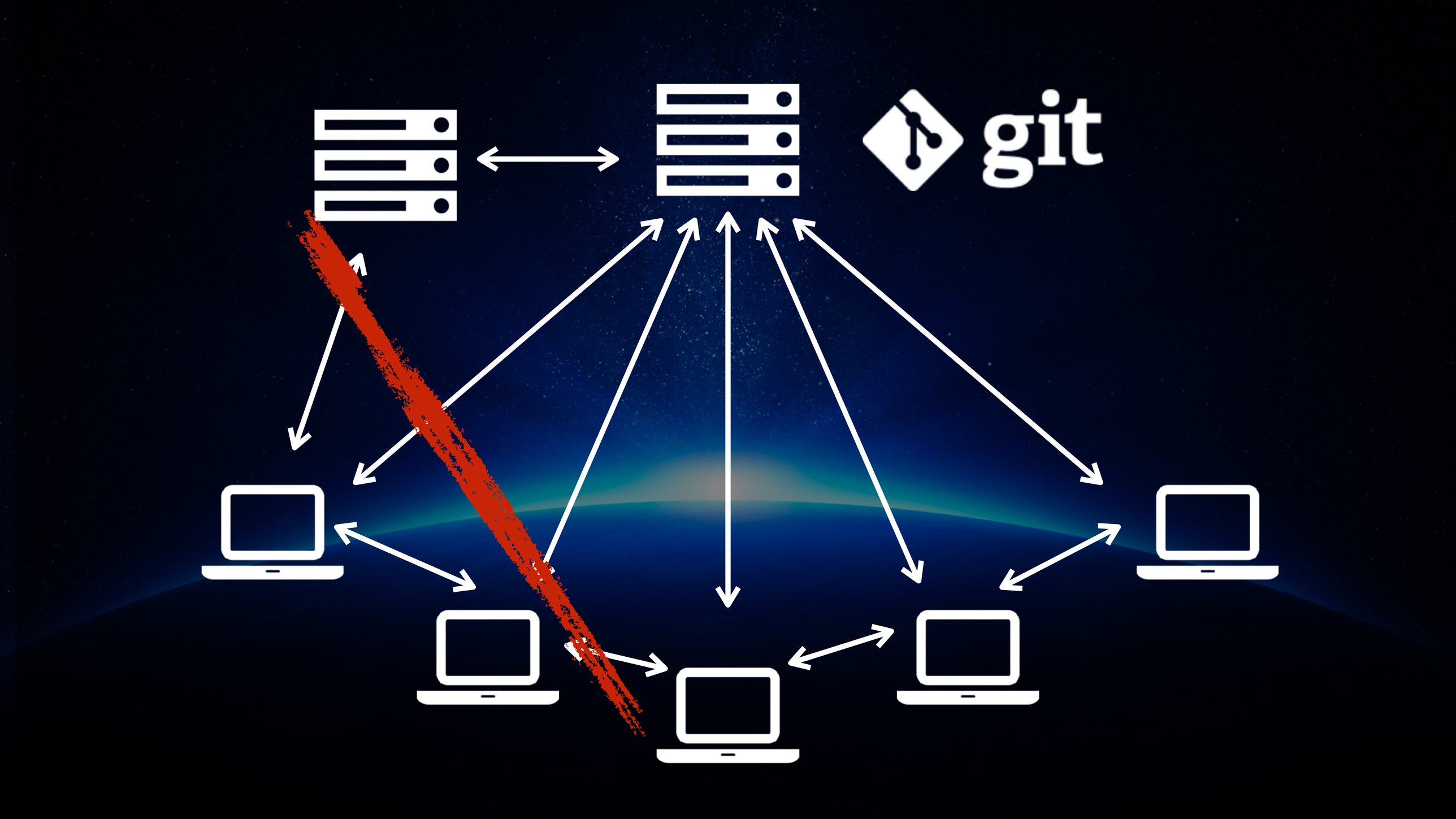
IPFS


cvs/svn


cvs/svn


cvs/svn


git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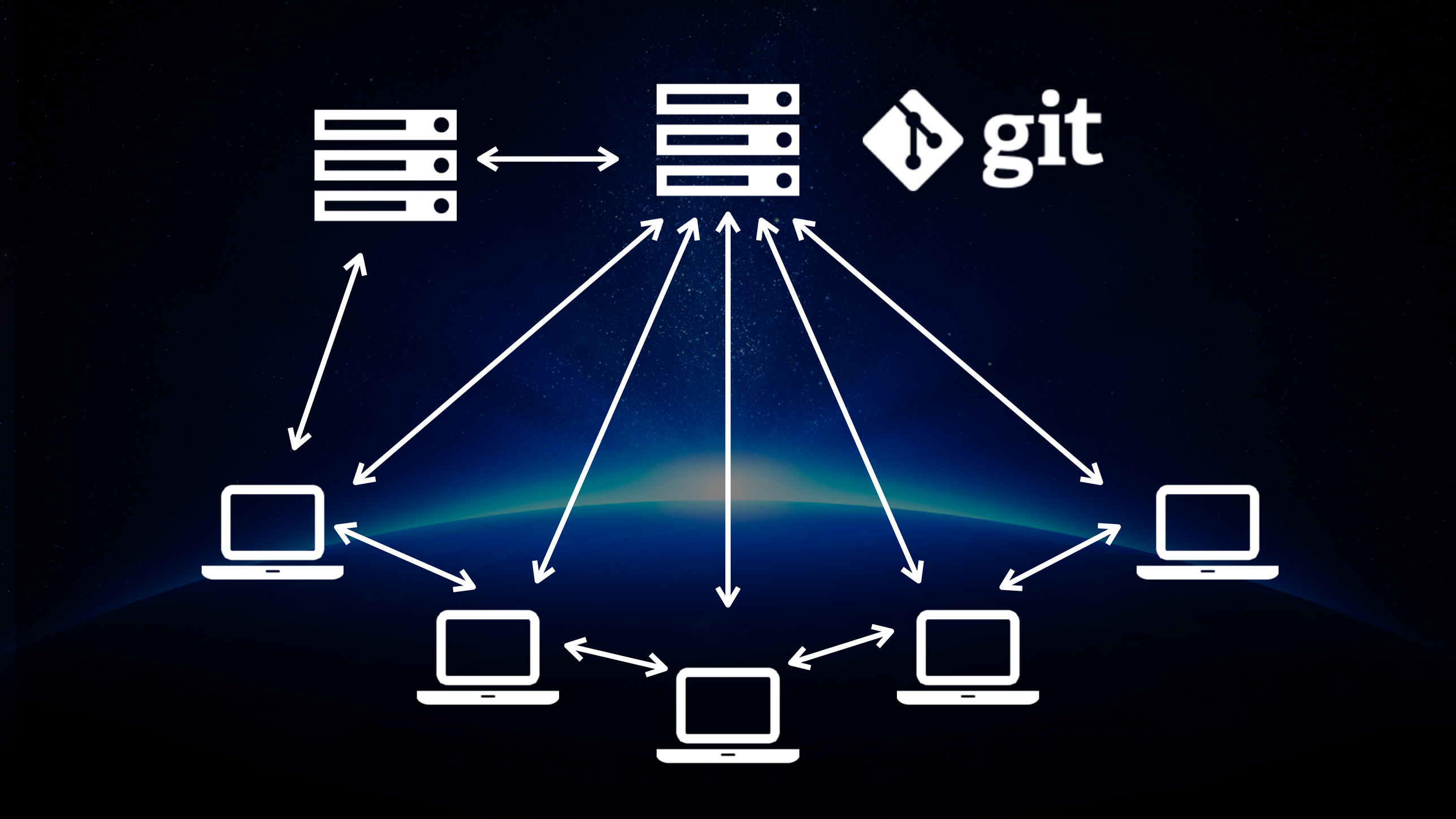
