

Decentralizing Internet Infrastructure with IPFS



> Whoami

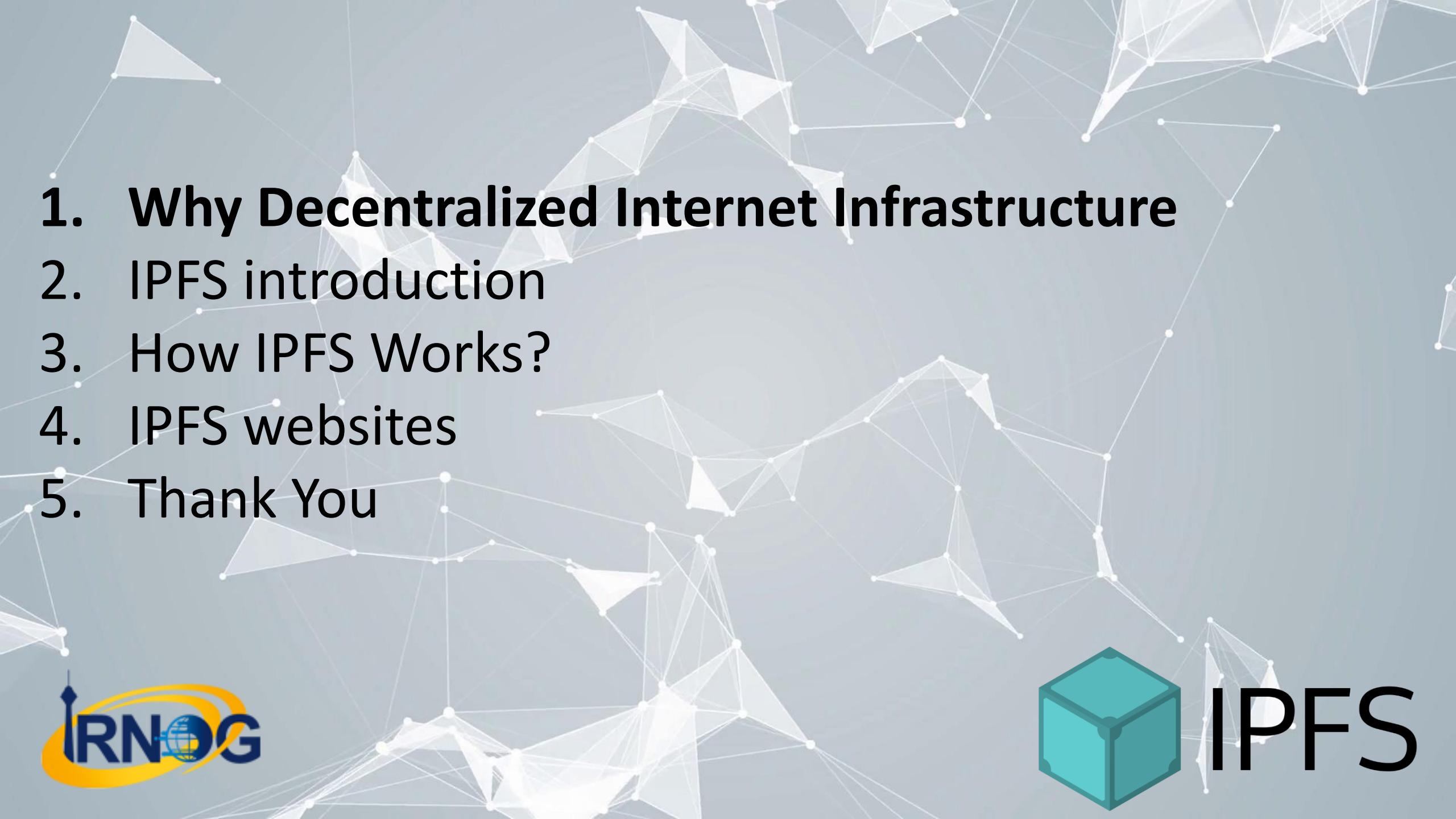
Pouria Mousavizadeh,

Network Engineer and Researcher

Twitter: @spmzt

Email: p.mousavizadeh@protonmail.com



- 
1. Why Decentralized Internet Infrastructure
 2. IPFS introduction
 3. How IPFS Works?
 4. IPFS websites
 5. Thank You



The Internet has some issues

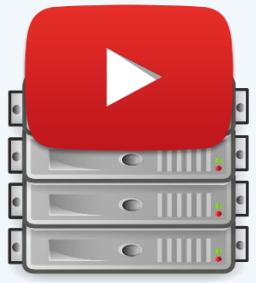
Services such as:

- trust management
- identity management
- name resolution
- resource/asset ownership management
- resource discovery

