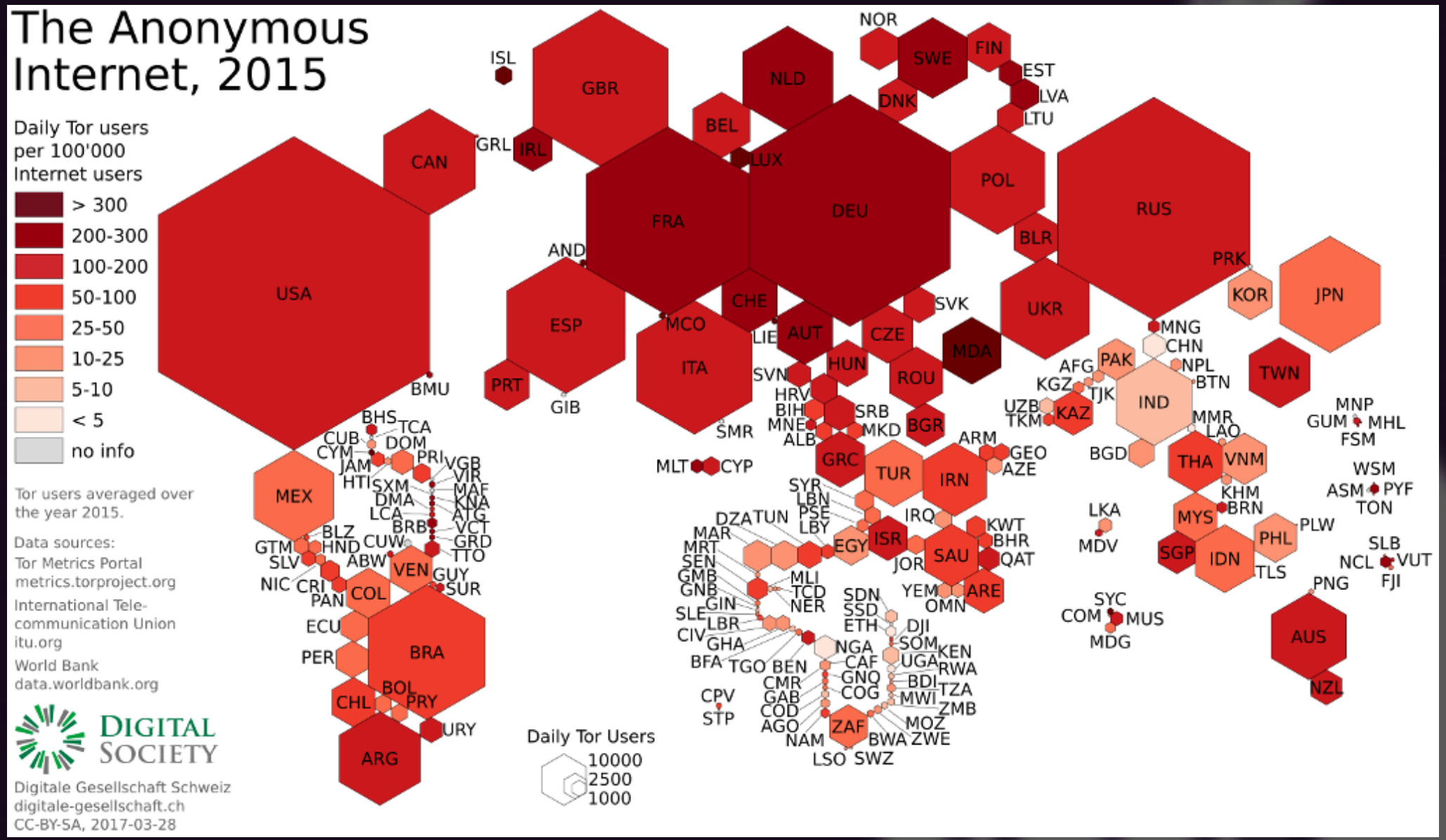
The Utility of the Tor Network

By: Hammas Bin Tanveer
Advisor: Dr. Rishab Nithyanand

The Anonymous Internet



A regular internet connection

Daniyal

Mahnaz

A regular internet connection

A regular internet connection

A regular internet connection

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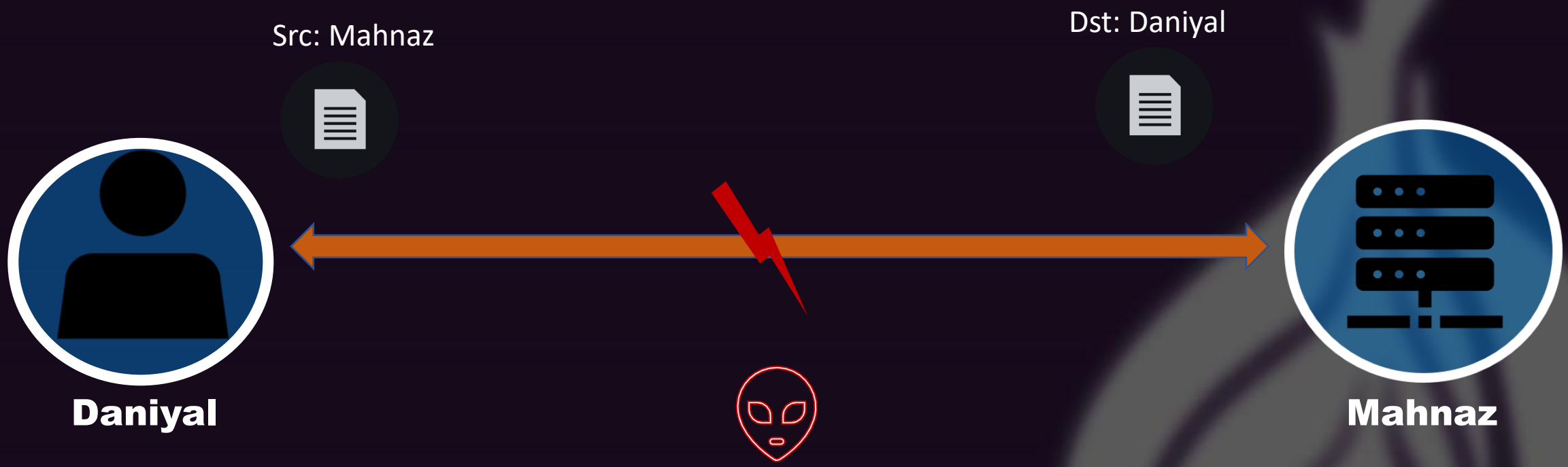

An internet connection through Tor

Daniyal

Mahnaz

An internet connection through Tor

Tor network

Daniyal

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Daniyal

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An internet connection through Tor

The setup

Daniyal

An internet connection through Tor

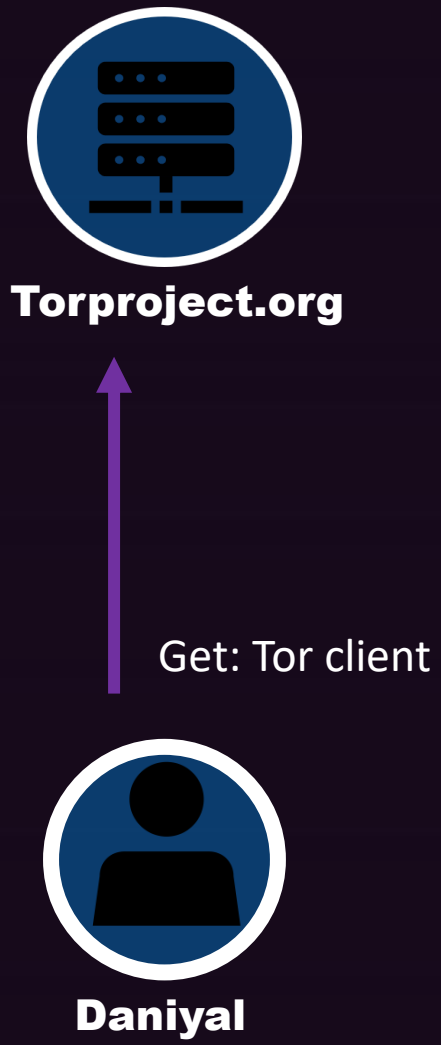
The setup

Torproject.org

Daniyal

An internet connection through Tor

The setup



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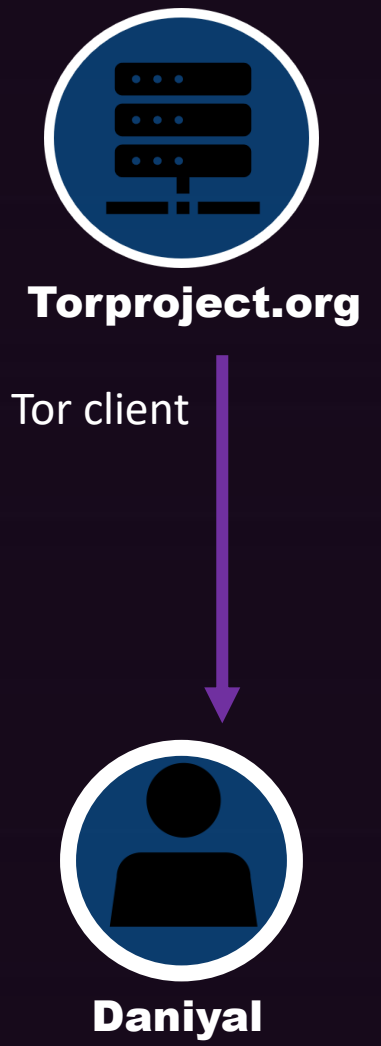