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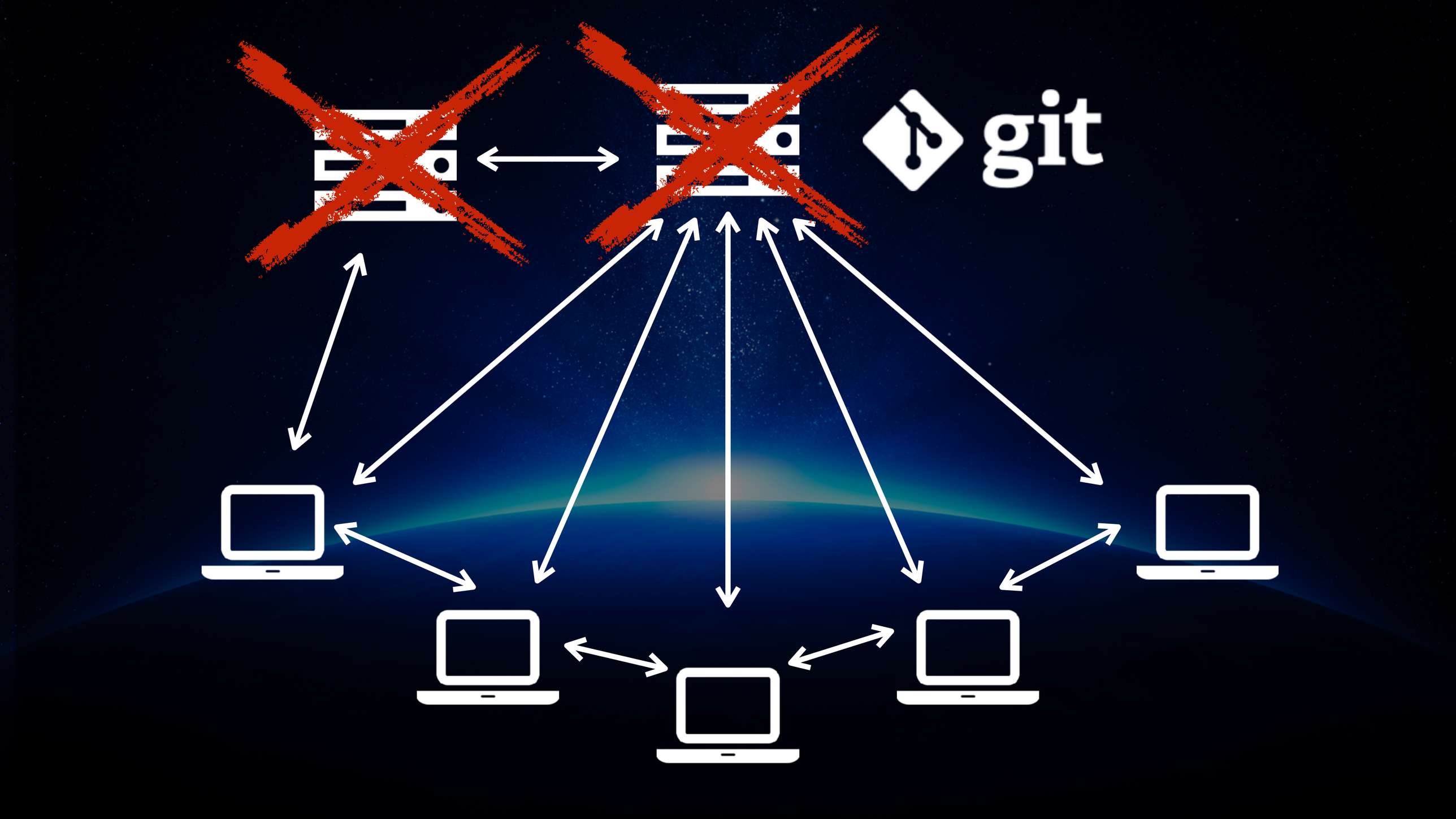
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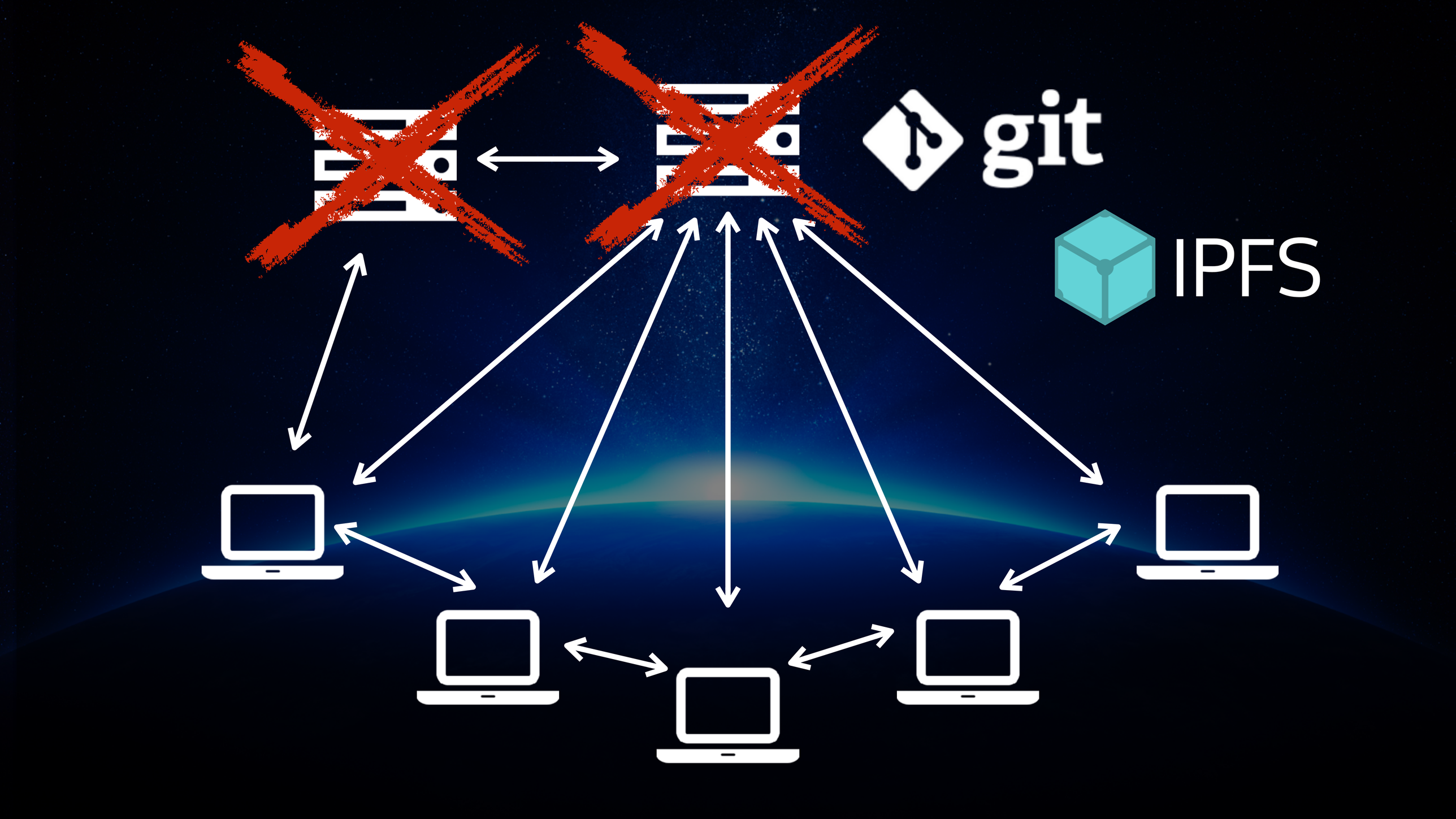
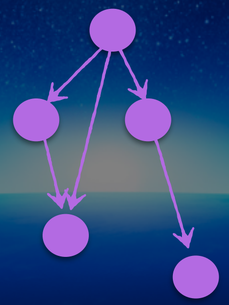