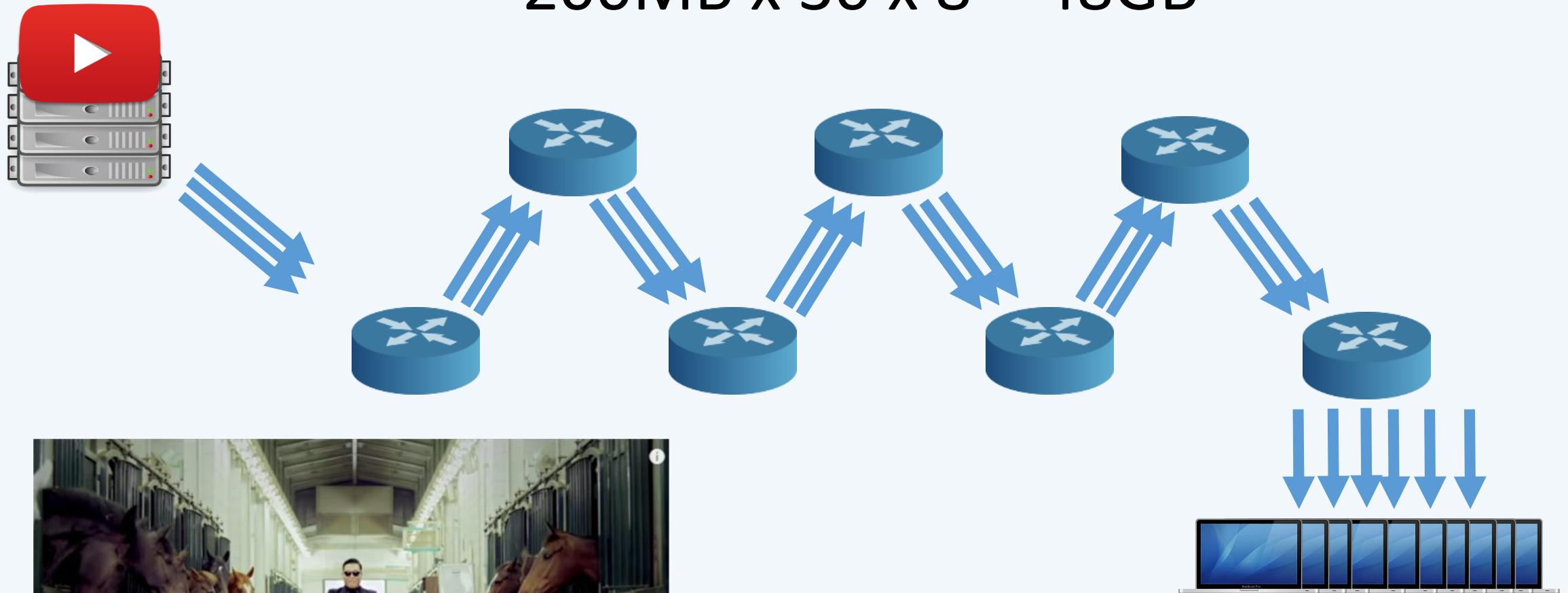




200MB

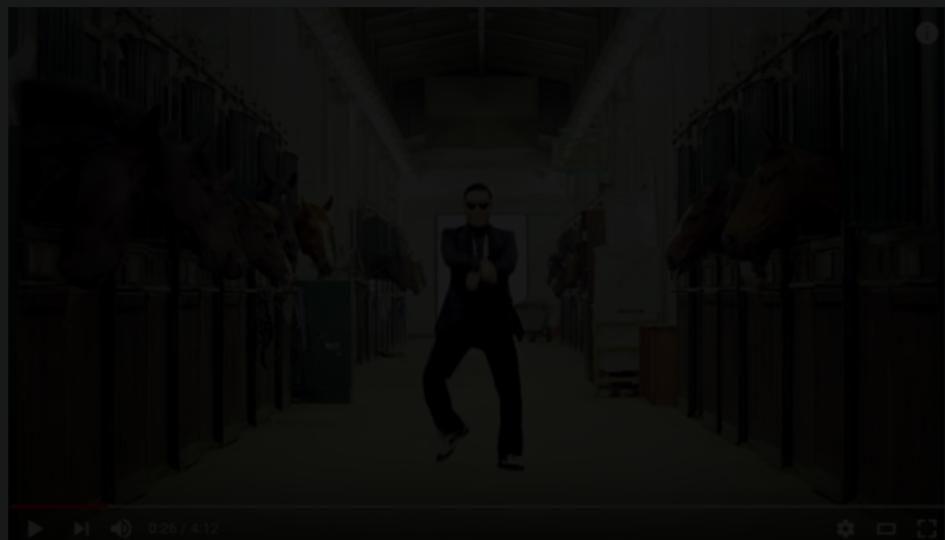


$$200\text{MB} \times 30 \times 8 = 48\text{GB}$$



$200\text{MB} \times 30 \times 8 = 48\text{GB}$

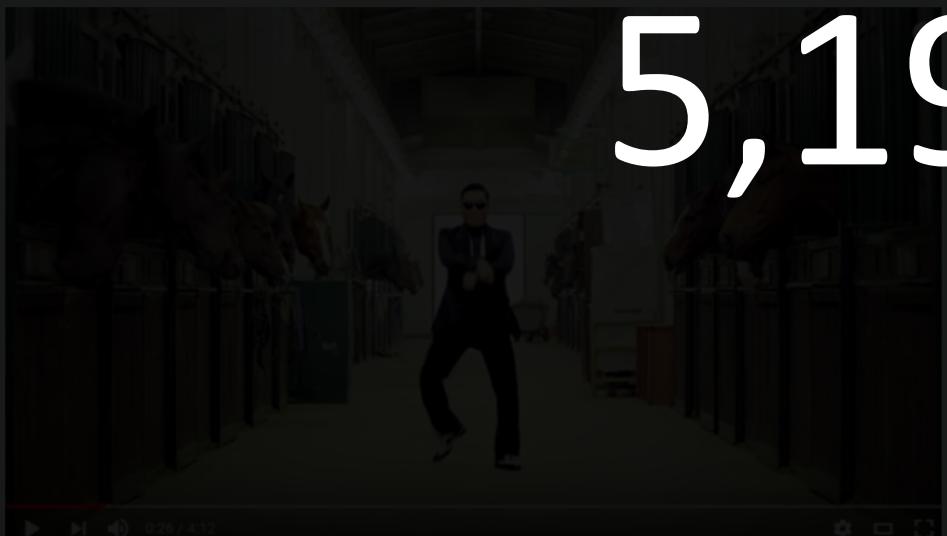
3,248,265,570



$200\text{MB} \times 30 \times 8 = 48\text{GB}$

3,248,265,570

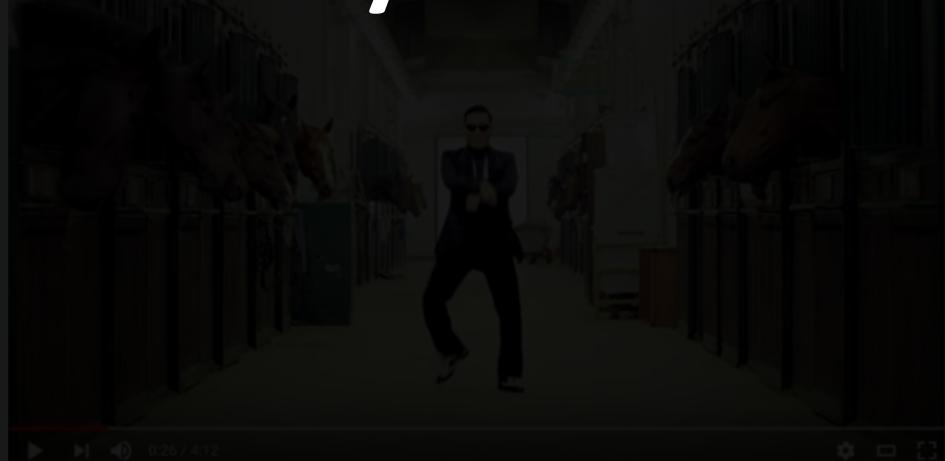
5,197 PB



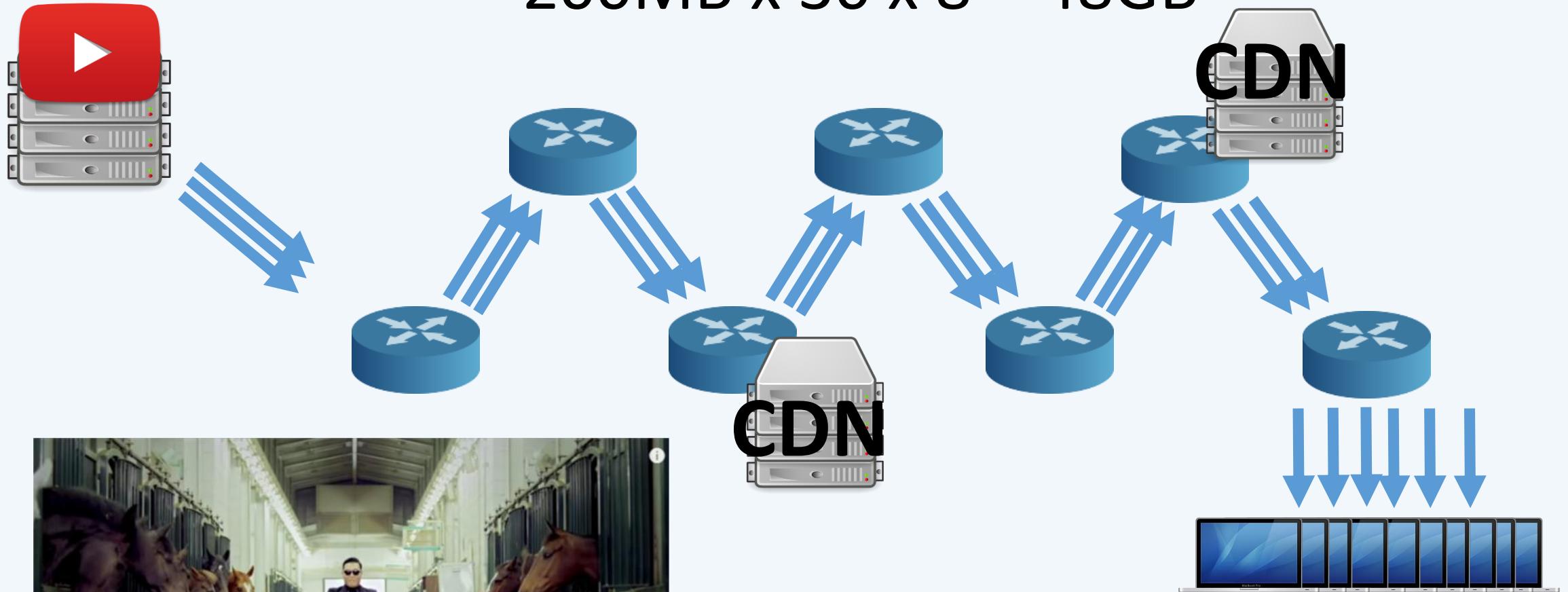
$$200\text{MB} \times 30 \times 8 = 48\text{GB}$$