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Daniyal

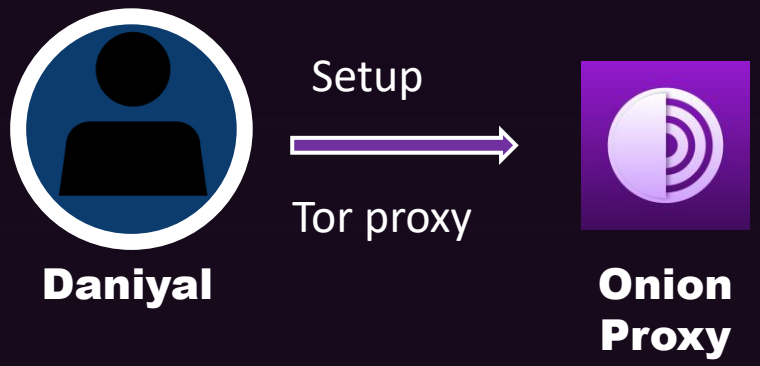
Setup

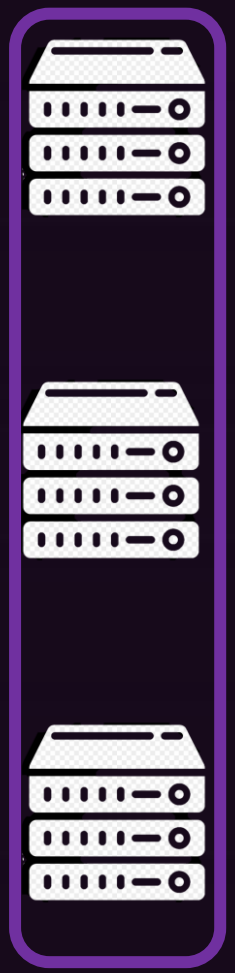
Tor proxy

Onion Proxy

An internet connection through Tor

Building a Tor circuit





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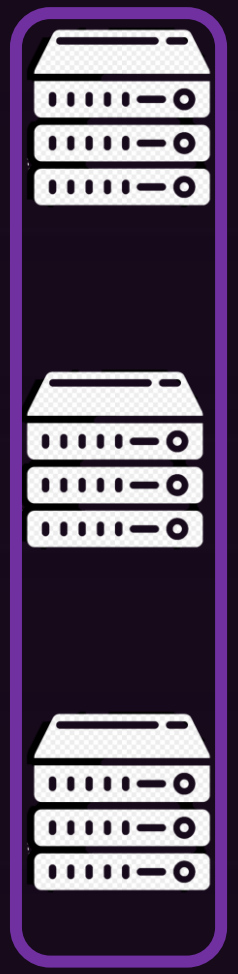

Directory Authorities

Onion Routers

An internet connection through Tor

Service Descriptors

- Contact Information
- Public Keys
- Average Bandwidth
- Exit Policy

A basic Exit policy Example for Web Browsing (*only*) -

```
ExitPolicy accept *:53          # DNS
ExitPolicy accept *:80          # HTTP
ExitPolicy accept *:443         # HTTPS
ExitPolicy reject *:*
```

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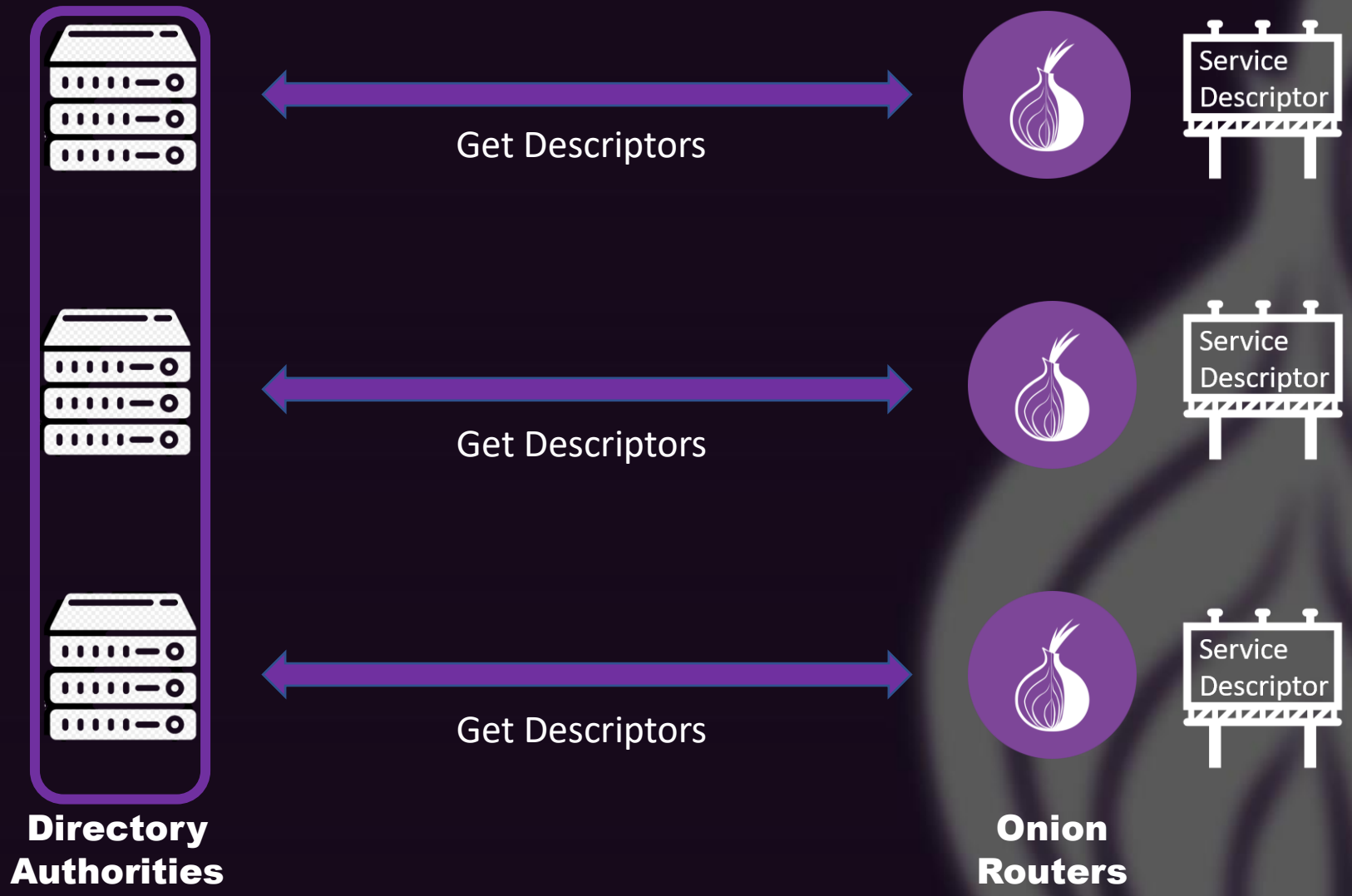