git
IPFS

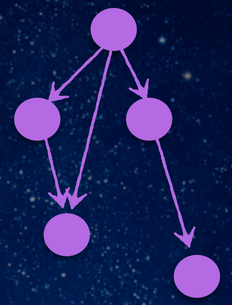
IPFS

merkledag



IPFS

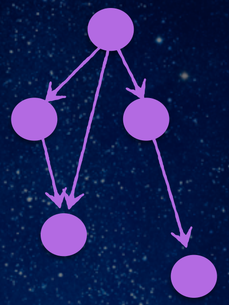
in IPFS
data forms a dag



it's called the **merkle dag**
because the links are hashes

IPFS

any data structures are
represented as dags



IPFS

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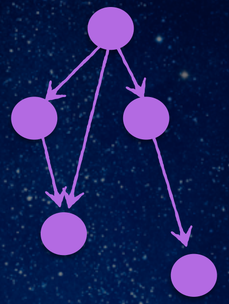
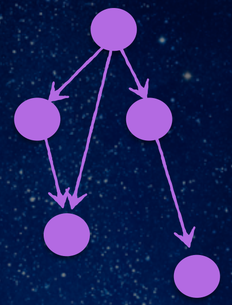


unix files
and dirs

IPFS

any data structures are
represented as dags



unix files
and dirs

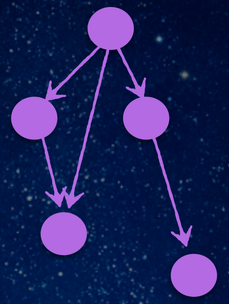
git

blob, tree, commit

IPFS

any data structures are represented as dags

unix files and dirs



git

blob, tree, commit

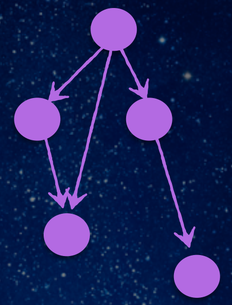
bitcoin

blocks, txns, wallets

IPFS

any data structures are represented as dags

unix files and dirs



kv-stores

git

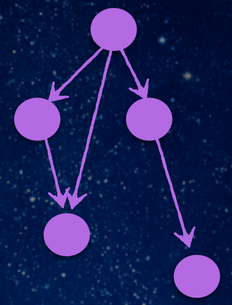
blob, tree, commit

bitcoin

blocks, txns, wallets

IPFS

any data structures are
represented as dags



unix files
and dirs

kv-stores

git

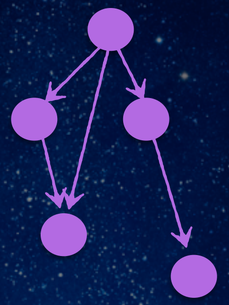
blob, tree, commit

bitcoin

blocks, txns, wallets

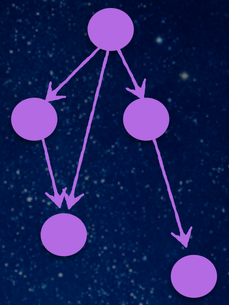
IPFS

unixfs as a dag



IPFS

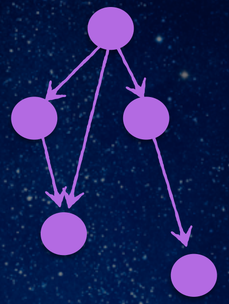
unixfs as a dag



files are dag nodes

IPFS

unixfs as a dag



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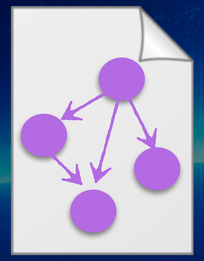
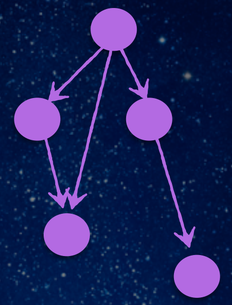