We Can't Do this with Multicast

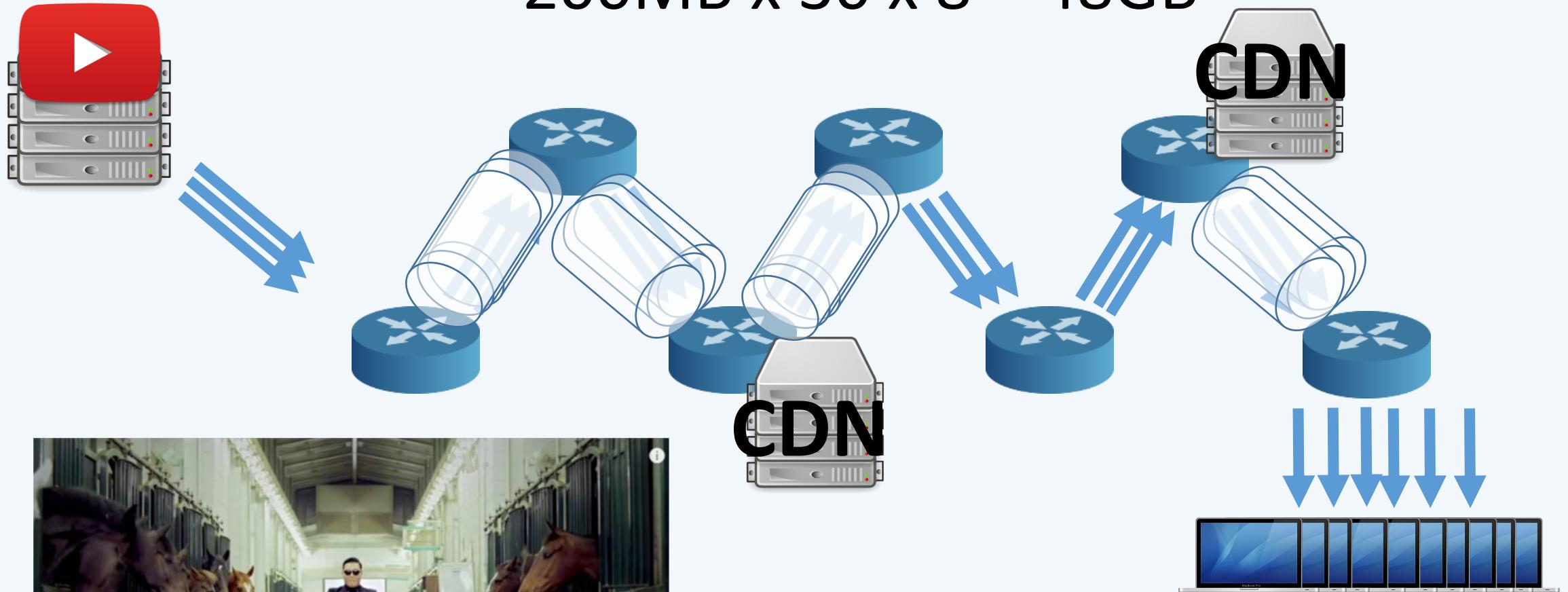
No any mbone exist on internet

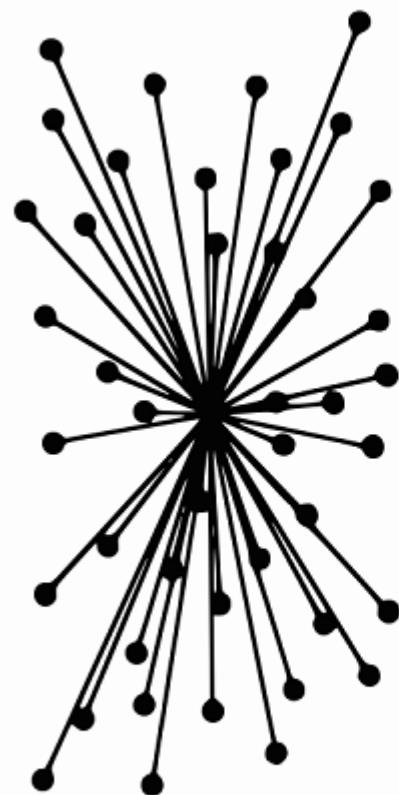


$$200\text{MB} \times 30 \times 8 = 48\text{GB}$$



$$200\text{MB} \times 30 \times 8 = 48\text{GB}$$

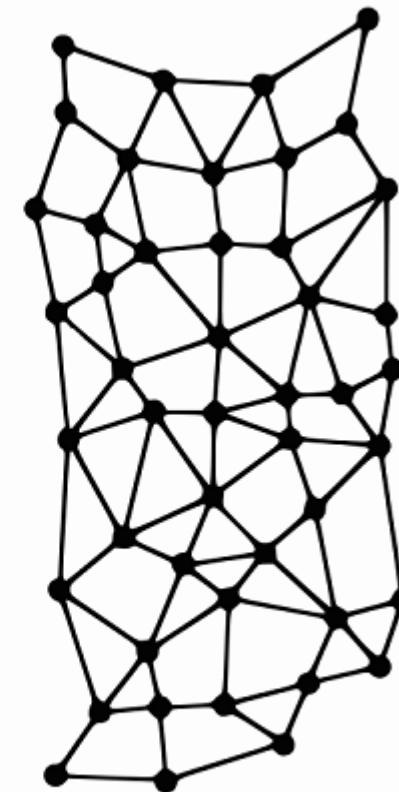




Centralized



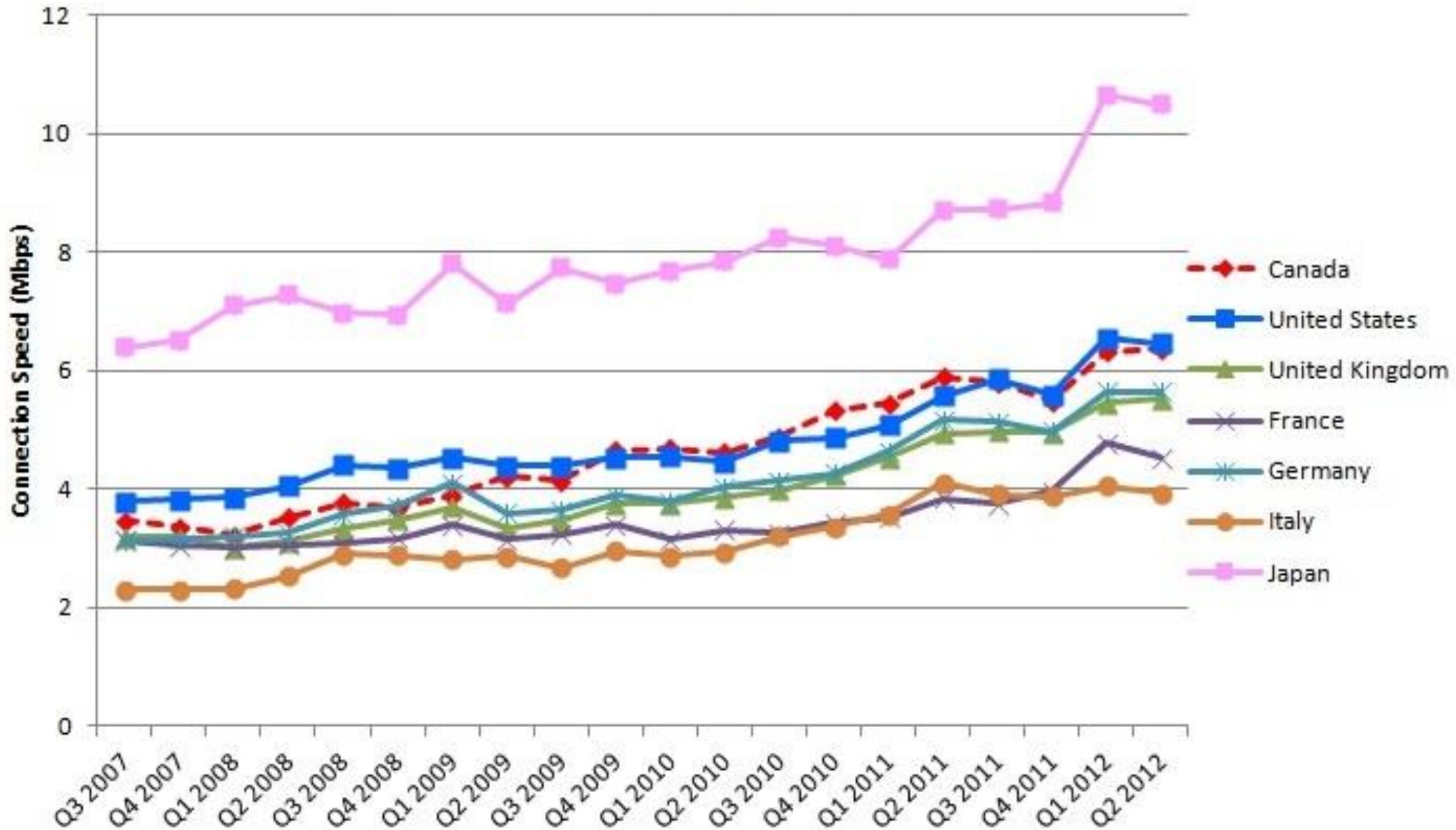
Decentralized



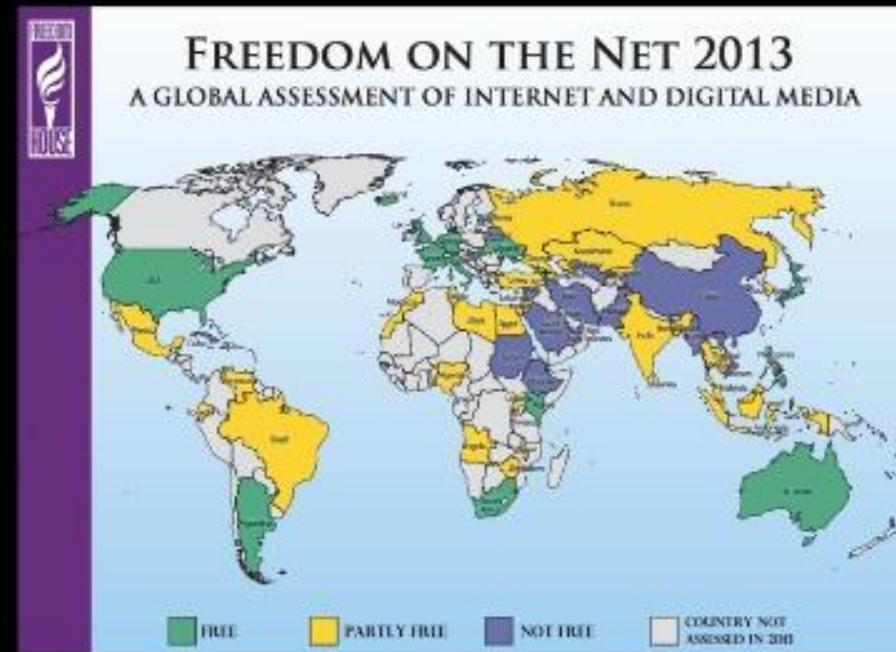
Distributed

Fig, 1 – Centralized, Decentralized and Distributed Networks

Average Connection Speed (Mbps) - G7 Countries



Human Disasters

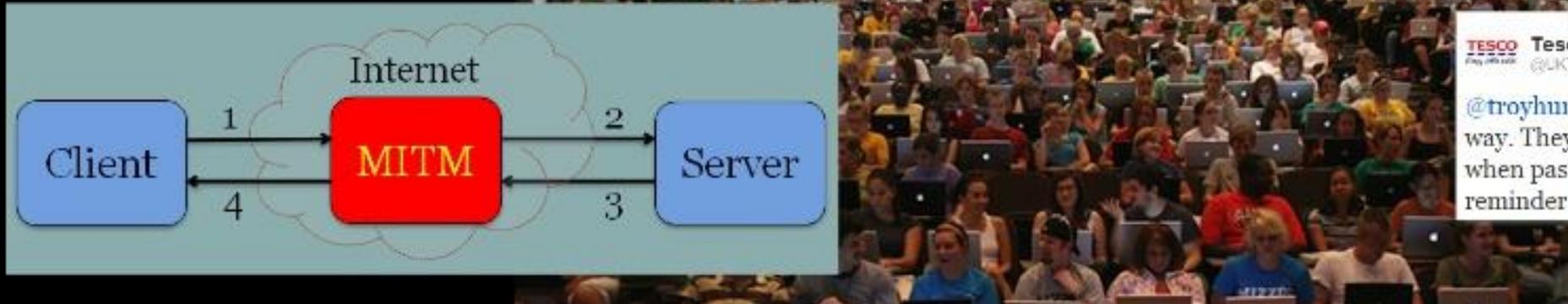
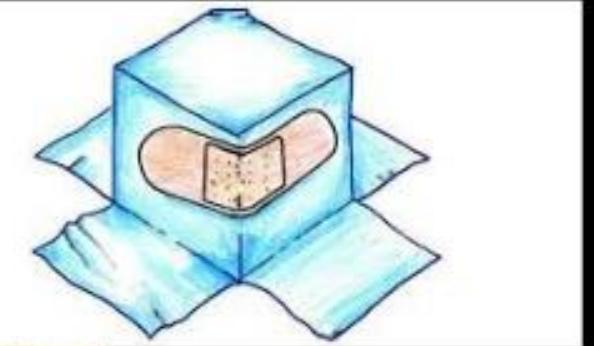


surprise oppression

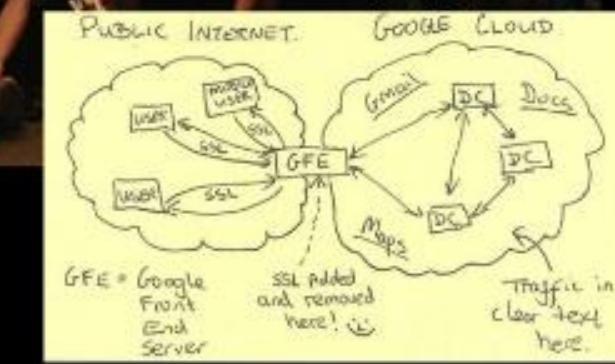
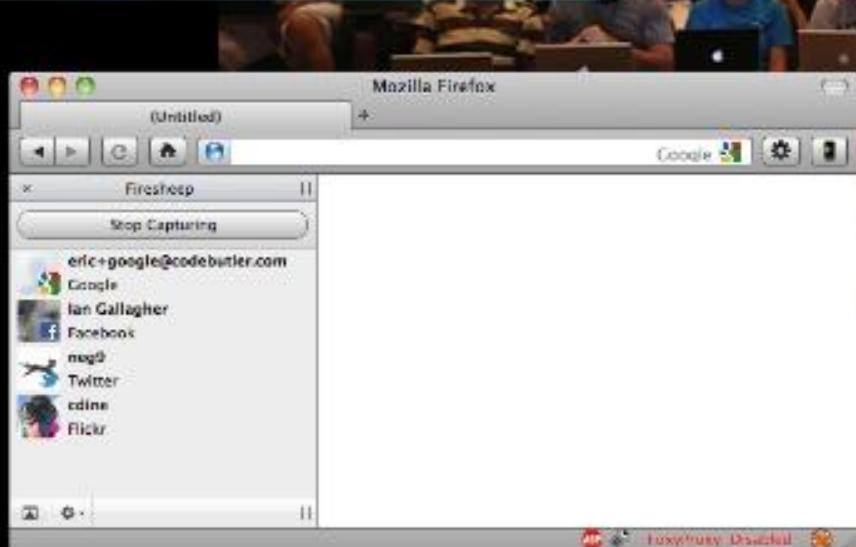
censorship



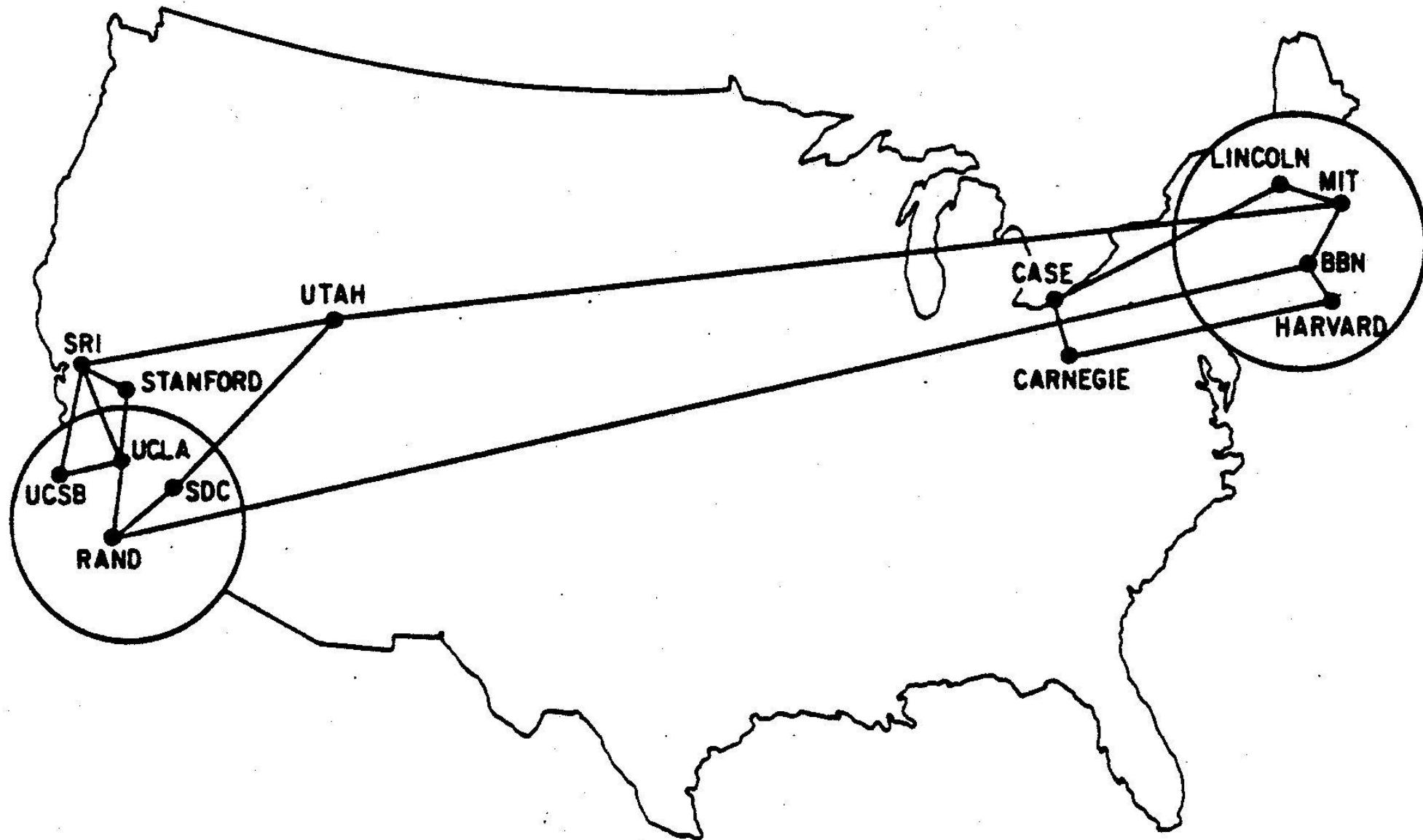
Awful Security Model



@troyhunt Passwords are stored in a secure way. They're only copied into plain text when pasted automatically into a password reminder mail.

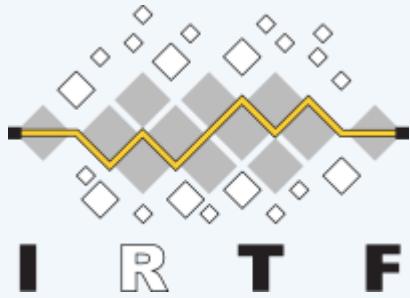


The Internet was meant to be distributed



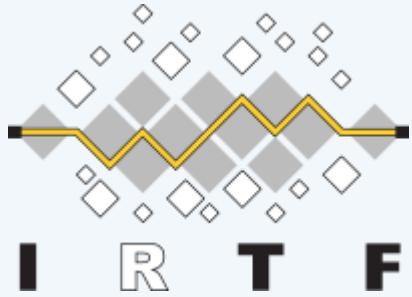
1. Why Decentralized Internet Infrastructure
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5. Thank You





Decentralized Internet Infrastructure (DINRG)

- resolution (Namecoin, Ethereum Name Service)
- identity management (OneName)
- distributed storage (IPFS, MaidSafe)
- distributed applications, or DApps (Blockstack)



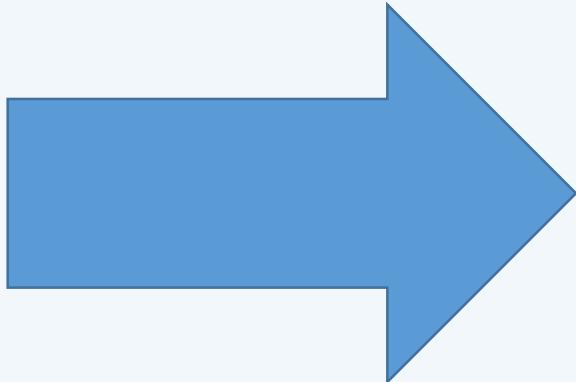
Decentralized Internet Infrastructure (DINRG)

- resolution (Namecoin, Ethereum Name Service)
- identity management (OneName)
- distributed storage (**IPFS**, MaidSafe)
- distributed applications, or DApps (Blockstack)

What is "IPFS"?

- The current section is a collection of ideas.
- Together they can be the basis for a future design of web.
- The next section is a description of IPFS, the specific "product".
- IPFS, an acronym for "InterPlanetary File System".