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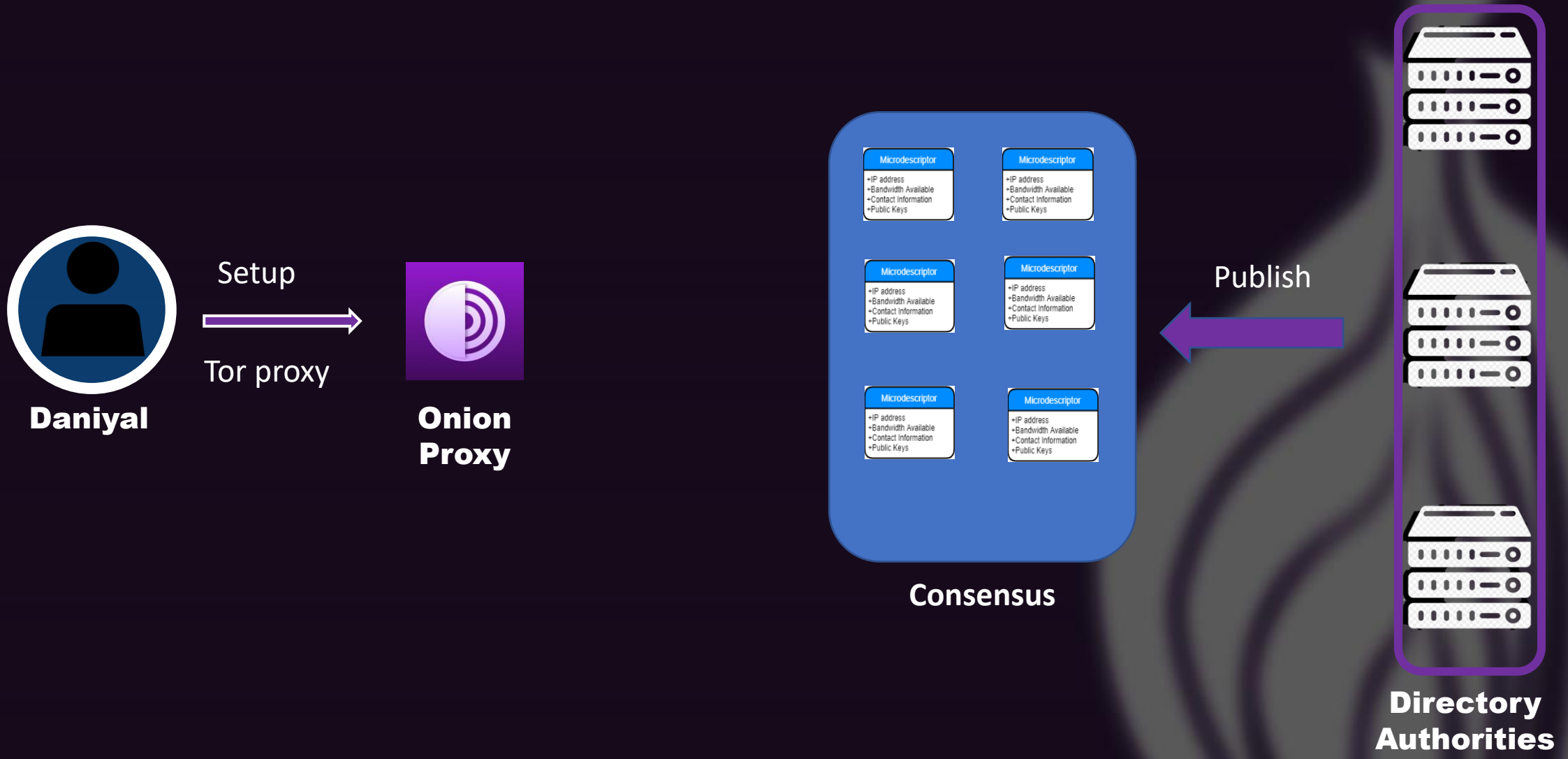

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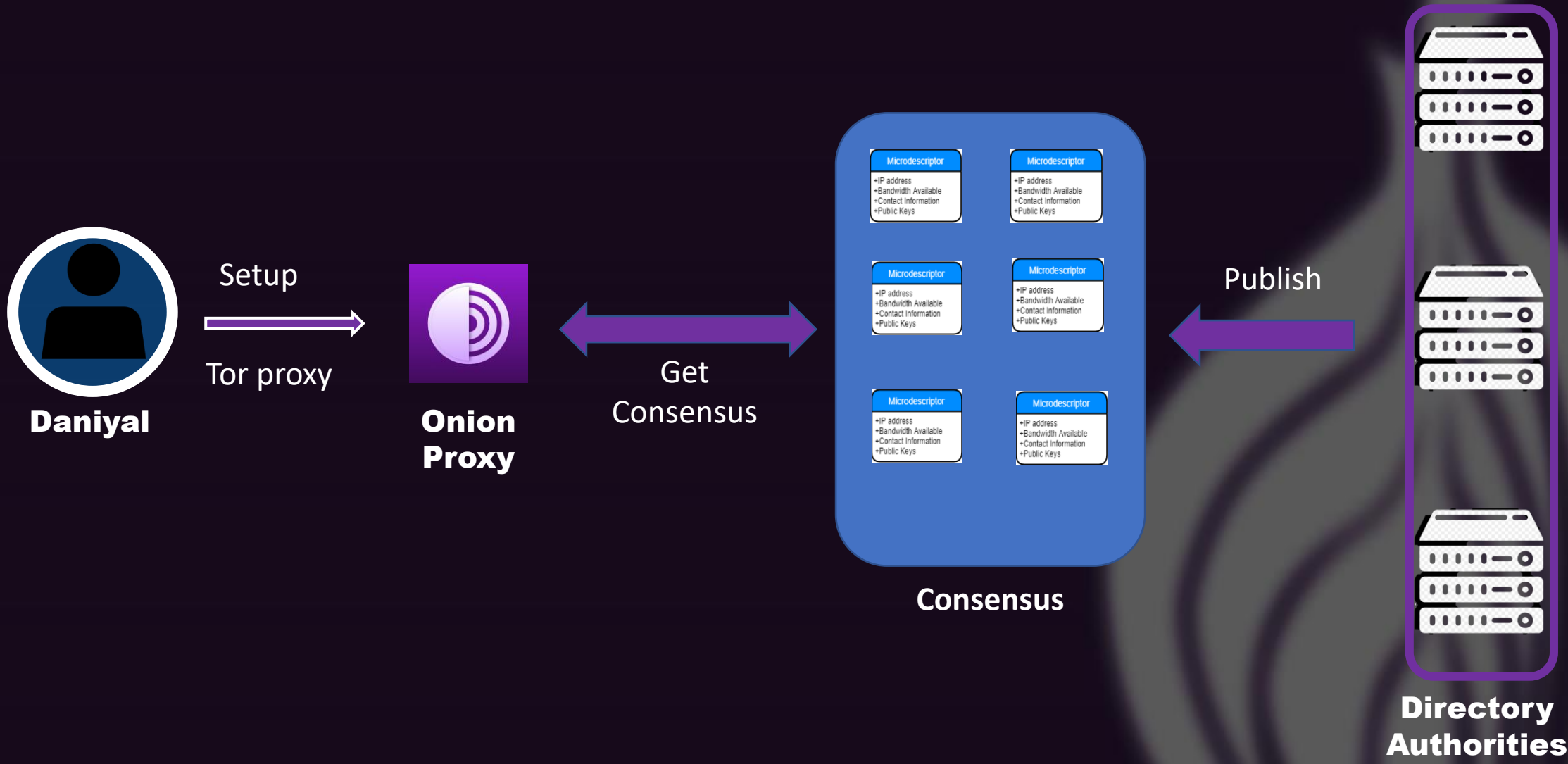