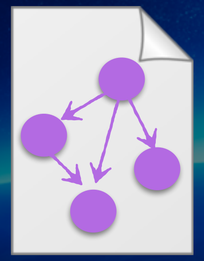
BIG files may be
split into many

IPFS

unixfs as a dag



files are dag nodes

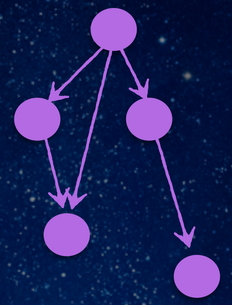


BIG files may be split into many

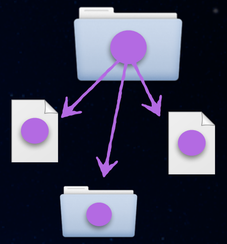
directories are also dag nodes

IPFS

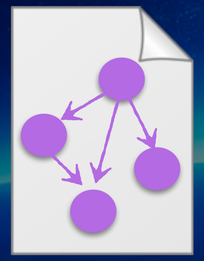
unixfs as a dag



files are dag nodes



which link
to others



BIG files may be
split into many

directories are
also dag nodes

http://example.com/foo/bar/baz.png

↓

http://10.20.30.40/foo/bar/baz.png

location path

http://example.com/foo/bar/baz.png

↓

http://10.20.30.40/foo/bar/baz.png

location path

/ipns/example.com/foo/bar/baz.png

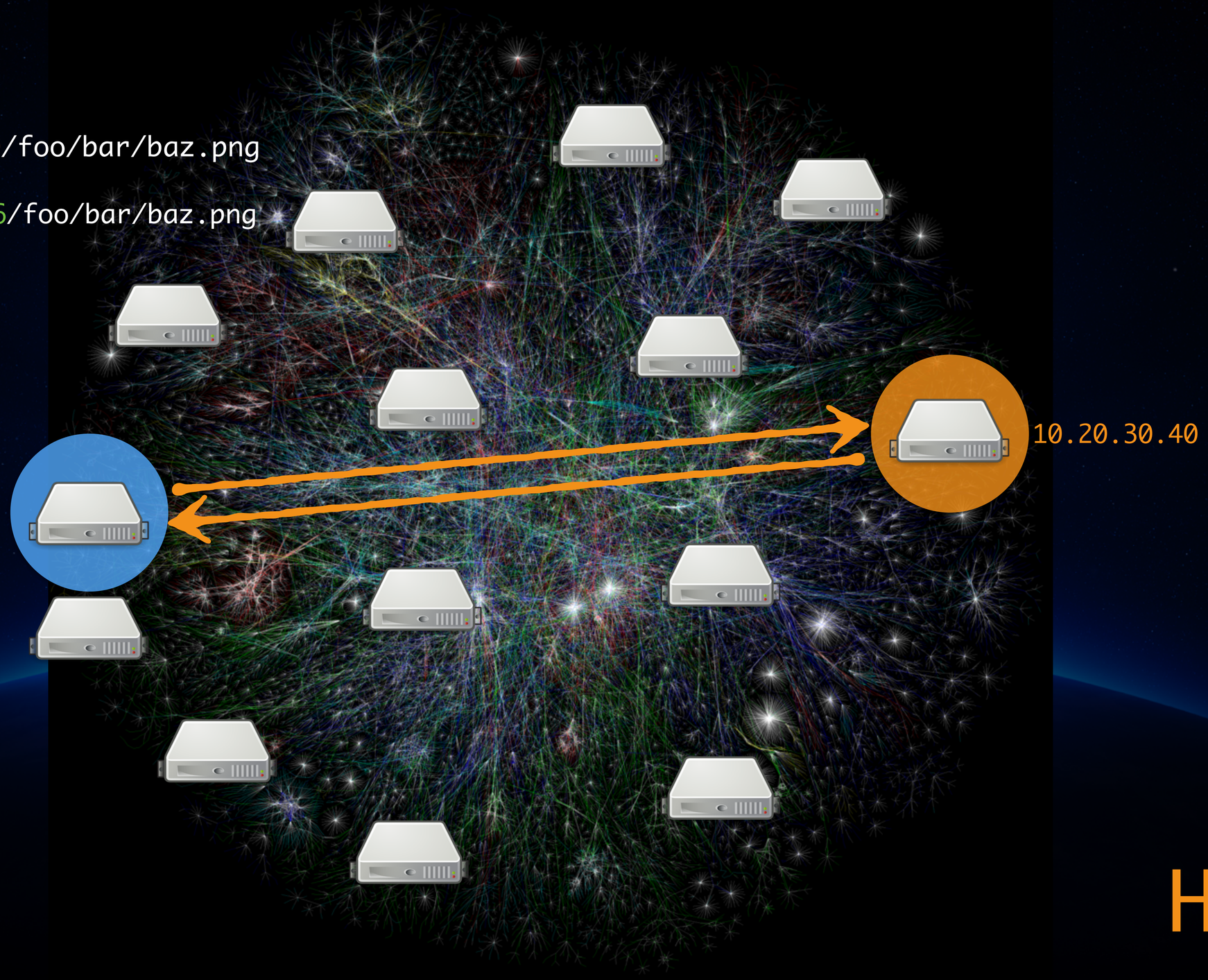
↓

/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png

content path

http://10.20.30.40/foo/bar/baz.png

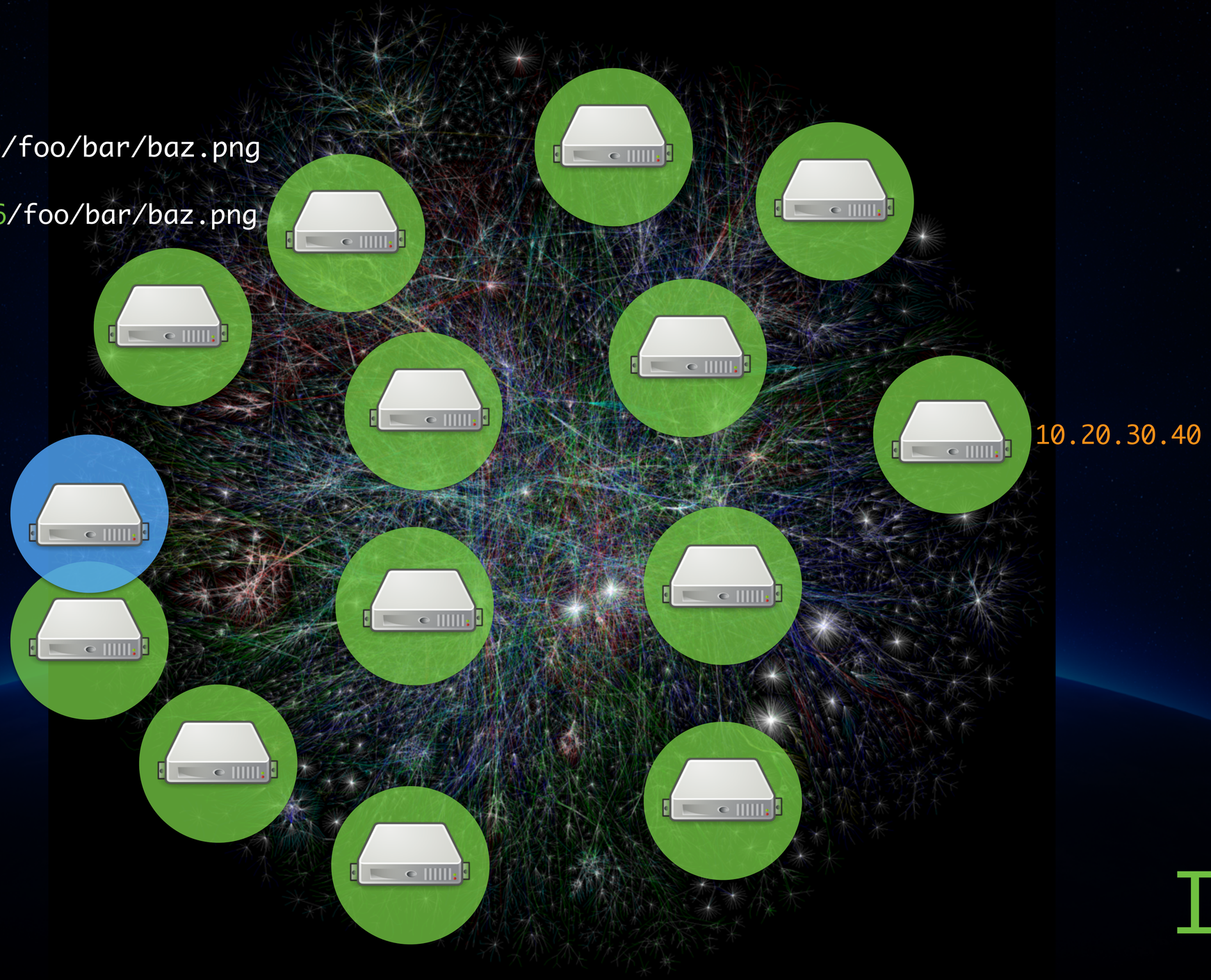
/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png



HTTP

http://10.20.30.40/foo/bar/baz.png

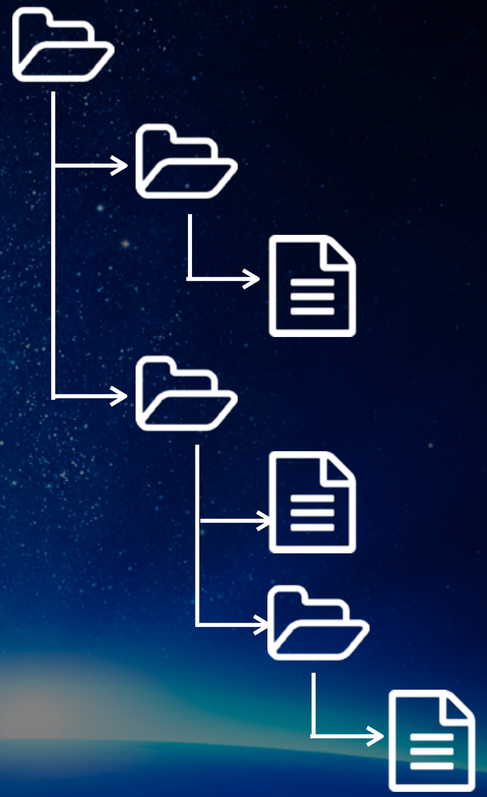
/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png