A protocol to upgrade the web



Hypertext Transfer Protocol



IPFS

InterPlanetary FileSystem

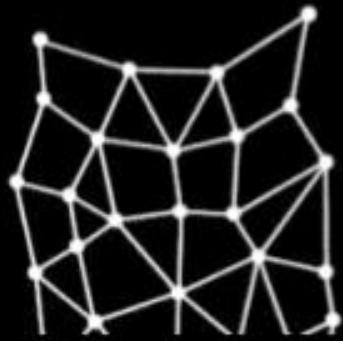


IPFS

Content Addressed File System



Offline



Distributed



IPFS



Permanent



Safer



Smarter



Faster

The IPFS Stack



The IPFS Stack



applications

Using the Data

IPNS

naming

IPLD

merkldag

Defining the Data

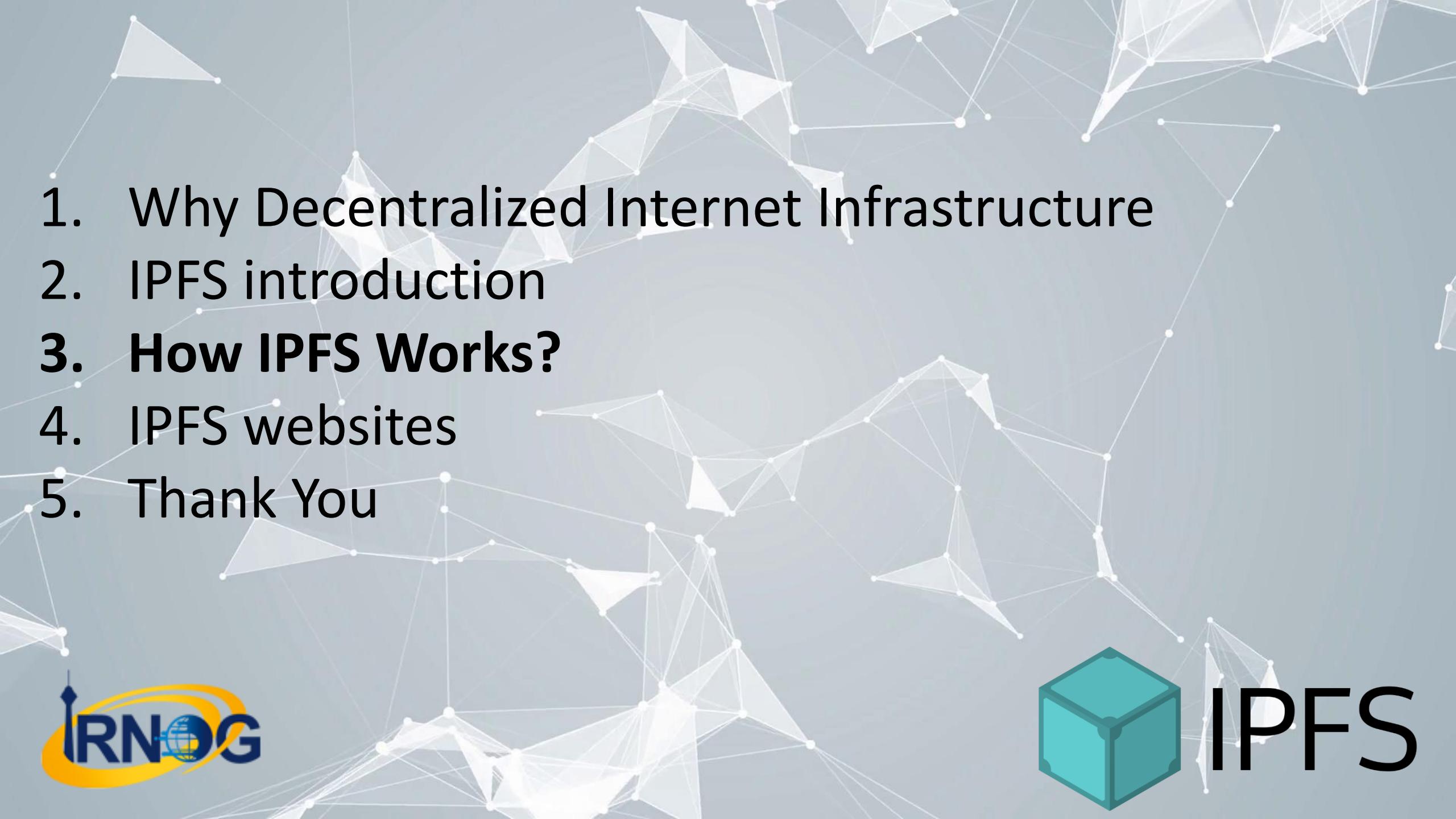
libp2p

exchange

routing

network

Moving the Data

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

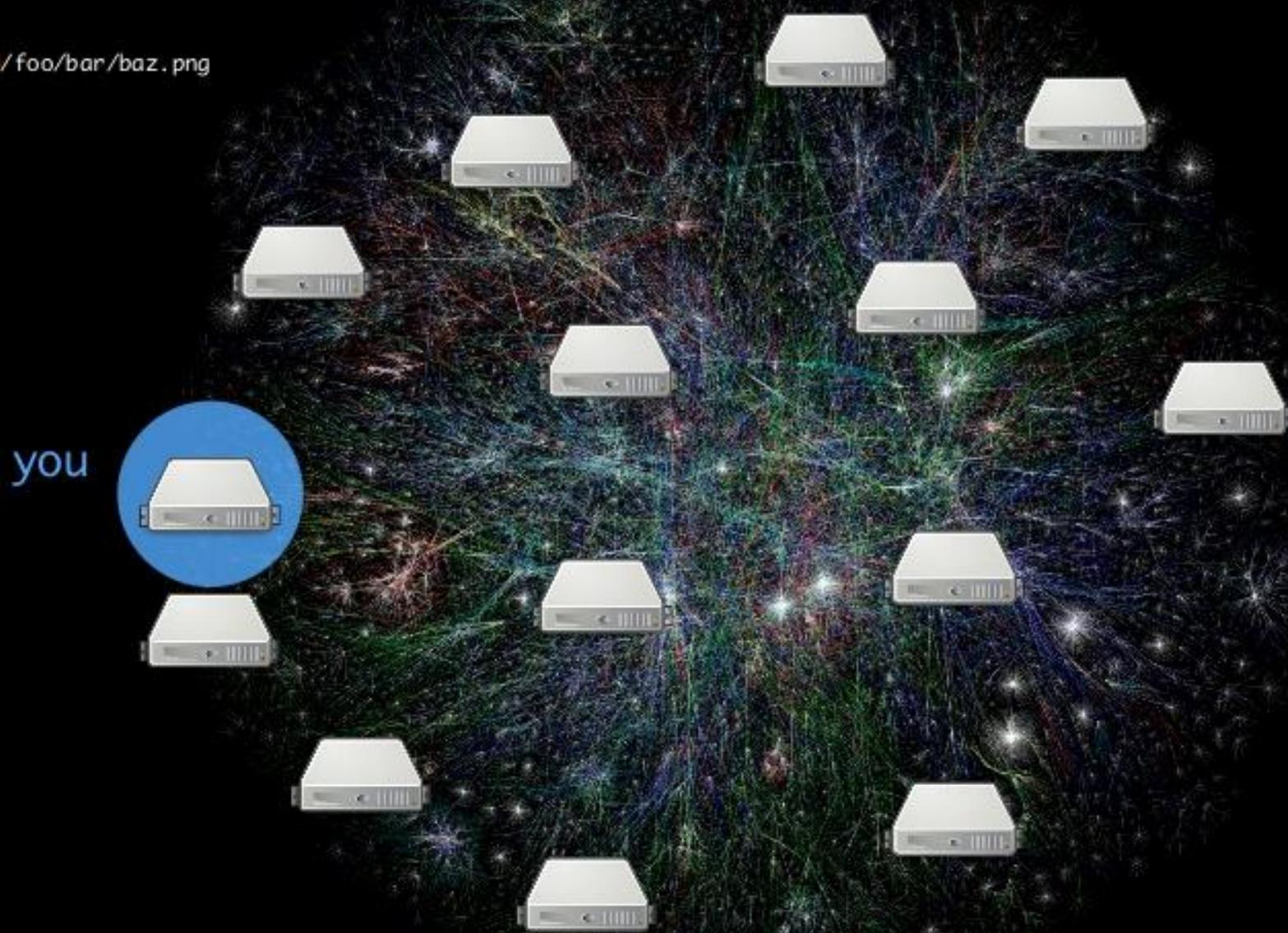


`http://10.20.30.40/foo/bar/baz.png`

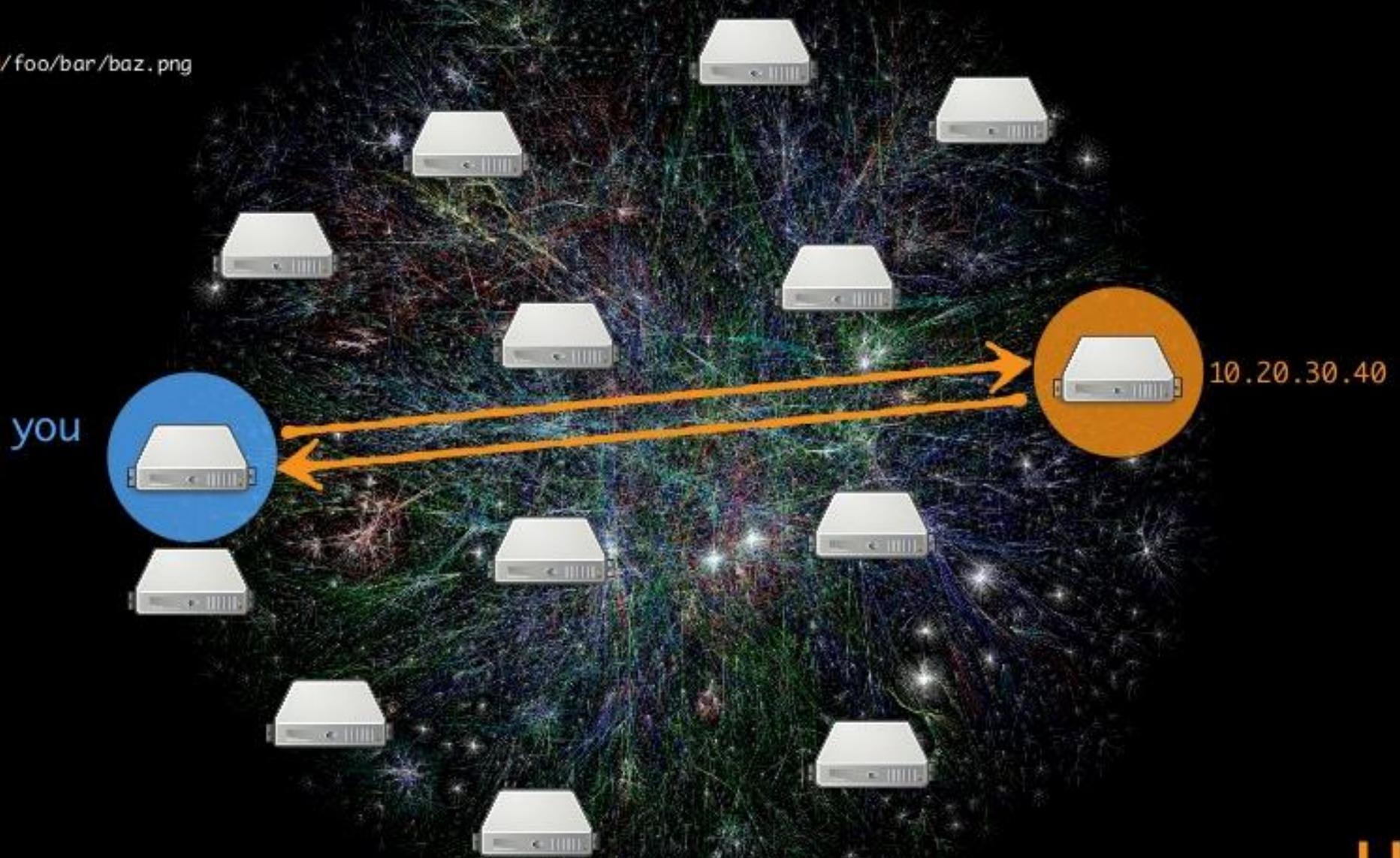
location

path

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



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



HTTP

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

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

you

`10.20.30.40`

HTTP

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



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

location

path



hash() -> QmW98pJrc6FZ6



http://



http://

location

path

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

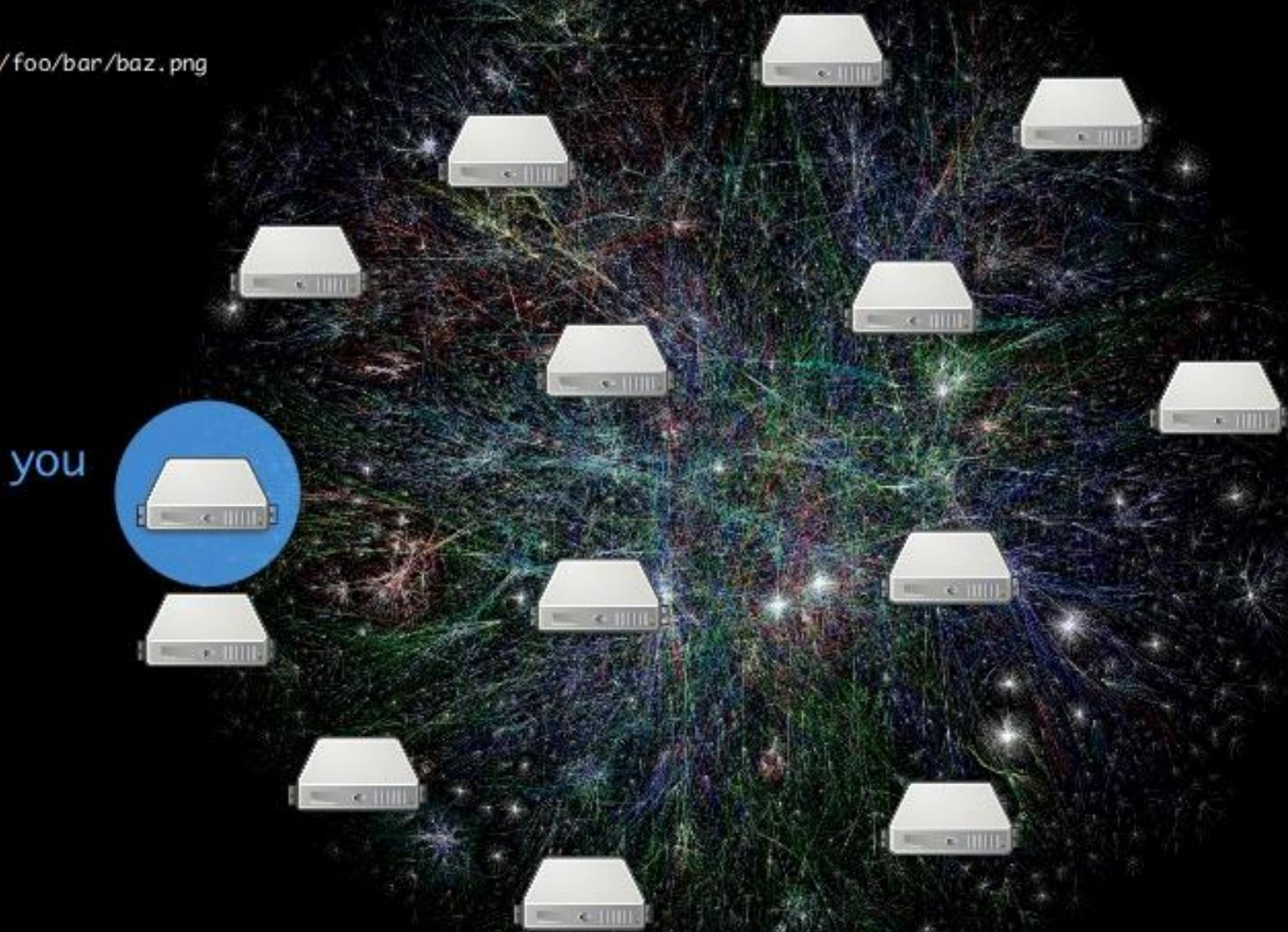


/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png

content

path

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



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