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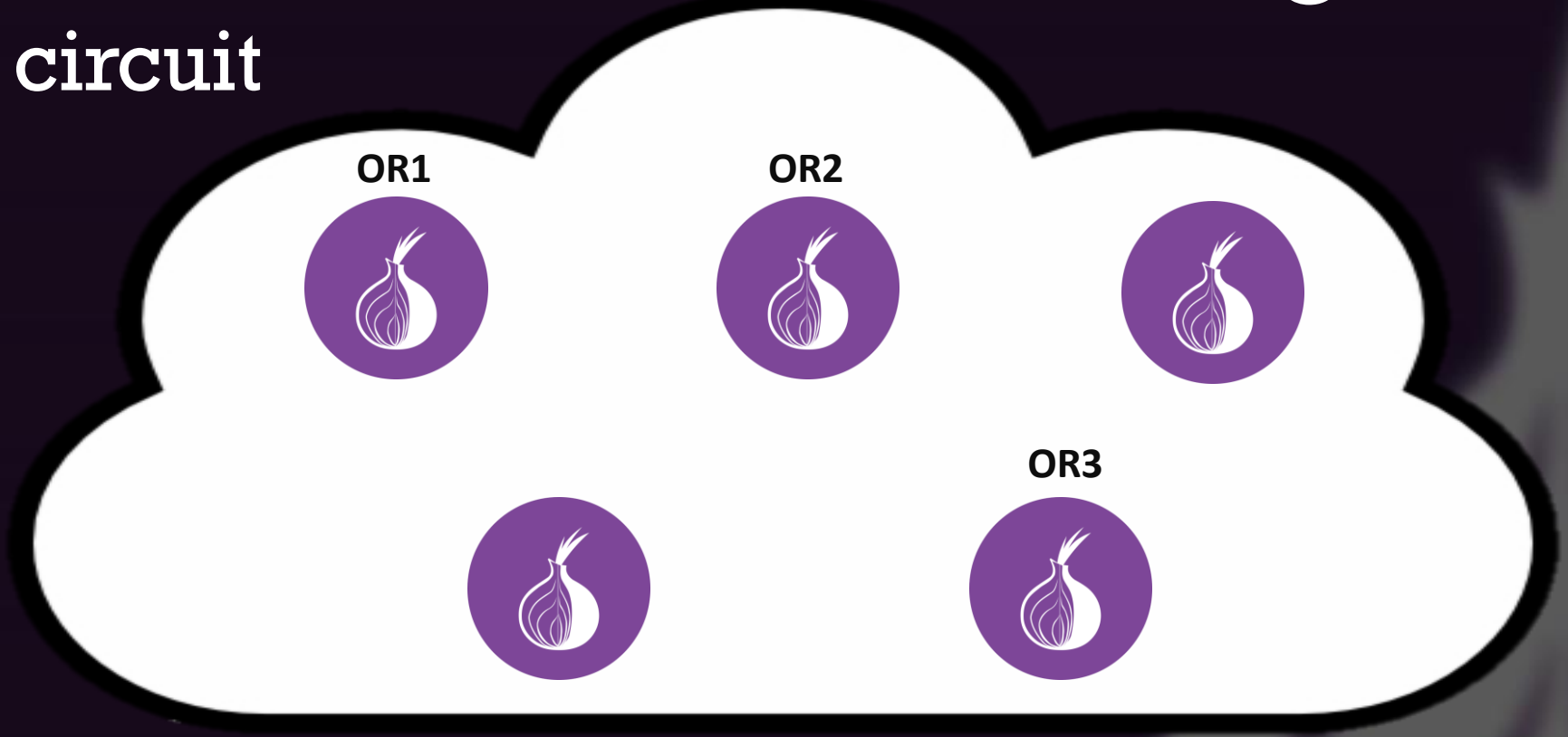

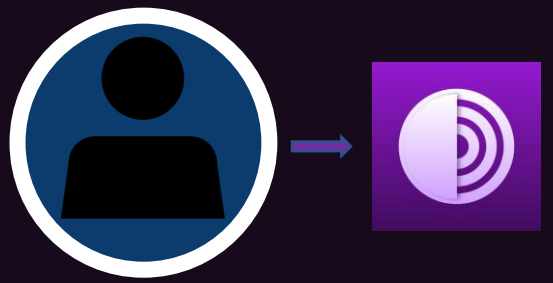

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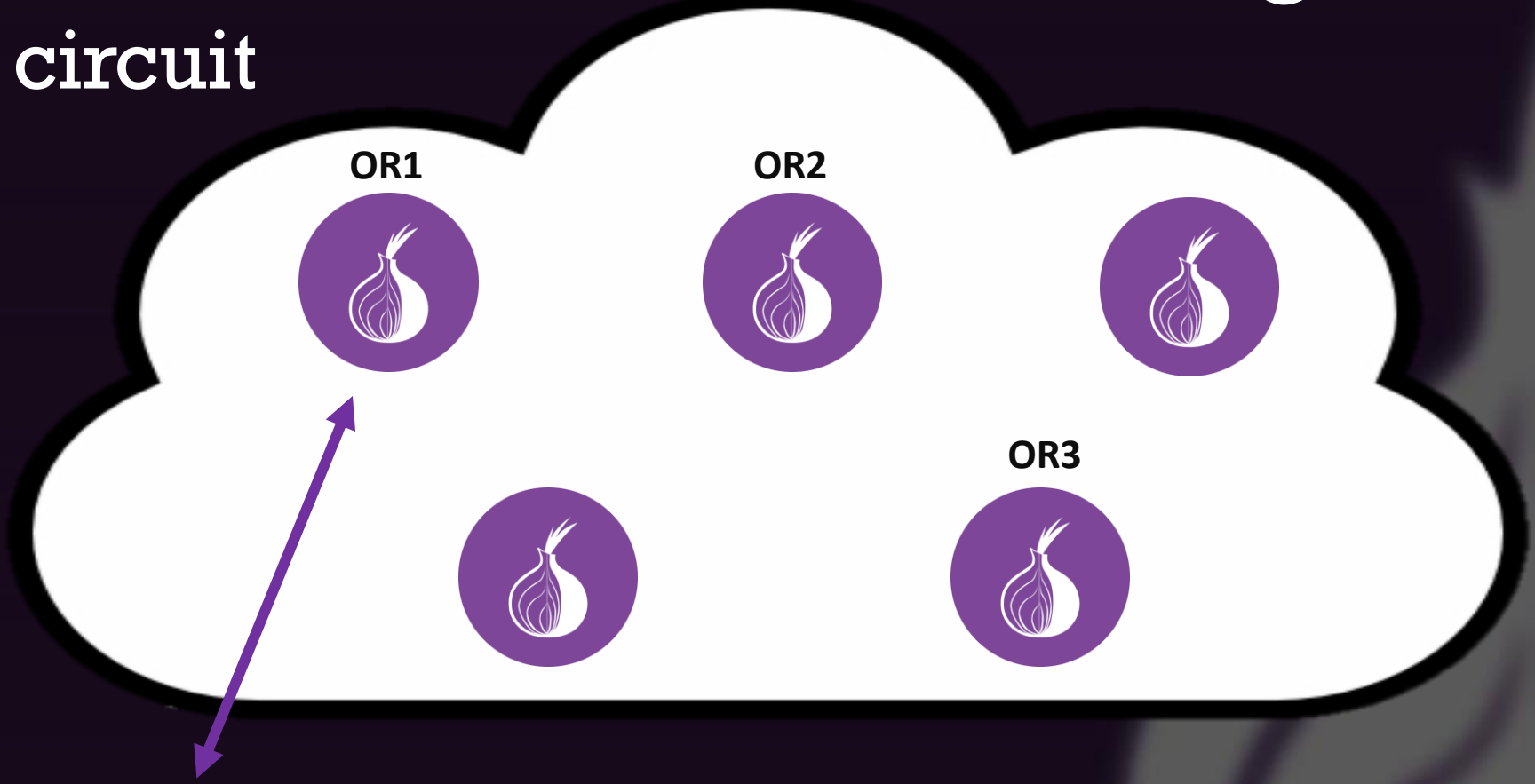