IPFS

/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png

content path

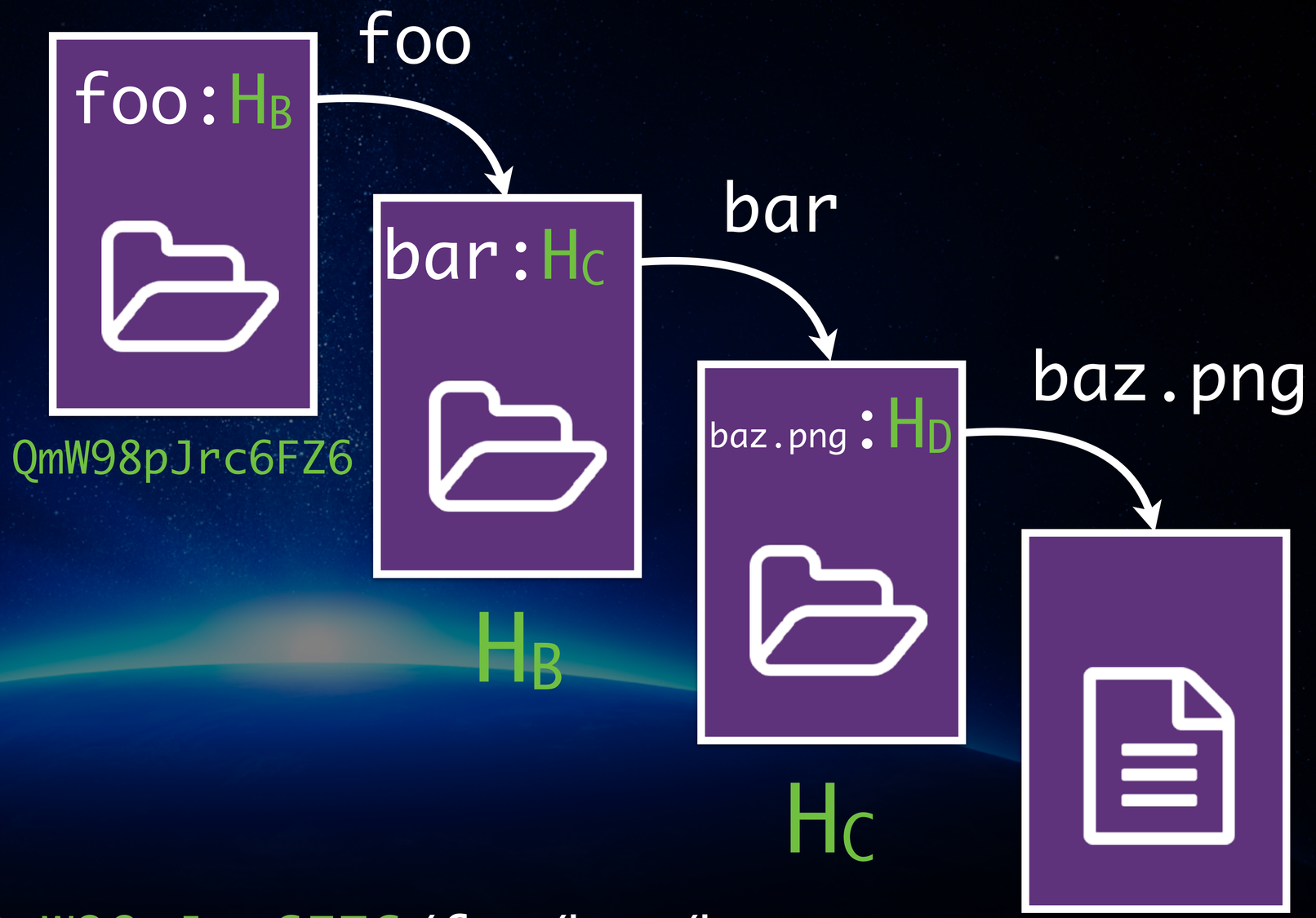


/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png

content path

/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png

content path

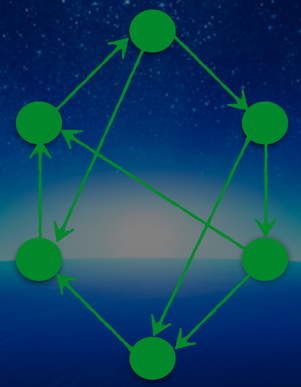


/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png

content path

IPFS