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

you

10.20.30.40

IPFS

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

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

you

10.20.30.40

IPFS

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

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

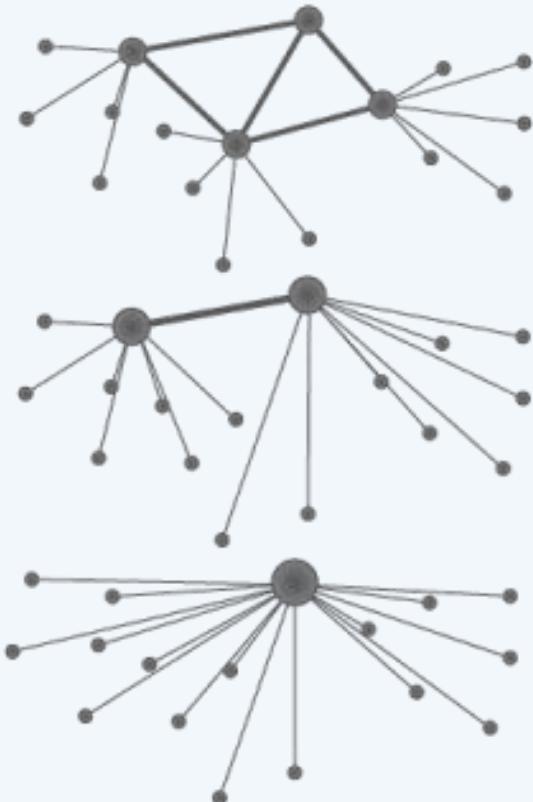
you

10.20.30.40

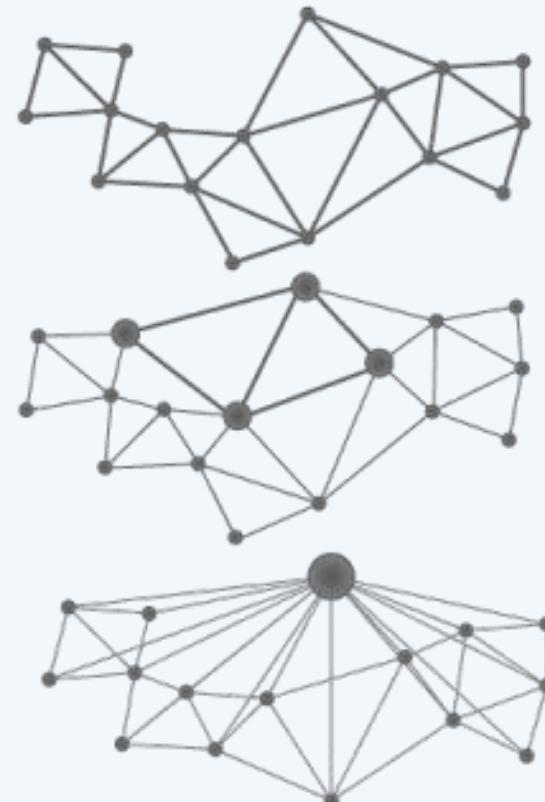
IPFS

Client-Server VS P2P Networks

Client/server



Peer-to-peer



More
Decentralized

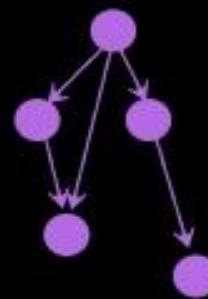
Less
Decentralized

Centralized

an IPFS node



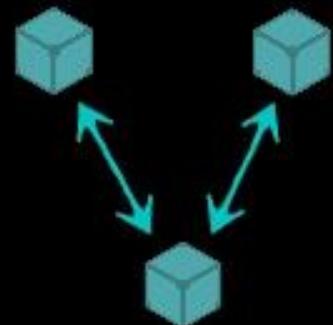
has pki based
identity



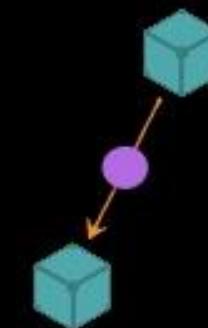
can store part
of the dag



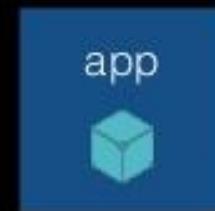
can be run
as a server



connects
to others



can get more
from peers



or embedded
in apps

The IPFS Stack



applications

Using the Data

IPNS

IPLD

naming

merkldag

Defining the Data

libp2p

exchange

routing

network

Moving the Data

libp2p

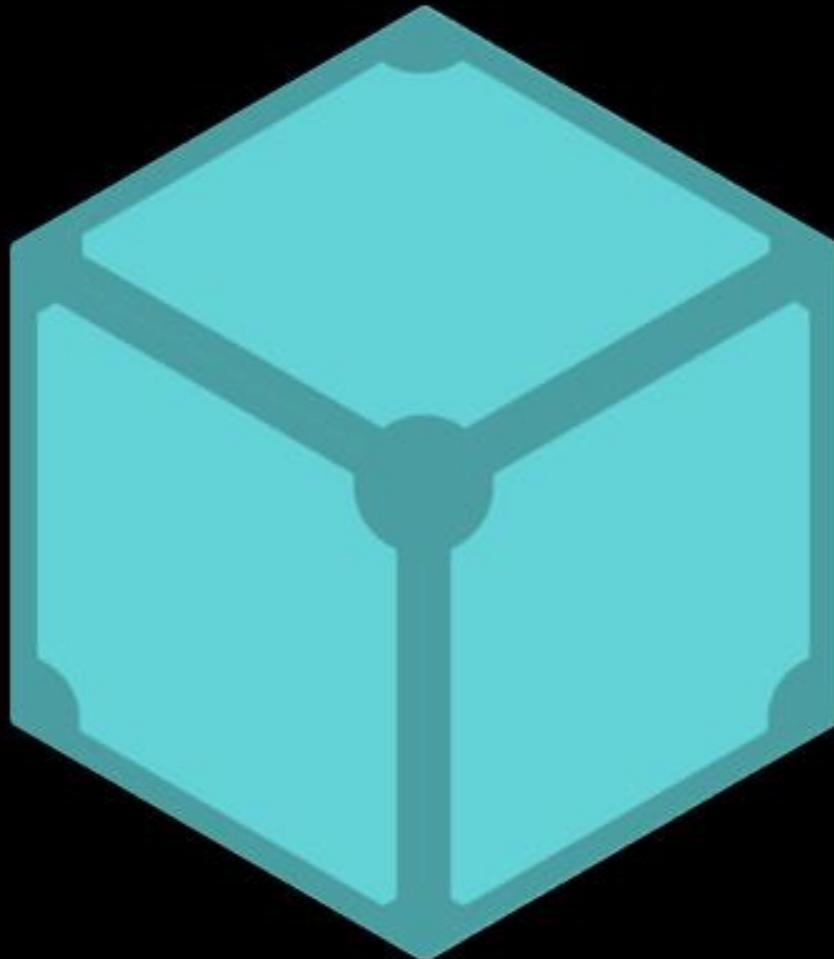
Content Routing

Peer Routing

Discovery

Transports

NAT Traversal



libp2p - a collection of peer-to-peer protocols

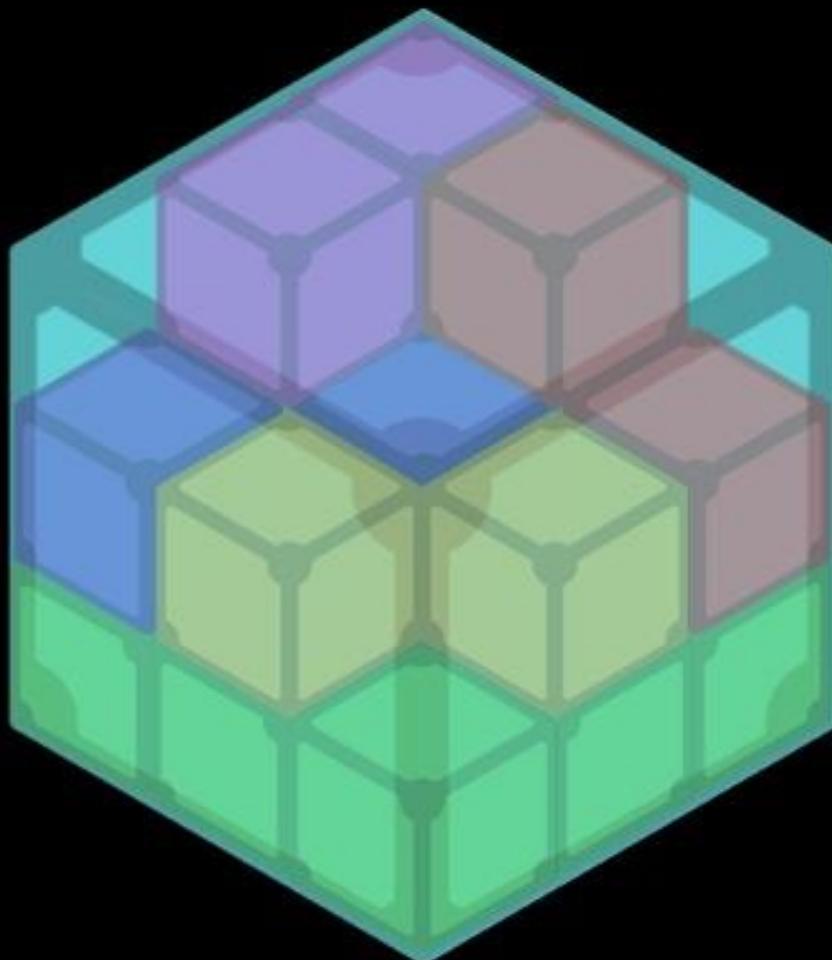
Content Routing

Peer Routing

Discovery

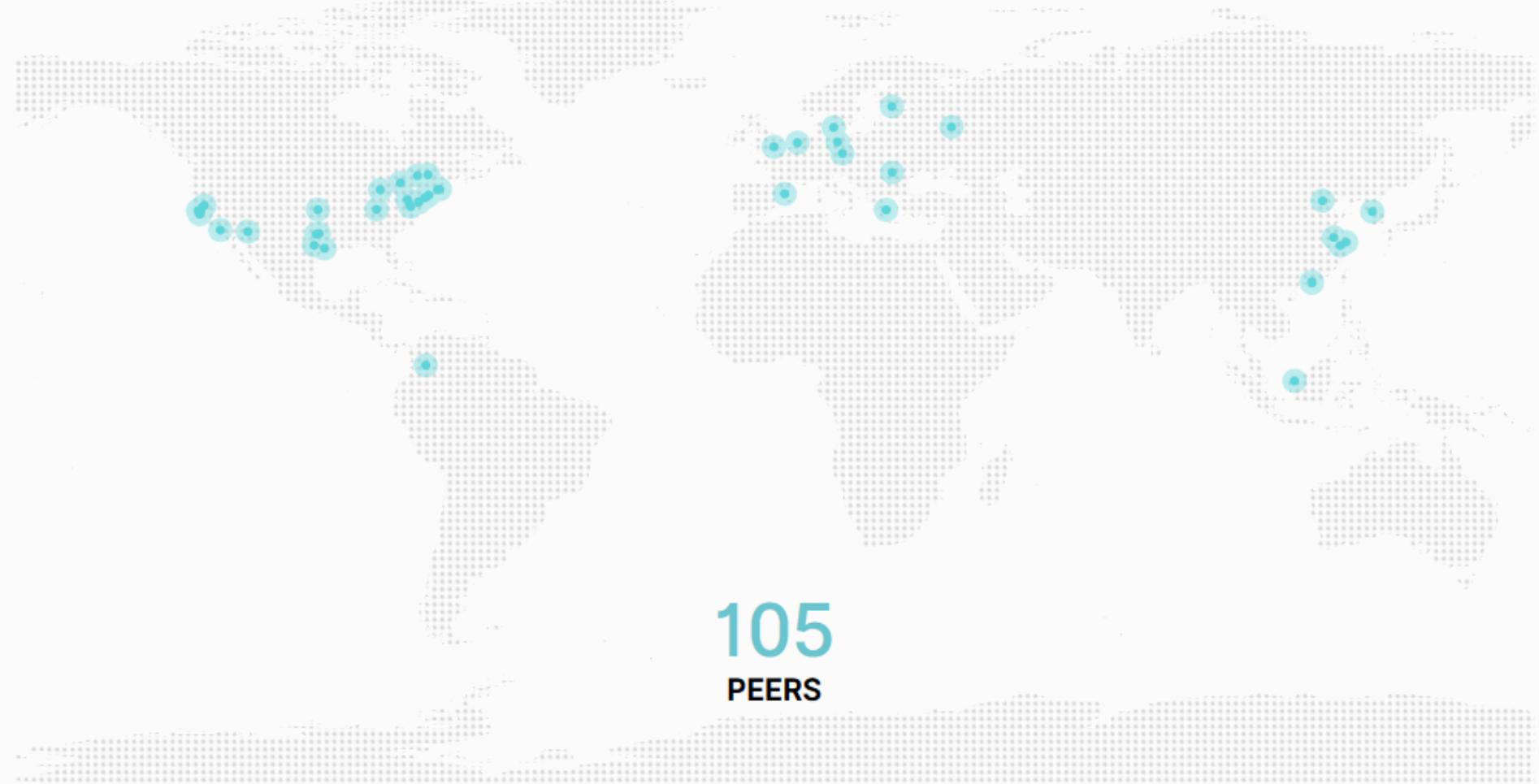
Transports

NAT Traversal





IPFS

[Status](#)[Files](#)[Explore](#)[Peers](#)[Settings](#)