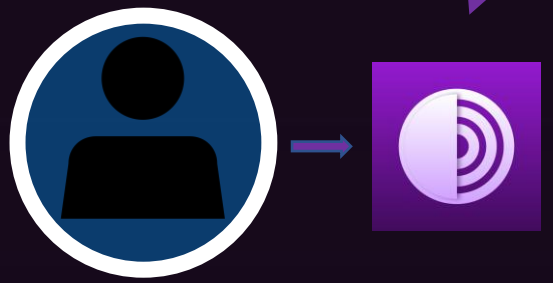

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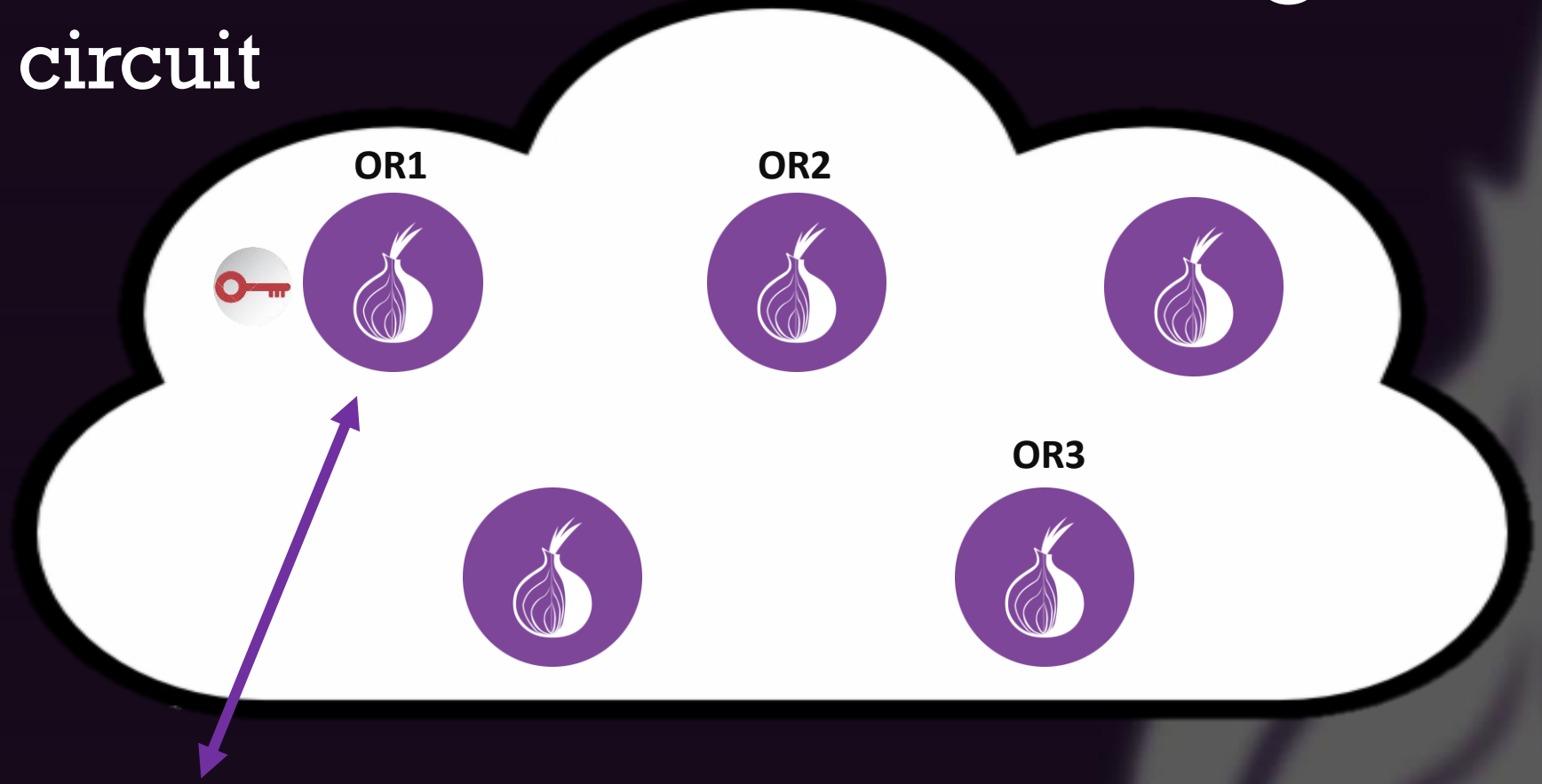

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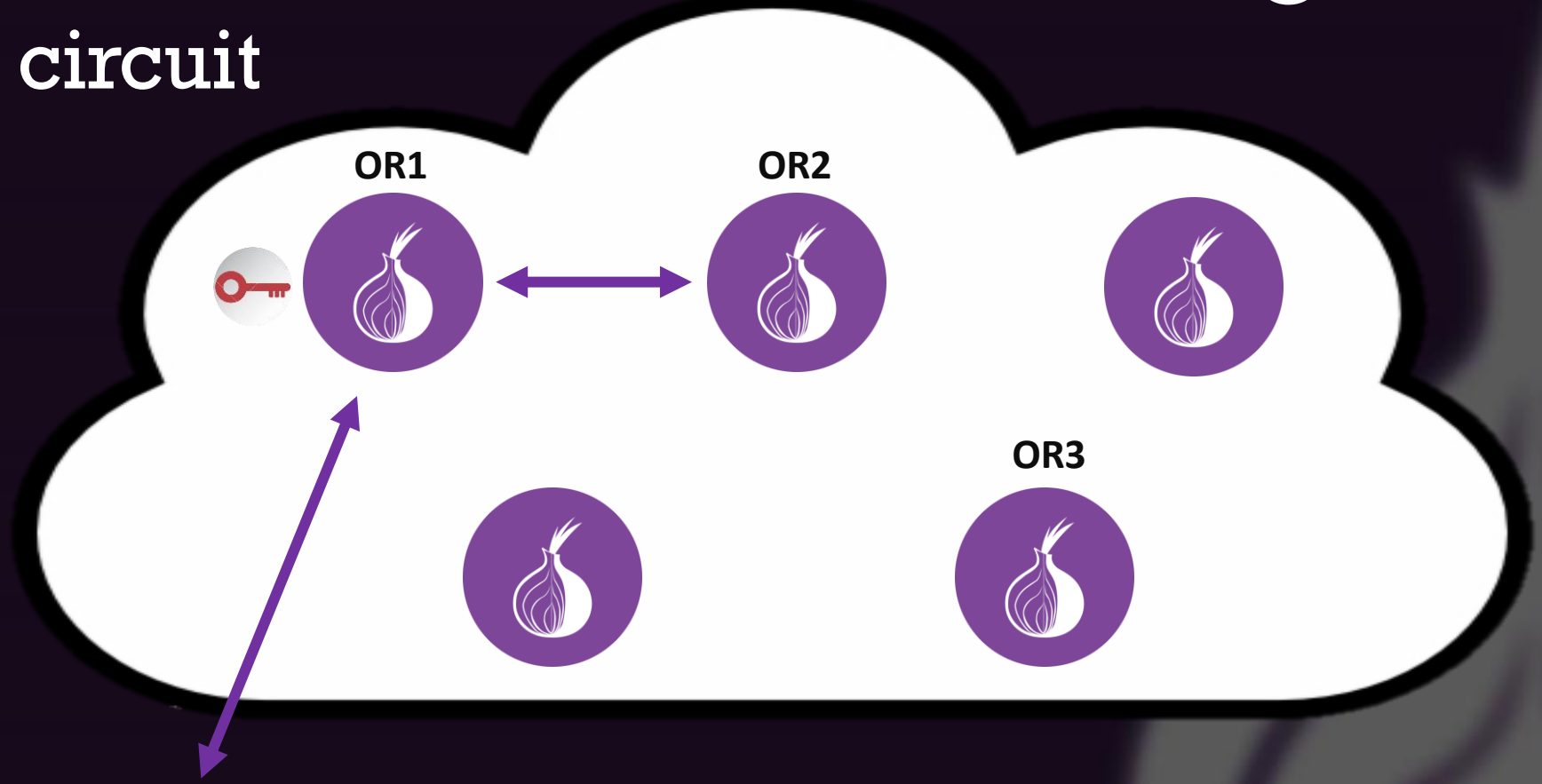