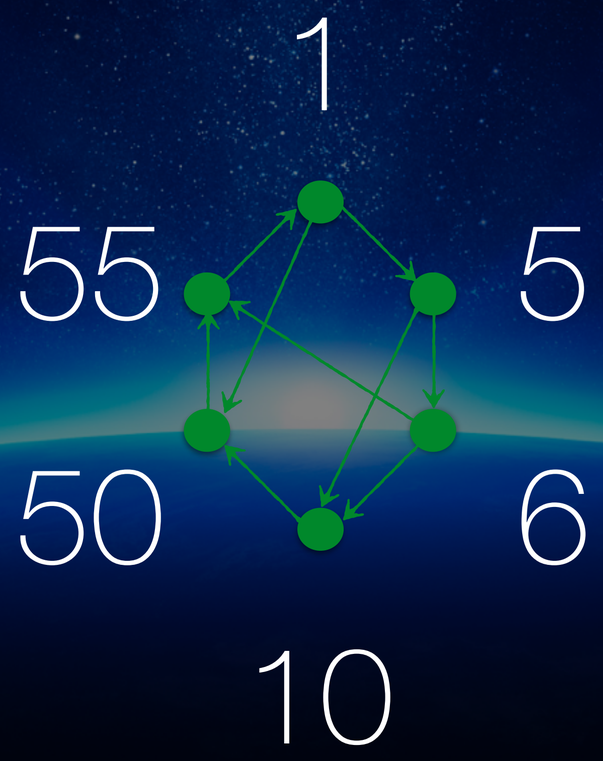
DHT

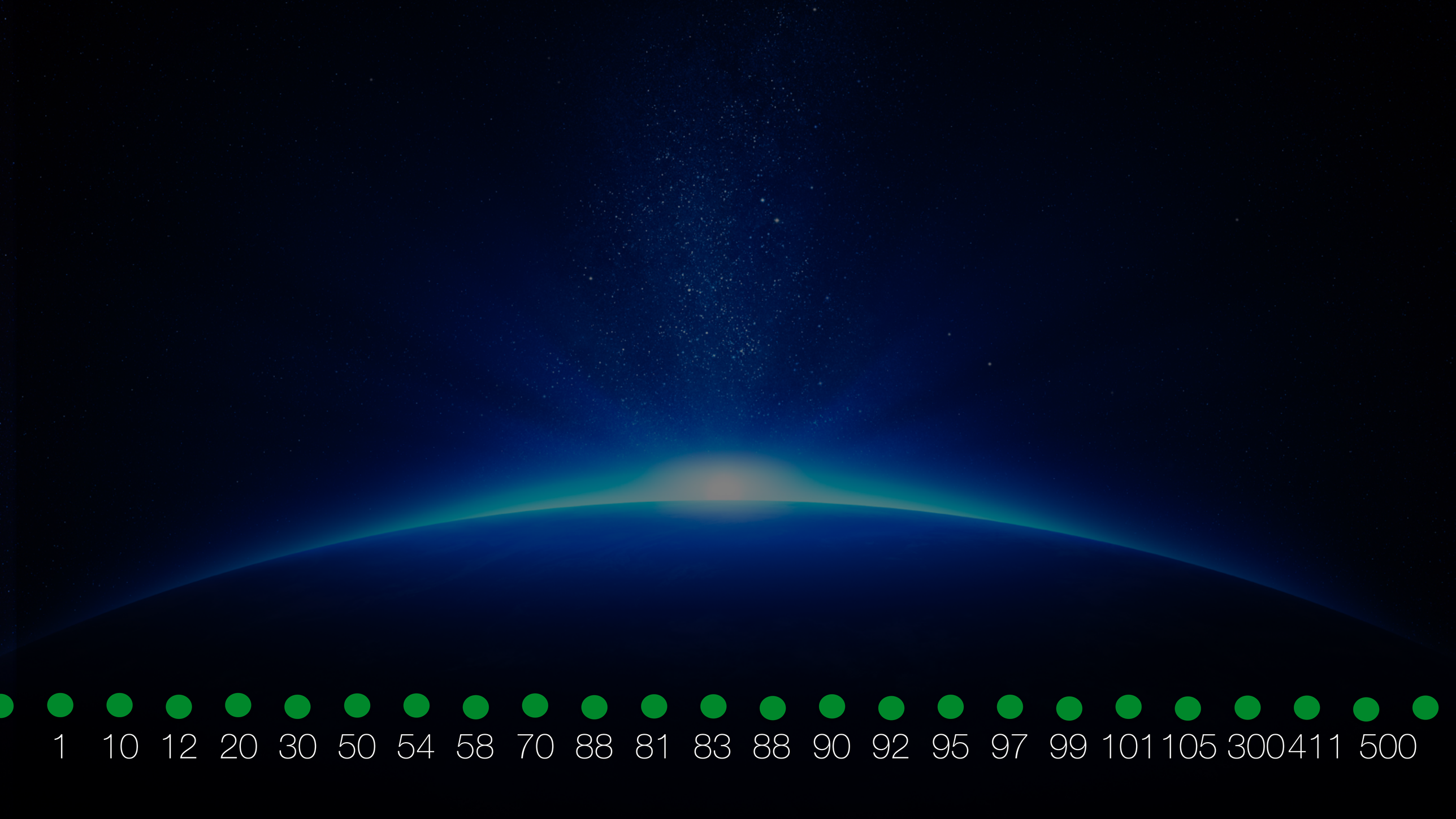


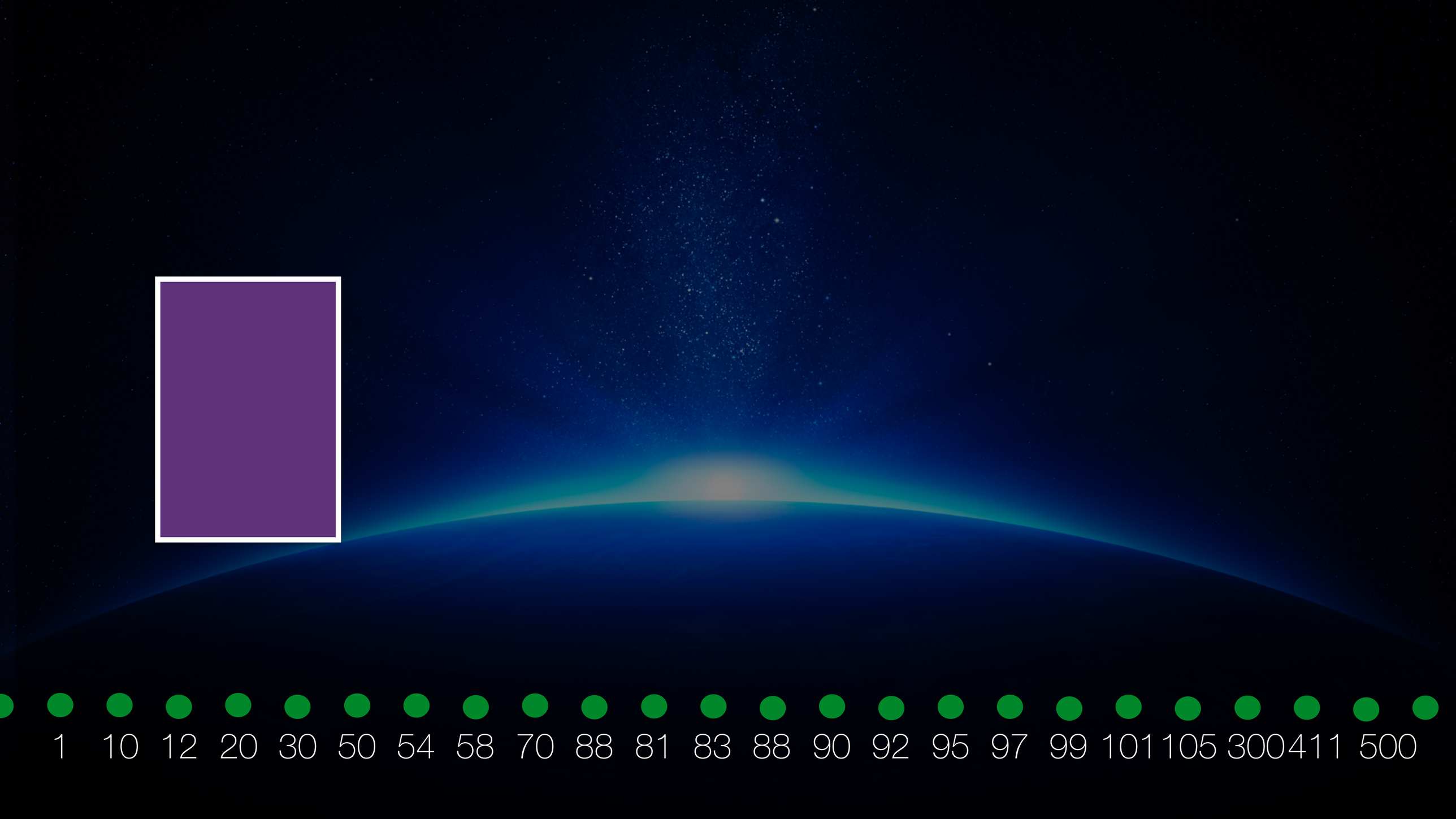
IPFS

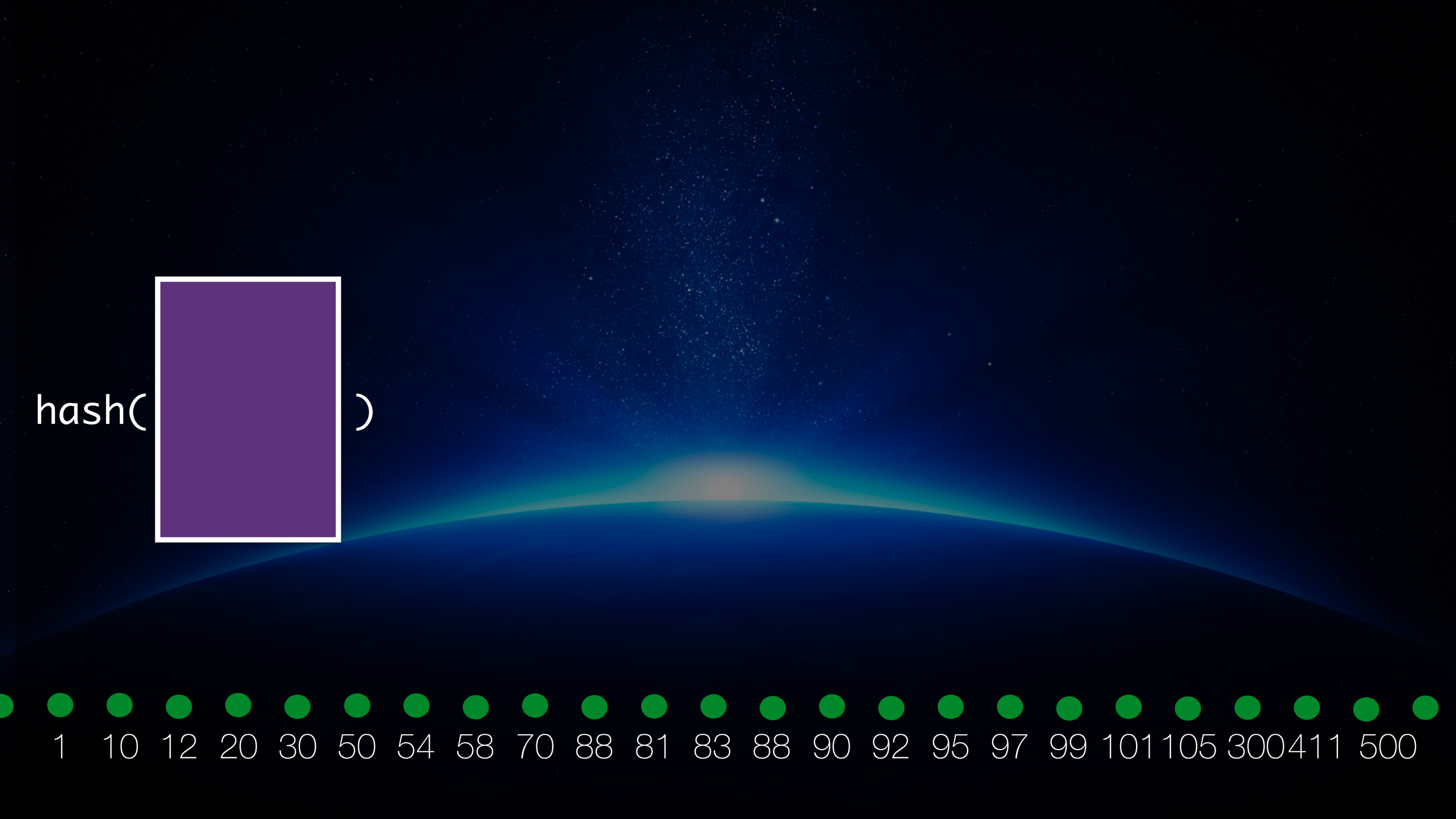
DHT are the Holy Grail* of P2P Networks

*from a survey paper


1
55
5
50
6
10

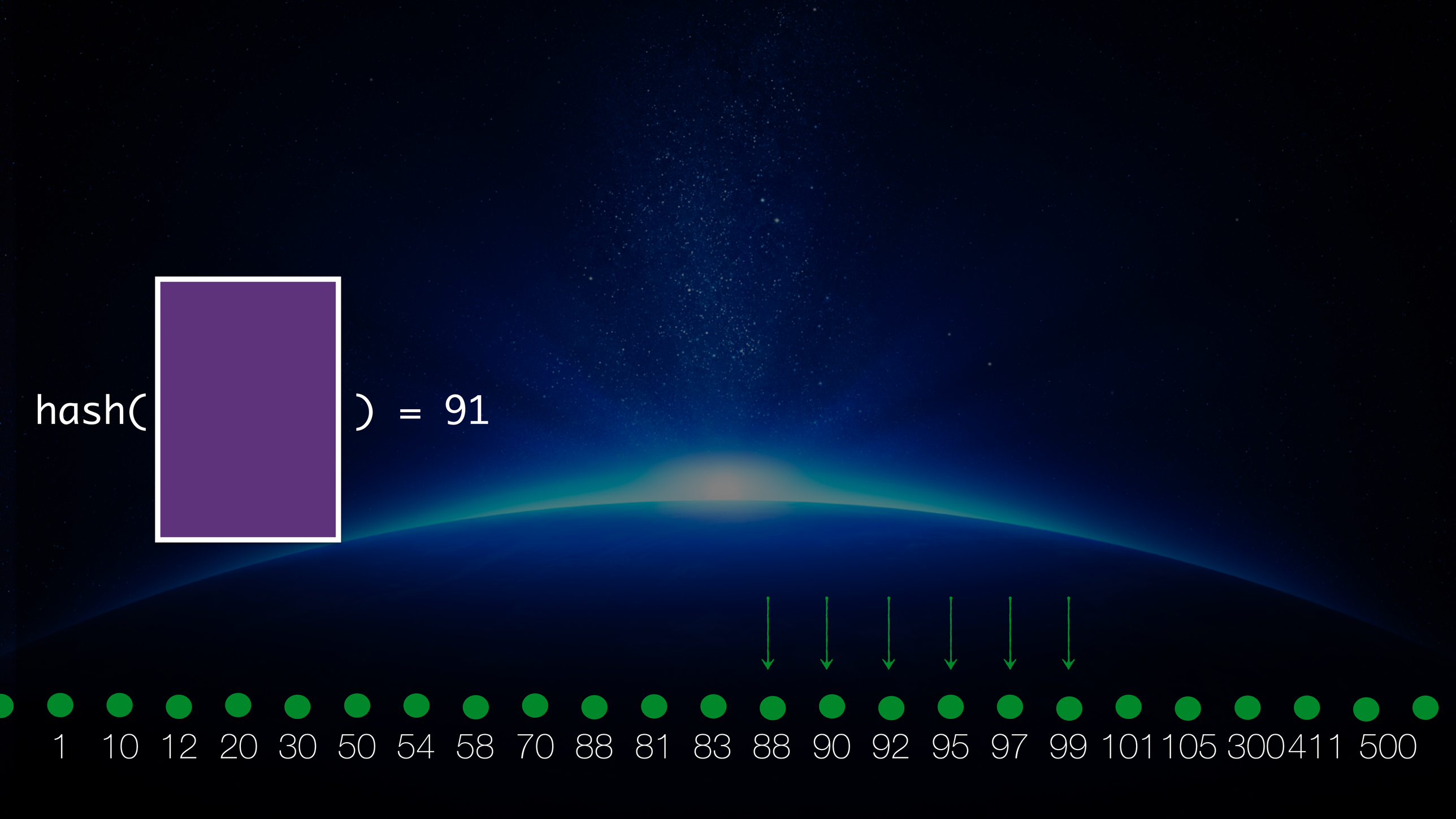

1 10 12 20 30 50 54 58 70 88 81 83 88 90 92 95 97 99 101 105 300 411 500