PEER ID	ADDRESS	LOCATION
QmVJxE2iF2bDTjtuCrxeti4vFxycUiVdGYWygihmTNAQnN	/ip4/188.166.85.91/tcp/4001	Amsterdam, Netherlands
QmcHJAЕiqTmwy1VRHzdWiMbF4JUKBXCxXJAgB1QnphHtPd	/ip4/190.156.42.73/tcp/48008	Colombia
QmXPTviYqvRhfpNpHutwxPYwPjNSUX882bfs68Lxfq9TS1	/ip4/192.99.37.156/tcp/4001	Montréal, Canada
QmZZ8gMho7vHfgA66FRoFj26psisWE3p1CNpeHsZBSiqme	/ip4/195.201.9.37/tcp/4001	Russian Federation
QmNjgPm3SYWsJkhcroHNLticysdNfqqkF7Yicp5cPvhNU5K	/ip4/202.130.114.66/tcp/22931	Central District, Hong Kong

The IPFS Stack



applications

Using the Data

IPNS

naming

IPLD

merkldag

Defining the Data

libp2p

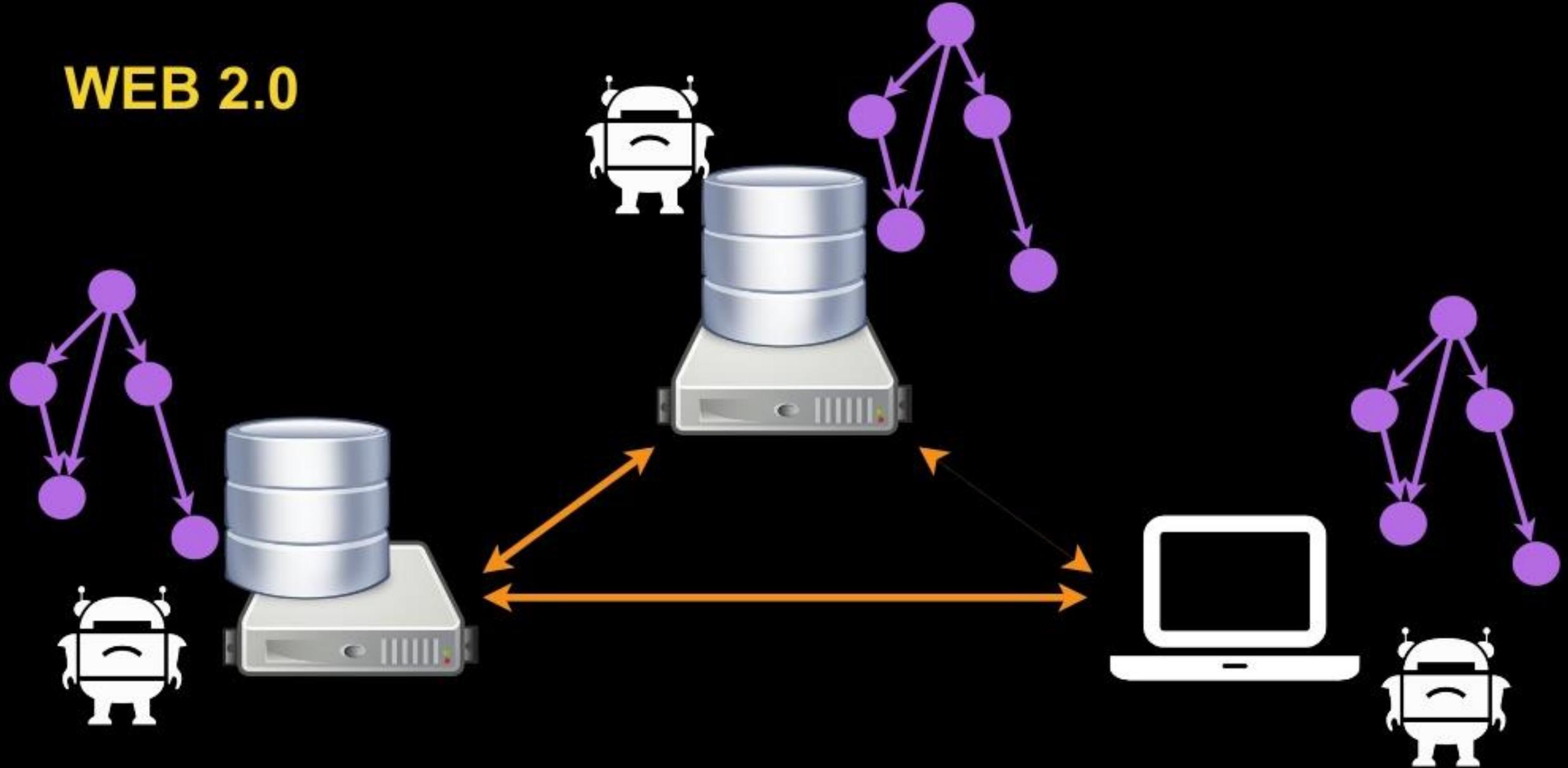
exchange

routing

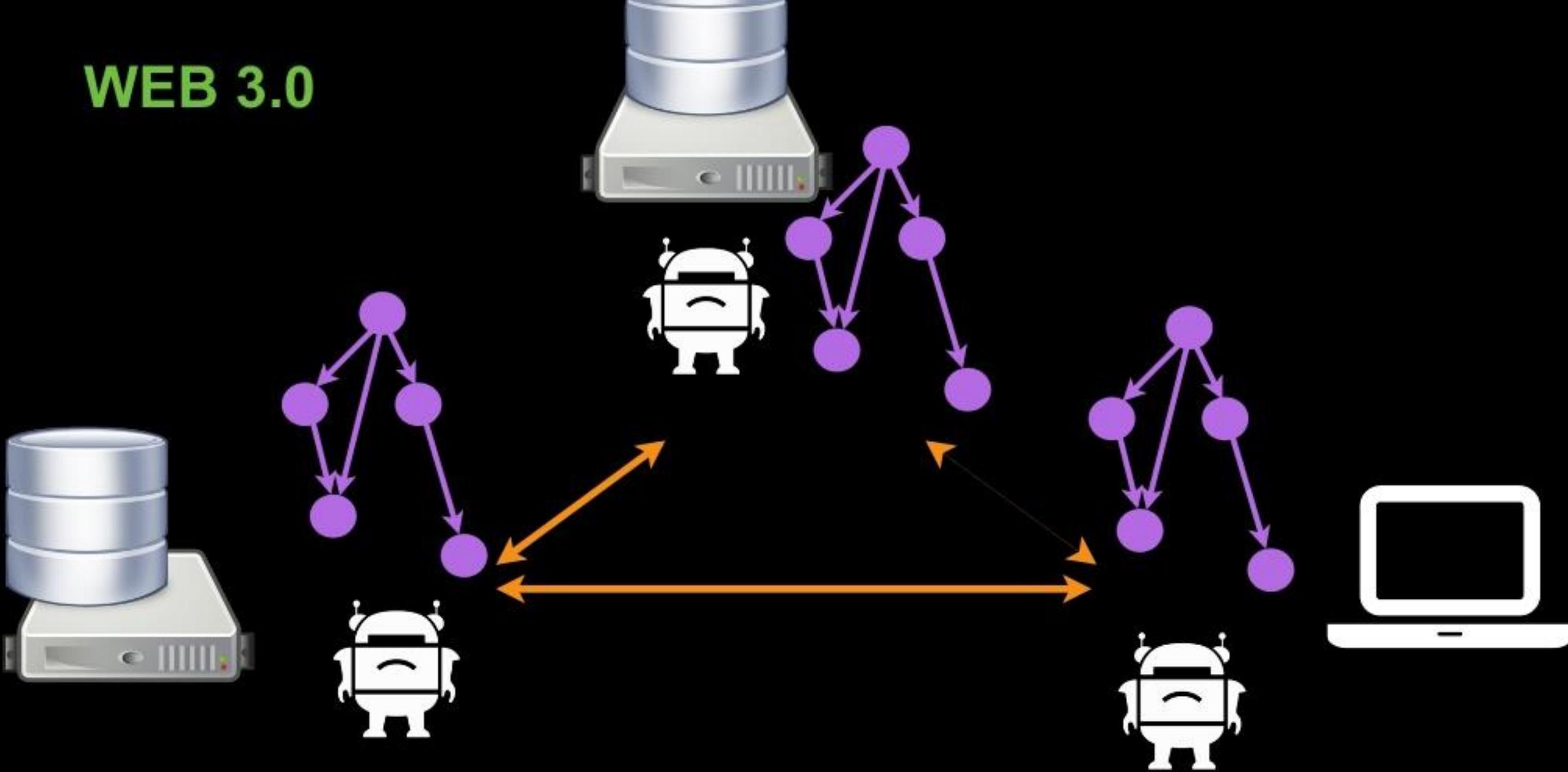
network

Moving the Data

WEB 2.0

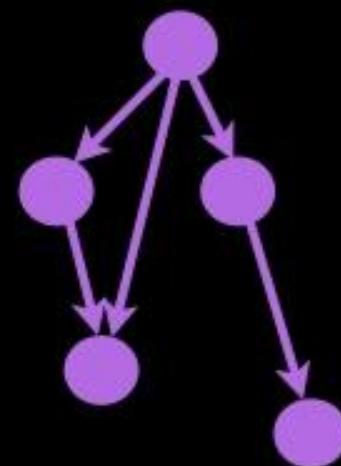


WEB 3.0



IPLD

a common hash-chain format
for distributed data structures



A CERTIFIED DIGITAL SIGNATURE

Ralph C. Merkle

BNR Inc.,

Palo Alto, Ca.

94304

Abstract

A practical digital signature system based on a conventional encryption function which is as secure as the conventional encryption function is described. Since certified conventional systems are available it can be implemented quickly, without the several years delay required for certification of an untested system.



commit	size
tree	0de24
parent	nil
author	Scott
committer	Scott
my commit message goes here and it is really, really cool	

98ca9..

tree	size
blob	e8455
blob	bc52a
tree	10af9

0de24..

tree	size
blob	bc52a
blob	b70f8
tree	10af9

10af9..

tree	size
blob	0adla
blob	0adla
tree	b70f8

b70f8..

blob	size
— LICENSE:	
(The MIT License)	
Copyright (c) 2007 Tom Preston-Werner	
Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:	
the Software must not be sold in trademarked packaging, or represented as being endorsed by the copyright holders.	
THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.	

e8455..