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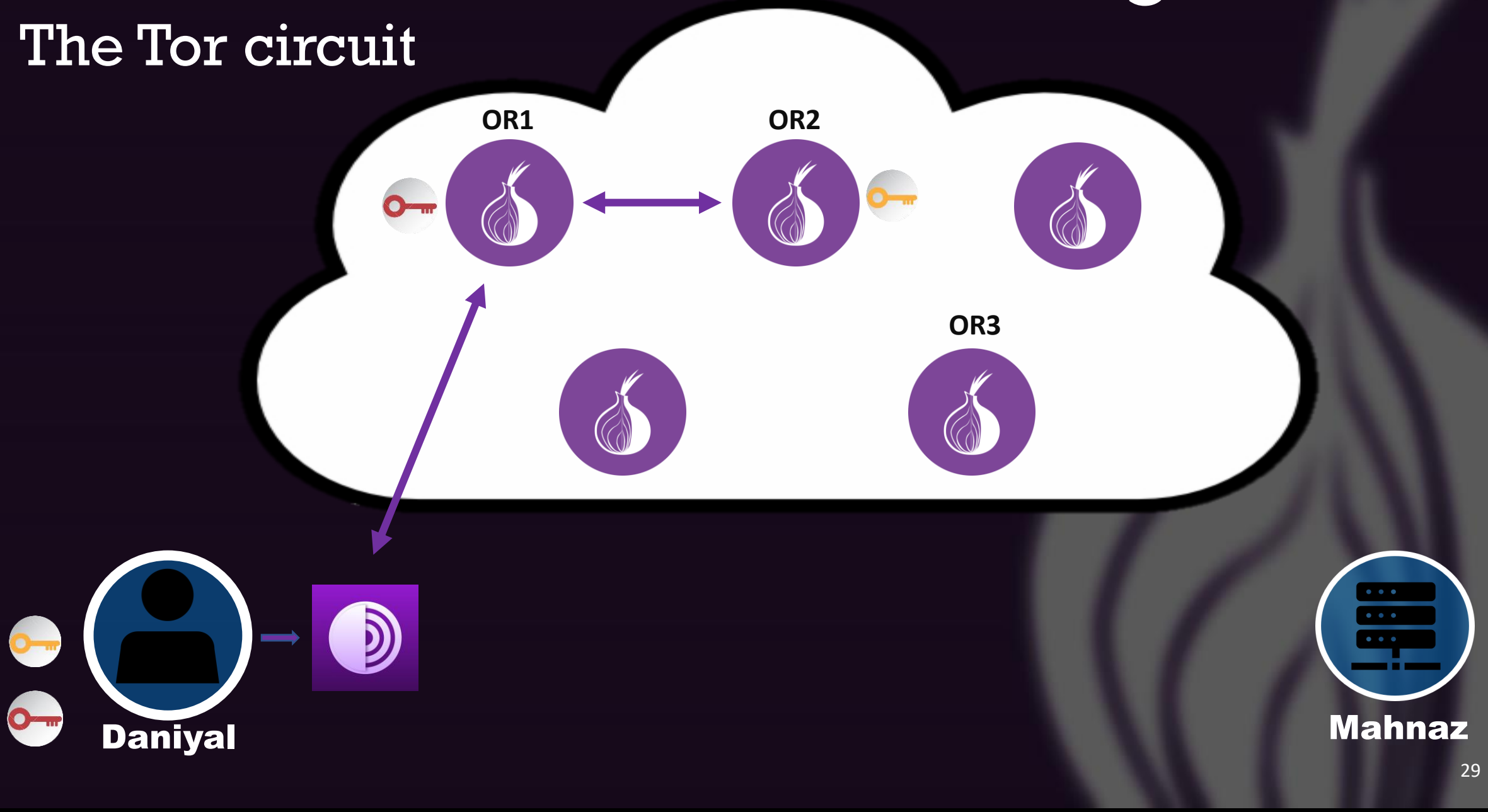

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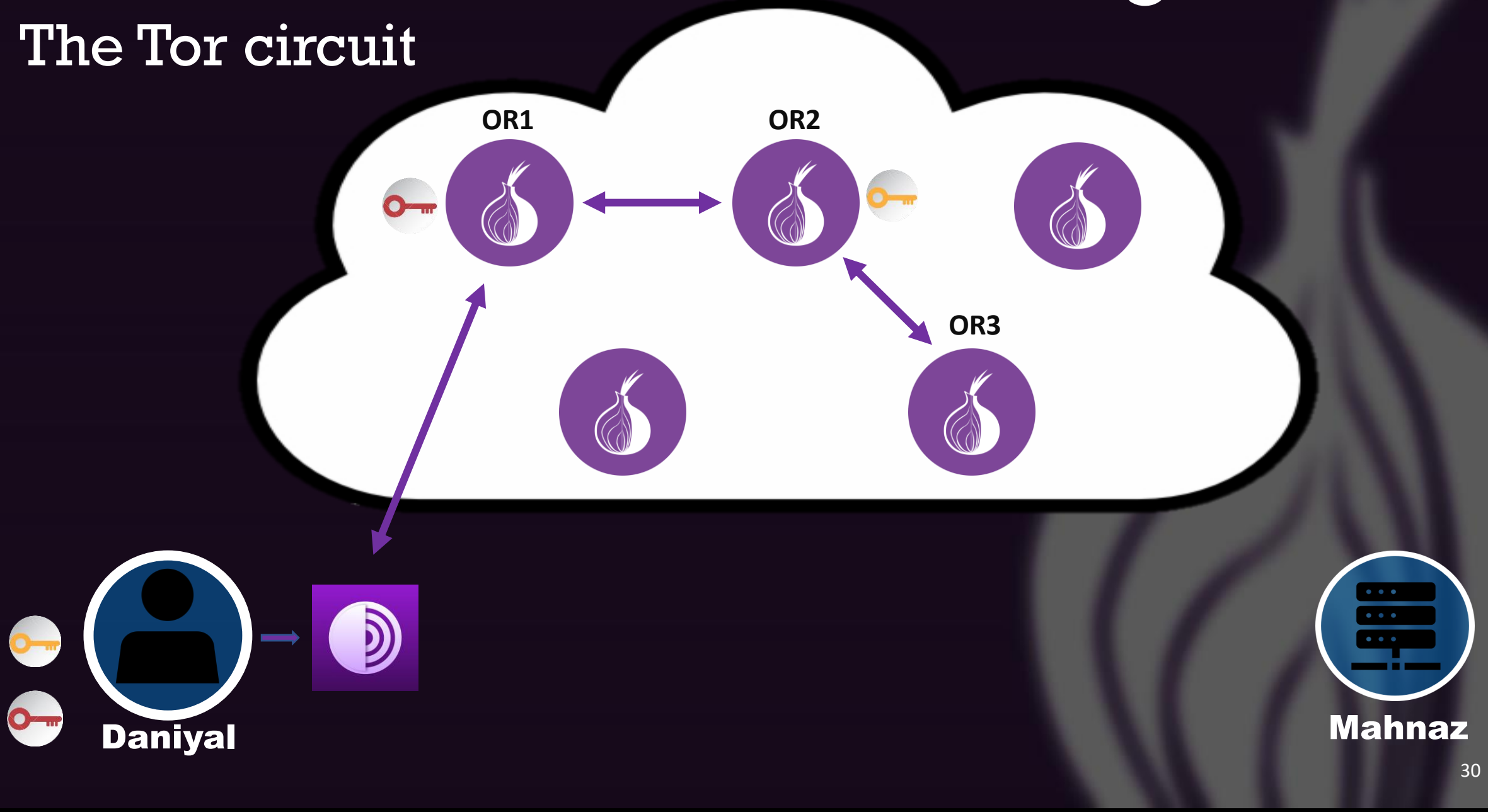

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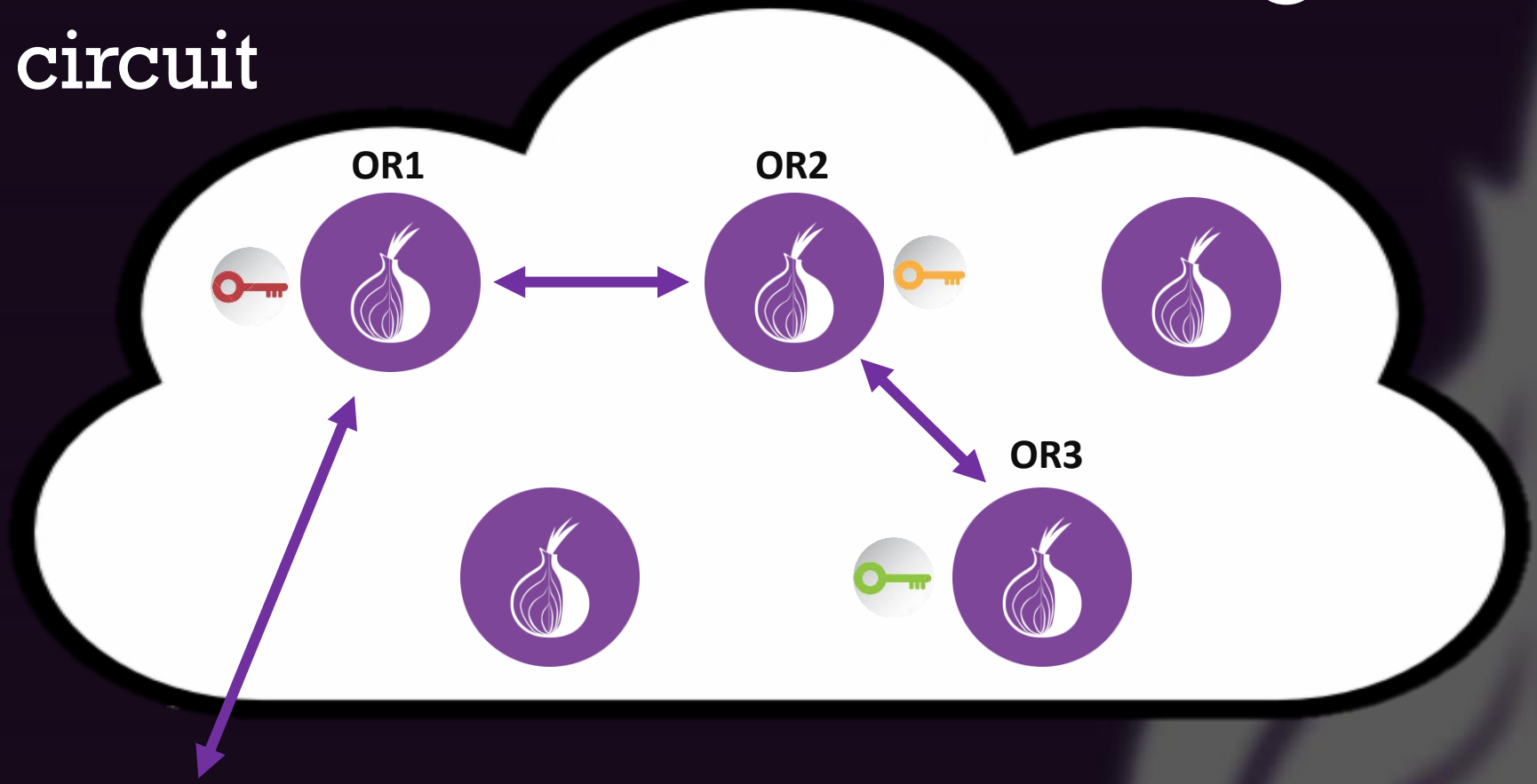