1 10 12 20 30 50 54 58 70 88 81 83 88 90 92 95 97 99 101 105 300 411 500


hash( )
1 10 12 20 30 50 54 58 70 88 81 83 88 90 92 95 97 99 101 105 300 411 500

hash( ) = 91

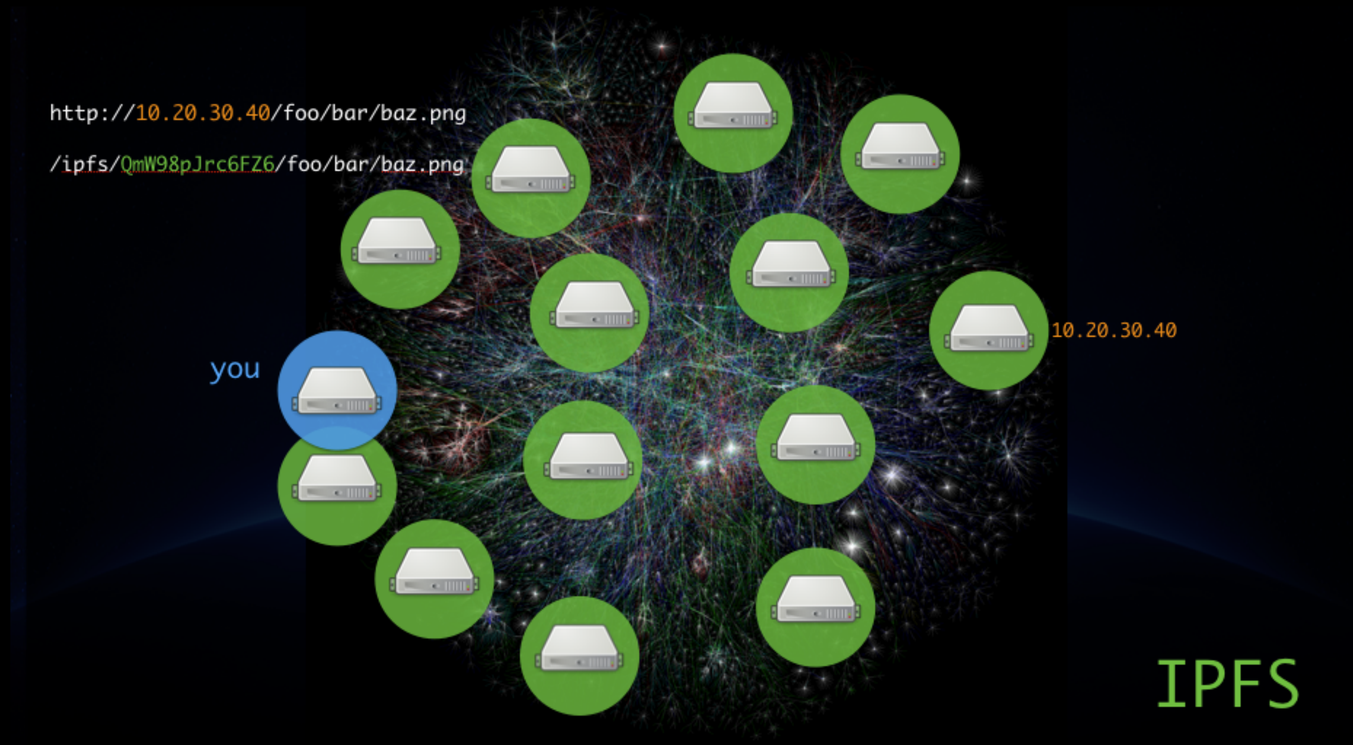
1 10 12 20 30 50 54 58 70 88 81 83 88 90 92 95 97 99 101 105 300 411 500


hash( ) = 91
1 10 12 20 30 50 54 58 70 88 81 83 88 90 92 95 97 99 101 105 300 411 500

Who has [redacted], which hash([redacted]) = 91?