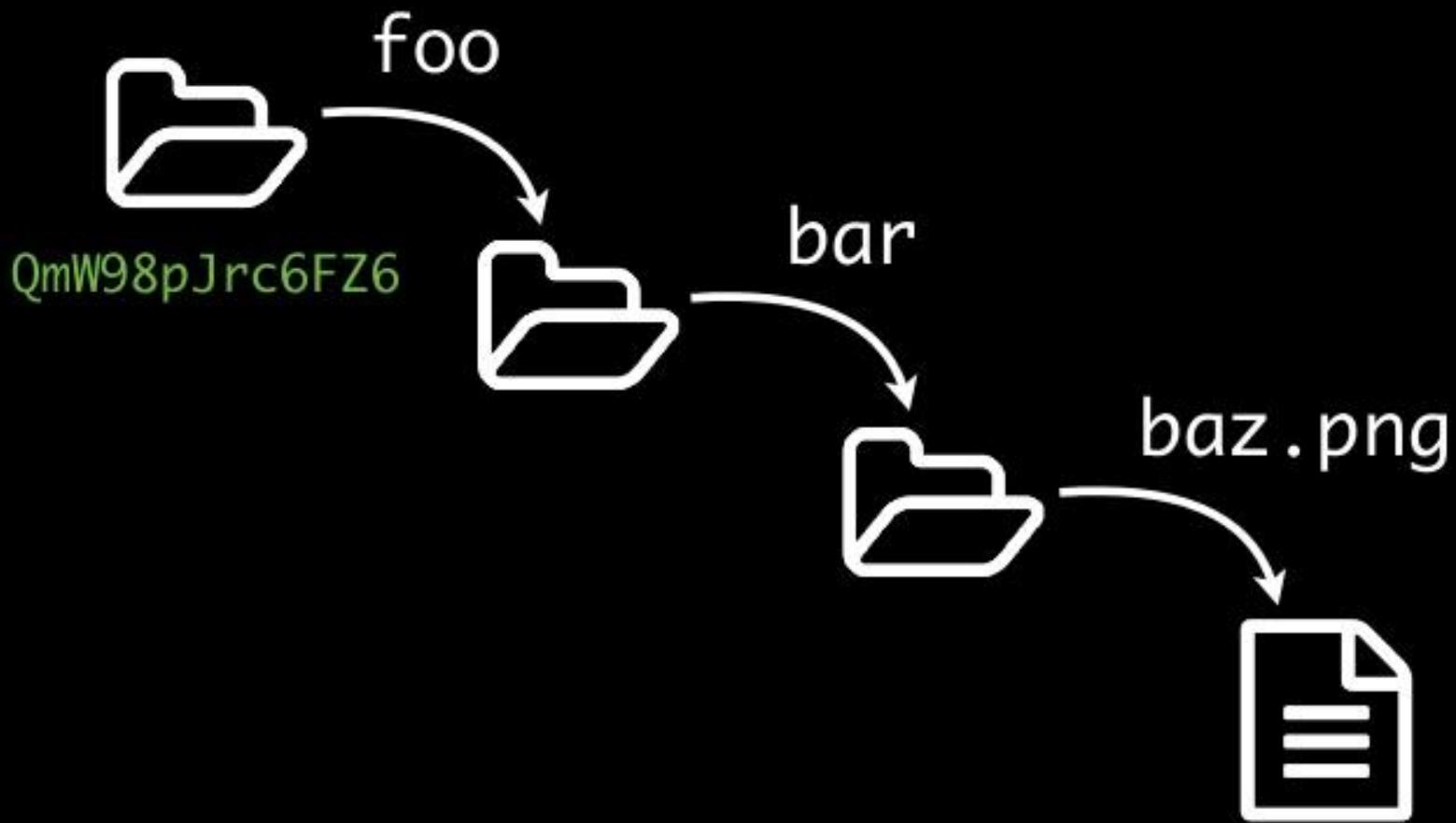
blob	size
require 'grit/index'	
require 'grit/status'	
module Grit	
class << self	
attr_accessor :debug	
end	

bc52a..

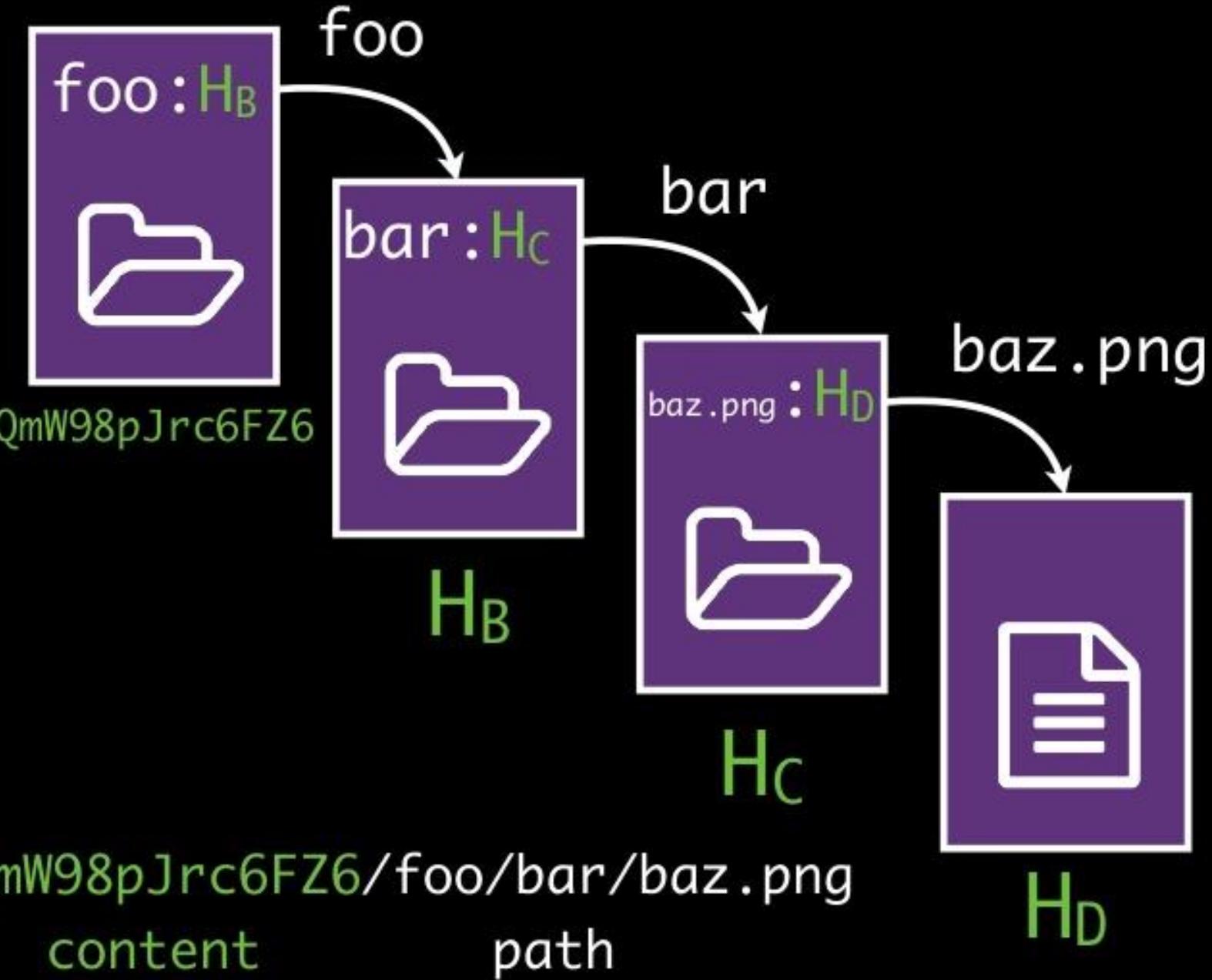
blob	size
require 'grit/git-ruby/repository'	
require 'grit/git-ruby/file_i18n'	
module Grit	
module Tricks	

0adla..

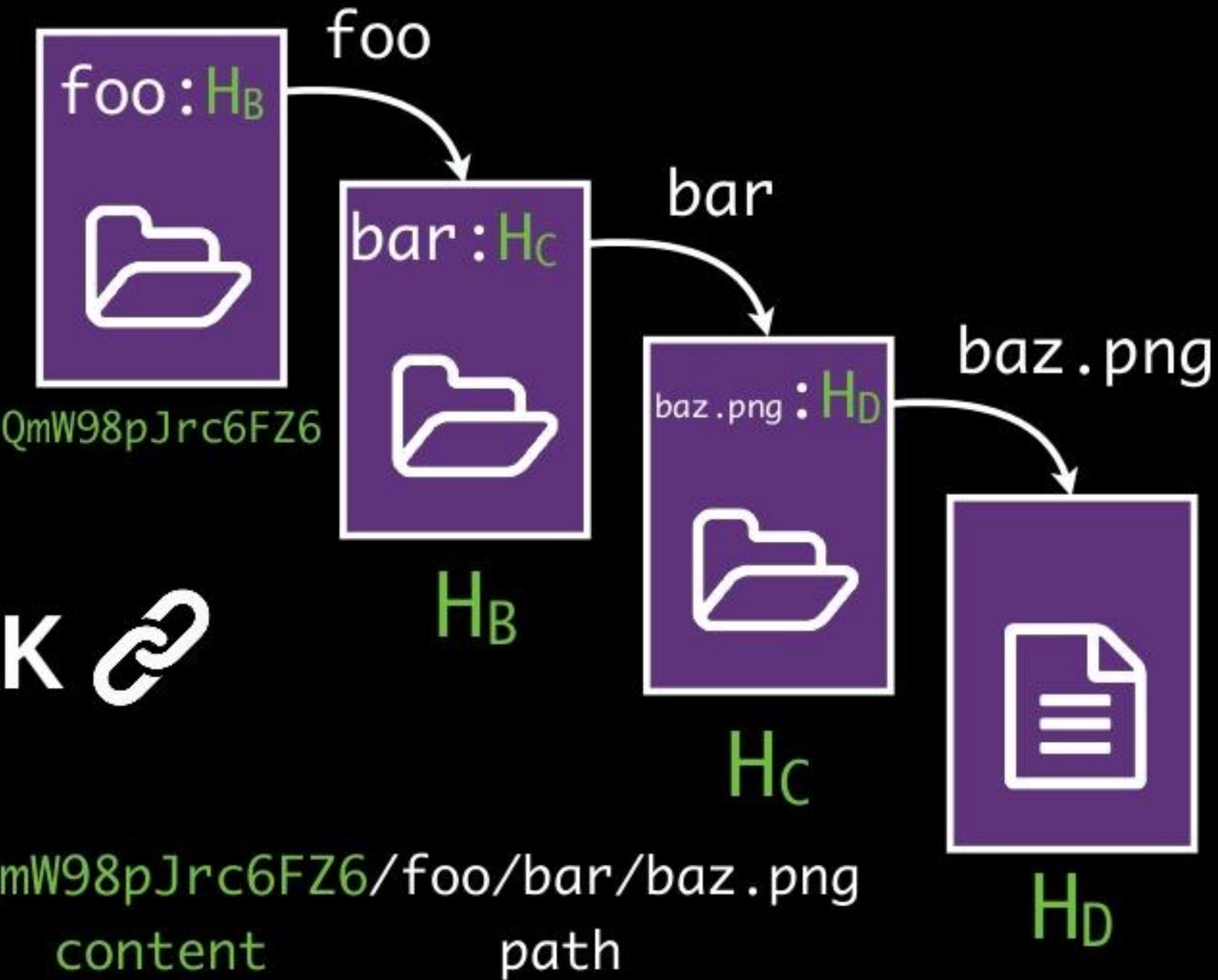




/ipfs/**QmW98pJrc6FZ6**/foo/bar/baz.png
content path



MERKLE LINK



MERKLE LINK

“URI”

immutable

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

mutability

key name	/ipns/QmYJPtosPTfoC/foo/bar/baz.png
content addr	/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png
	fs:/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png
	ipfs:/ipfs/QmW98pJrc6FZ6/foo/bar/baz.png



3. jbenet@lorien ~ (zsh)

```
jbenet @ earth : ~ > ipfs add -r ~/demo/basic
added QmajFHHivh25Qb2cNbnnnEeUe1gDLHX9ta7hs2XKX1vazb basic/cat.jpg
added QmZ7uhHuR3zctKYgiyEntay5xreRyE9NtE8TDQSnxvkE2R basic/foo.jpg
added QmTz3oc4gdpRMKP2sdGUPZTAGRngqjsi99BPoztyP53JMM basic/test/bar
added QmTz3oc4gdpRMKP2sdGUPZTAGRngqjsi99BPoztyP53JMM basic/test/baz/b
added QmYNmQKp6SuaVrpgWRsPTgCQCnpXUYGq76YEKBXuj2N4H6 basic/test/baz/f
added QmX1ebVUtfY11ZCpVmqyE5mDoN62SpLd8eLPpg5GGV1ABt basic/test/baz
added QmYNmQKp6SuaVrpgWRsPTgCQCnpXUYGq76YEKBXuj2N4H6 basic/test/foo
added QmNtpA5TBnqHrKf3cLQ1AiUKXiE4JmUodbG5gXrajg8wdv basic/test
added QmWNj1pTSjbauDHPdyg5HQ26vYcNWnubg1JehmwAE9NnU9 basic/tree-in-cosmos.jpg
added QmbtJUxwLnQ1UF1E8xnjgcZsdGaDdz7S6rg3rNYcGV9m basic/vm/Makefile
added QmTagEY4NYY8WZkFSWM2xpyH71J7z78Usz2QJRoaE8qJ basic/vm/disk.vdi
added QmeLW1ZJPDeLMp7WC4gWTkYvQyAMQECEwSVsox3jWdvQpJ5 basic/vm/vbox
added QmbtJUxwLnQ1UF1E8xnjgcZsdGaDdz7S6rg3rNYcGV9m basic/vm/vm/Makefile
added QmRXgisKJmSSii3UUTn9QqvhKoAAcyt7CqNbFFSpGamB9k basic/vm/vm/disk.vdi
added QmQjgMyaqgouThuGFkZQNNaJpa7QawR4P2yRv7N1Y2ffsE basic/vm/vm
added QmVu5LxhbDo866EmmFJF8zNNfdXvn35FjavhREHrfxFGuA basic/vm
added QmTTToTPSAn4y9KRxueN8zHtNye7cupdFstVP3ChJKizpJv basic
```

JSON → IPLD

```
{  
  "username": "@VannevarBush",  
  "followers": [  
    "@FredTerman",  
    "@ClaudeShannon",  
    "@DougEngelbart",  
    ...  
  ]  
}
```

```
{  
  "username": "/ipfs/QmWxCC8BrWSUJR2AJQZu7TE",  
  "followers": [  
    "/ipfs/QmP8AmEKHHMnaBaQsEJVGs7ZbBSQAxhPn",  
    "/ipfs/QmVDGZWUgo4beprgwcmppoaBXxSainGHd",  
    "/ipfs/QmfVQwj2cyhrKQV1BY1y2nAcQcjiKEkvE",  
    ...  
  ]  
}
```

YML → IPLD

```
username: @VannevarBush
```

```
followers:
```

- @FredTerman
- @ClaudeShannon
- @DougEngelbart

```
username: /ipfs/QmWxCC8BrWSUJR2AJQZu7TEniAa6
```

```
followers:
```

- /ipfs/QmP8AmEKHHMnaBaQsEJVGs7ZbBSQAxhPn9
- /ipfs/QmVDGZWUgo4beprgwcmpoaBXxSainGdt
- /ipfs/QmfVQwj2cyhrKQV1BY1y2nAcQcjKEkvEY

The IPFS Stack

applications

Using the Data

IPNS

naming

IPLD

merkldag

Defining the Data

libp2p

exchange

routing

network

Moving the Data

DNS

is used for all sorts of things

A	@	104.236.176.52
A	disabled-dev0.4.0	104.236.179.241
AAAA	disabled-dev0.4.0	fc98:424c:b433:d7e2:7ec
AAAA	h	fce3:c53b:c3c5:2f54:8bb
MX	1	aspmx.l.google.com.
MX	5	alt1.aspmx.l.google.com.
TXT	@	dnslink=/ipfs/QmTgNJEg(
TXT	h	dnslink=/ipfs/QmcQBvKTI
NS	ns1.digitalocean.com.	
NS	ns2.digitalocean.com.	