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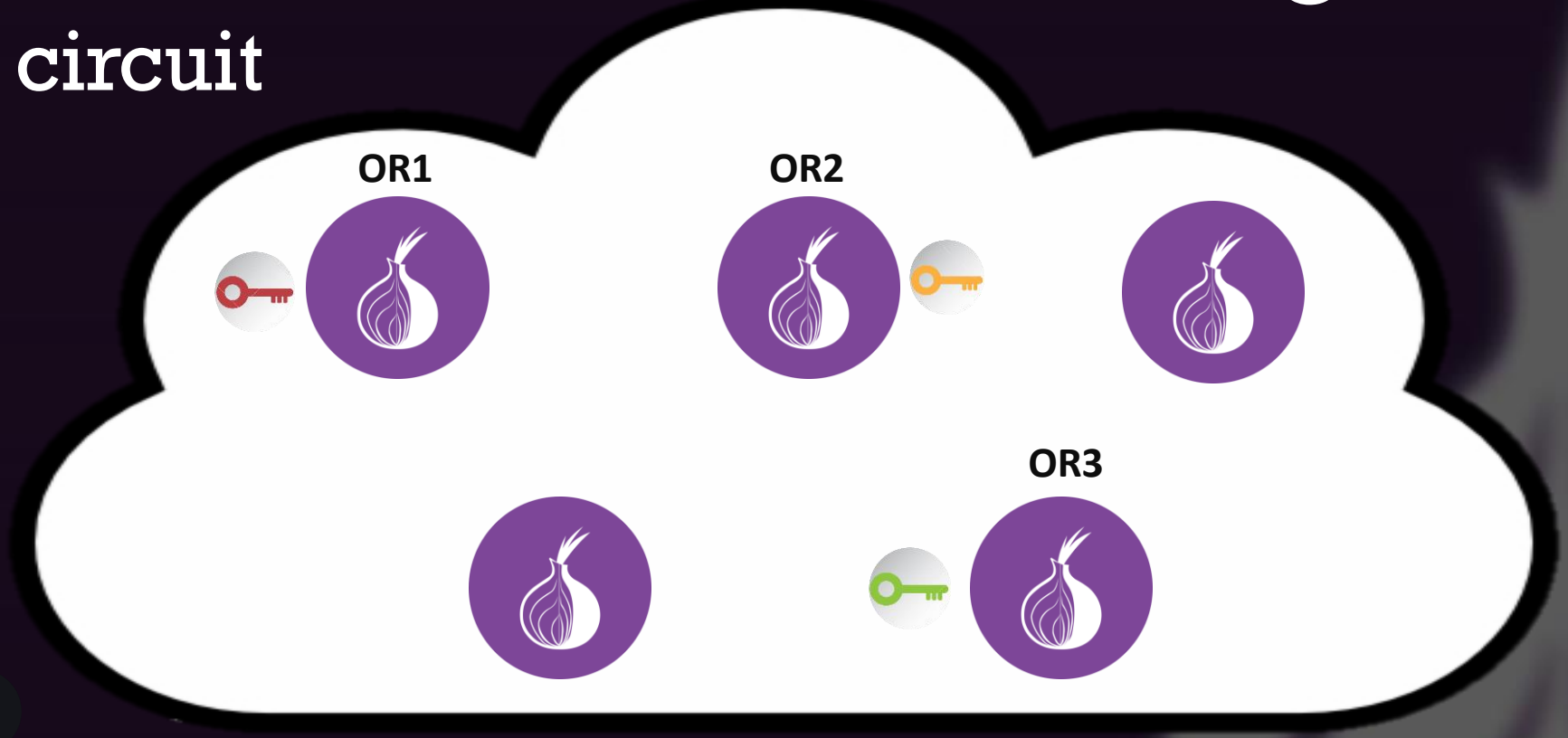

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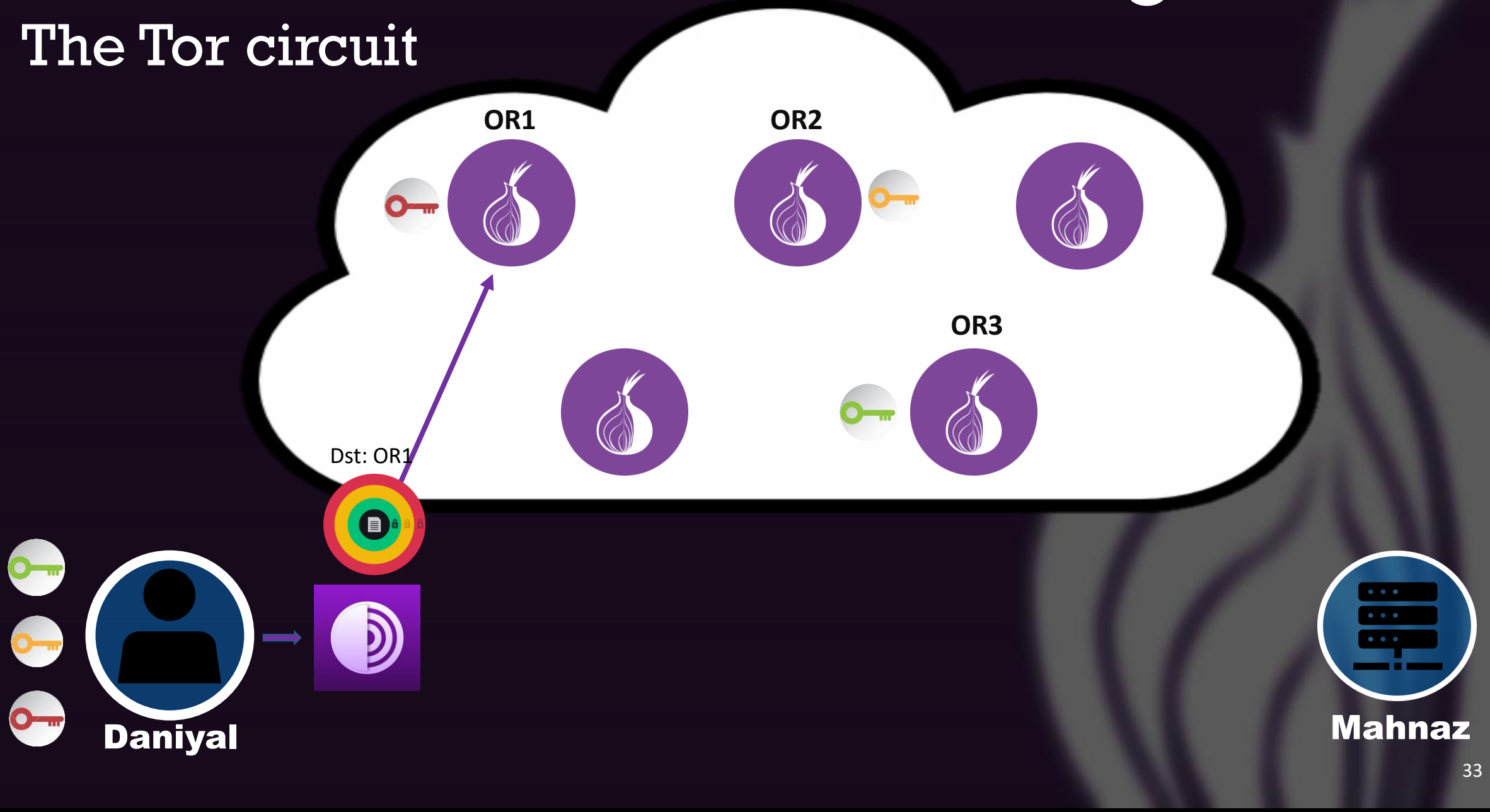