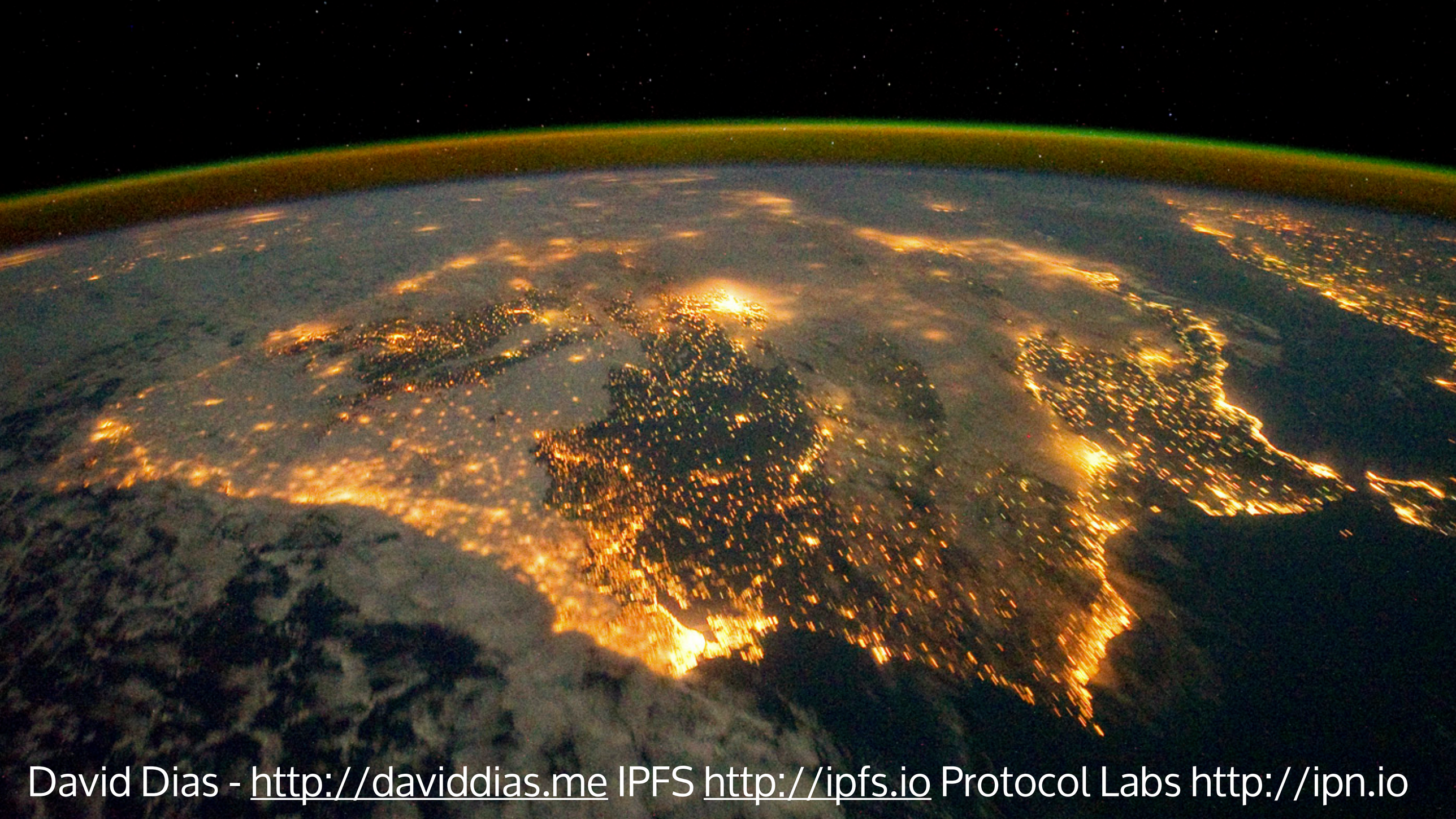
The Distributed Web

- Applications with no-origin
- Leverage network cache
- Resilient to network splits



Serve data to everywhere

Serve data **from** everywhere



David Dias - http://daviddias.me IPFS http://ipfs.io Protocol Labs http://ipn.io

Thank you!

David Dias - http://daviddias.me IPFS http://ipfs.io Protocol Labs http://ipn.io