DNS

is used for all sorts of things

```
type: A  
sub: subdomain  
value: 104.236.176.52  
TTL: 180s
```

A	@	104.236.176.52
A	disabled-dev0.4.0	104.236.179.241
AAAA	disabled-dev0.4.0	fc98:424c:b433:d7e2:7ec
AAAA	h	fce3:c53b:c3c5:2f54:8bb
MX	1	aspmx.l.google.com.
MX	5	alt1.aspmx.l.google.com.
TXT	@	dnslink=/ipfs/QmTgNJEg(
TXT	h	dnslink=/ipfs/QmcQBvKTI
NS	ns1.digitalocean.com.	
NS	ns2.digitalocean.com.	

DNS Links

```
jbenet @ earth : ~ > dig TXT ipfs.io

; <>> DiG 9.8.3-P1 <>> TXT ipfs.io
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 37227
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;ipfs.io.      IN TXT

;; ANSWER SECTION:
ipfs.io.    120  IN TXT  "dnslink=/ipfs/QmTgNJEgQaCqRht9KSXNyZsCp2xpHZmBRms28NRMmtcERp"

;; Query time: 169 msec
;; SERVER: 209.244.0.3#53(209.244.0.3)
;; WHEN: Tue Nov 17 16:44:28 2015
;; MSG SIZE  rcvd: 98
```

DNS Links



3. jbenet@lorien ~ (zsh)

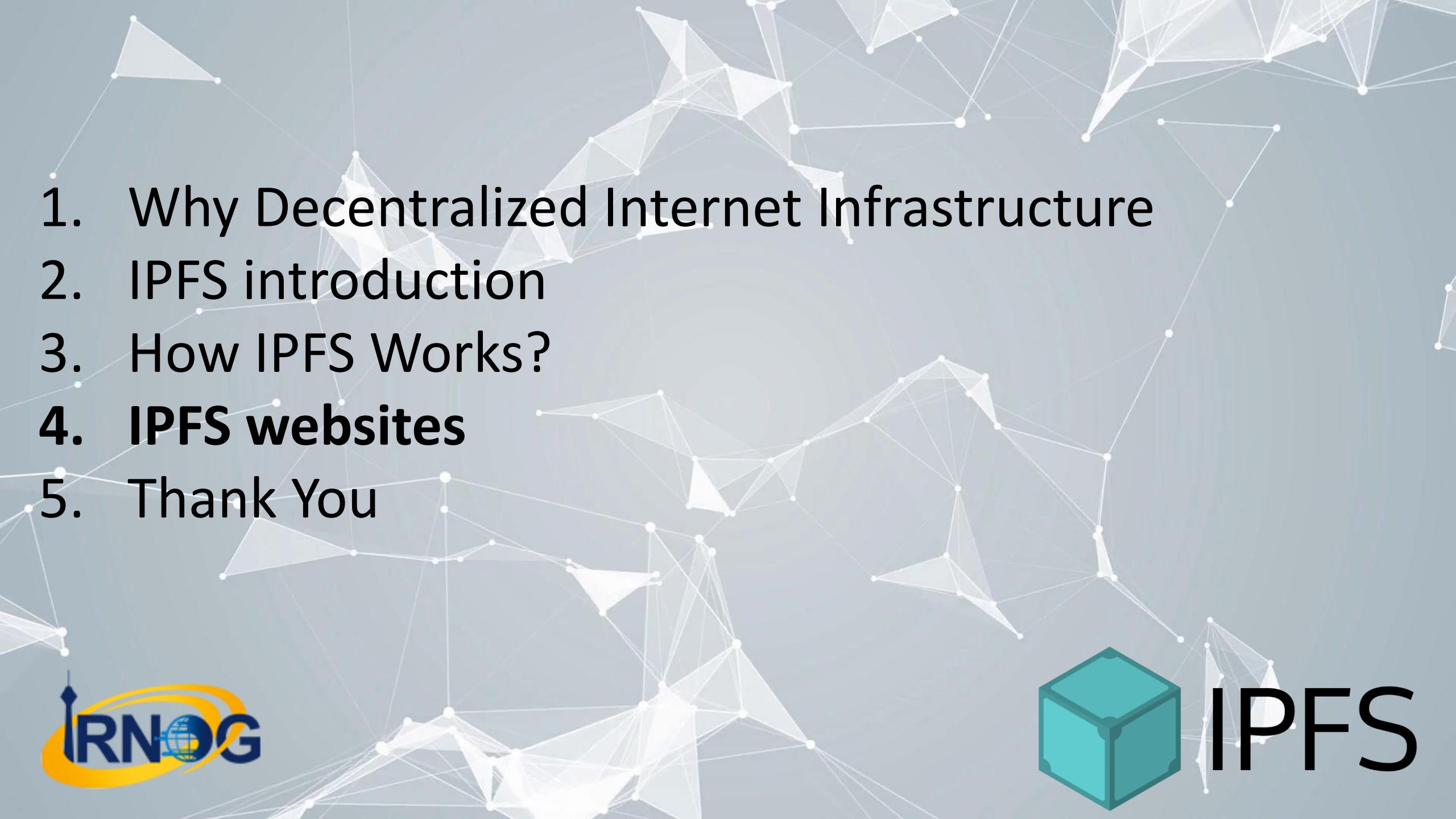
```
jbenet @ earth : ~ > dig TXT ipfs.io

; <>> DiG 9.8.3-P1 <>> TXT ipfs.io
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 37227
;; flags: qr rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0

;; QUESTION SECTION:
;ipfs.io.      IN TXT

;; ANSWER SECTION:
ipfs.io.    120  IN TXT  "dnslink=/ipfs/QmTgNJEgQaCqRht9KSXNyZsCp2xpHZmBRms28NRMmtcERp"

;; Query time: 169 msec
;; SERVER: 209.244.0.3#53(209.244.0.3)
;; WHEN: Tue Nov 17 16:44:28 2015
;; MSG SIZE  rcvd: 98
```

- 
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 5. Thank You



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BUG REPORT



Orbit

github.com/haadcode/orbit
p2p chat on IPFS



IPFS



IPLD

libp2p

The screenshot shows the Orbit application interface. At the top center is a red circular logo with the word "ORBIT". To the left is a sidebar with a "#nyc" channel header and a list of messages from 22:19:57 to 19:55:40. The main area is a chat window with a dark background. A message from "haad" at 22:24:47 says "richard: Herangham Kookoo! nNaNvike #foo". Below it, "haad" says "except from node1 --> haad". Other messages include "haad: which reminds me that I should add /nick tanyu", "haad: The little dots should bounce or", "haad: Ideally theywouldn't need to be dis", "haad: gotta go, hopefully jbenet can get h", "node1 will keep caching this channel", "dignifiedquire: I'm in", "haad: now I really gotta go -->", "node1 cache head just in case", "dignifiedquire: good night haad", "haad: o/", and "haad: lo/". On the right side of the interface, there is a vertical log of messages and a video player window displaying a cartoon bird.

used to archive data of

arXiv.org

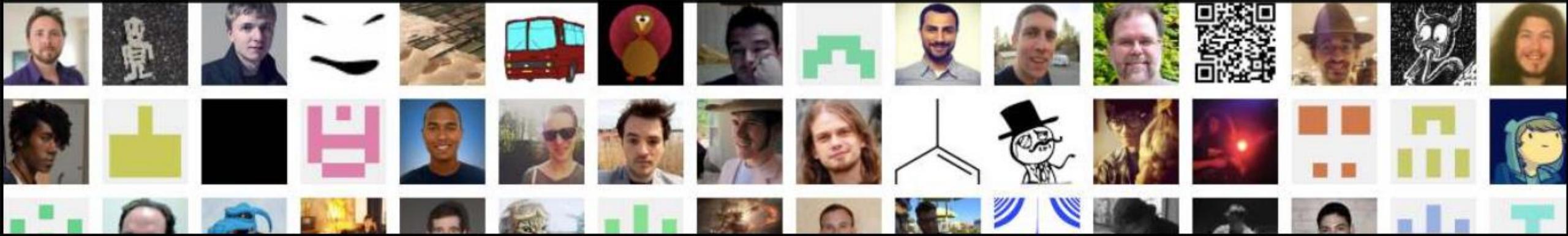


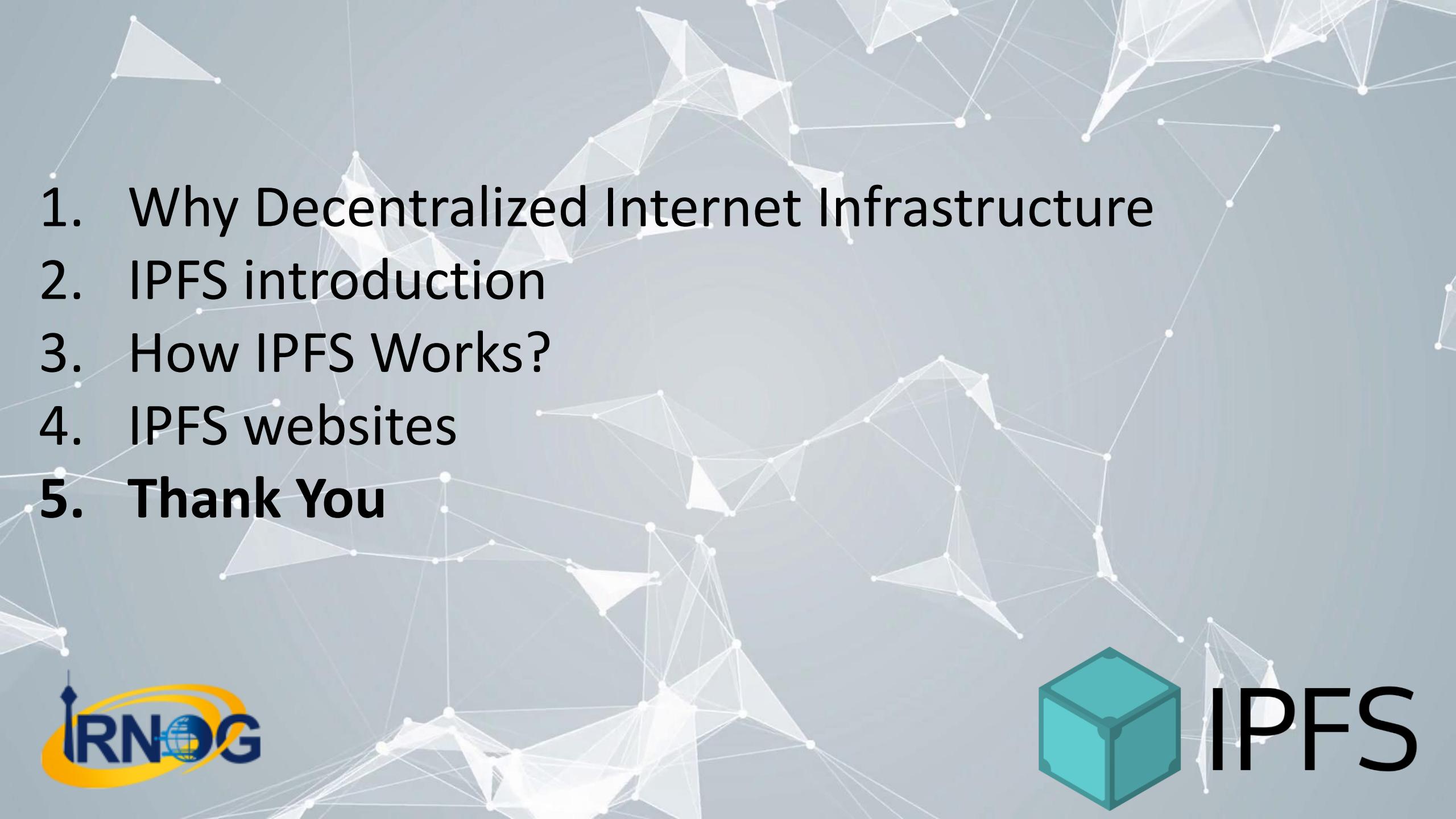


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