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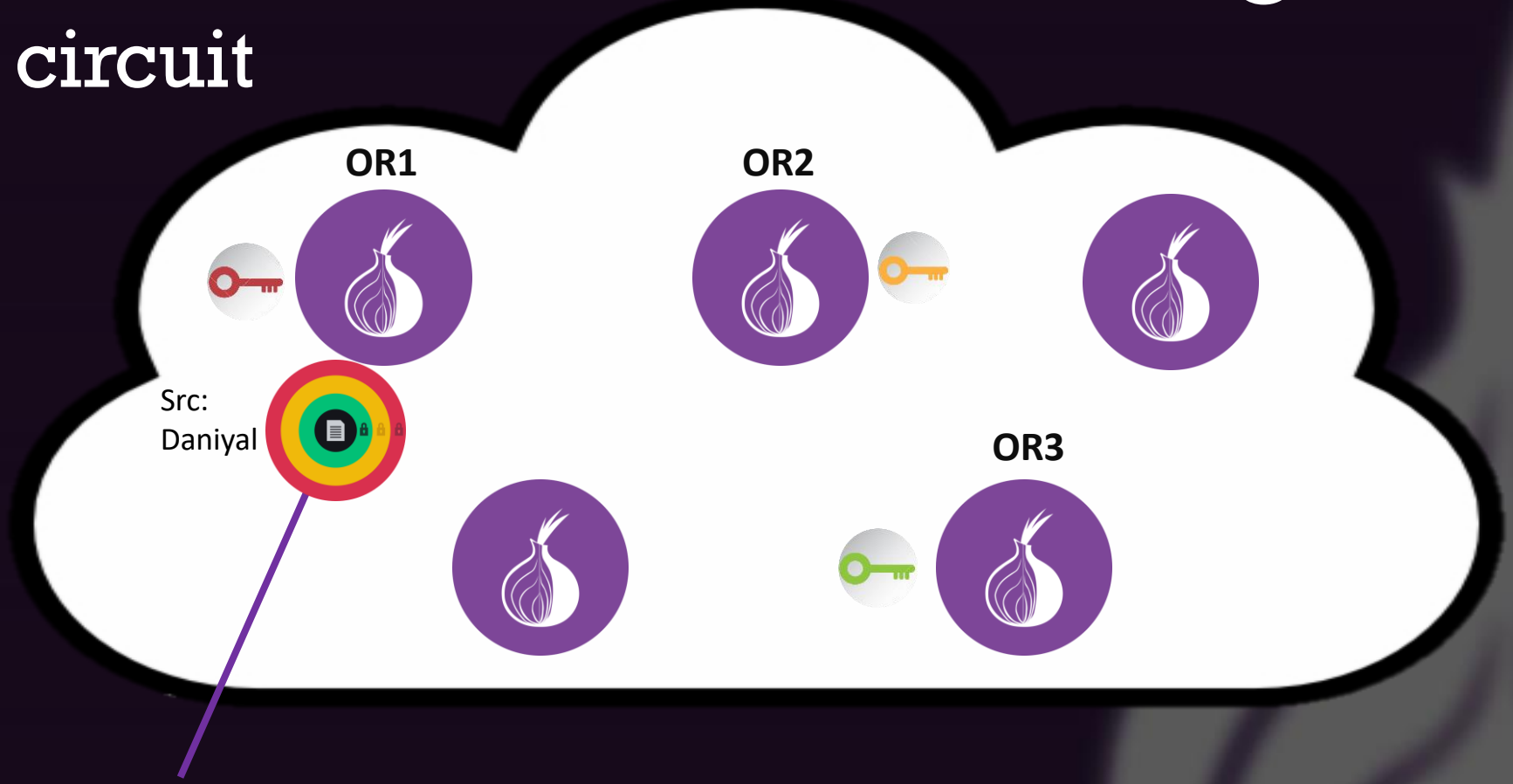

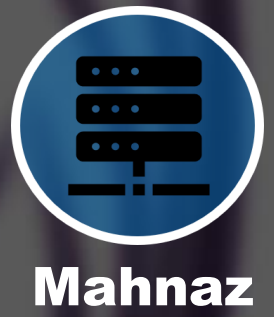

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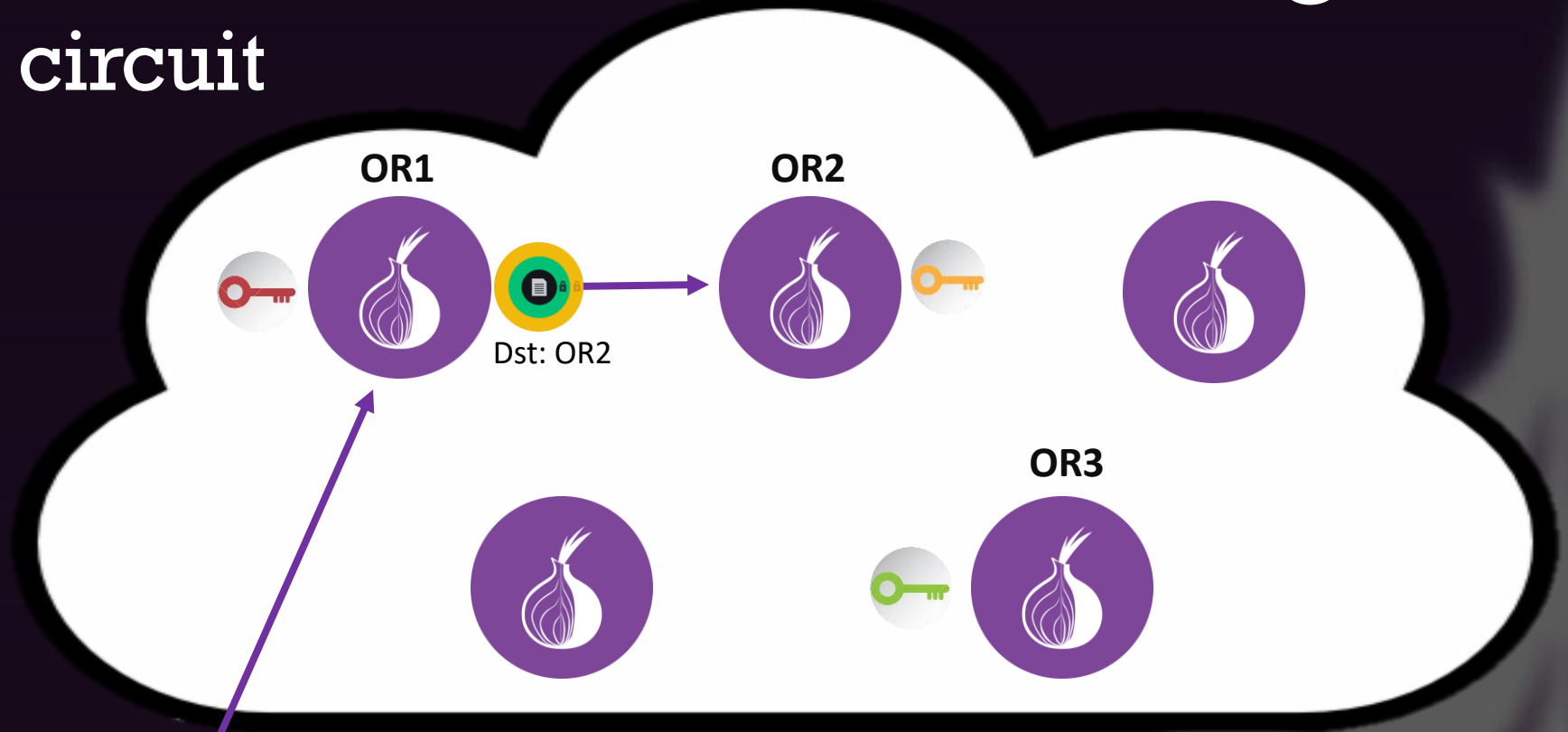

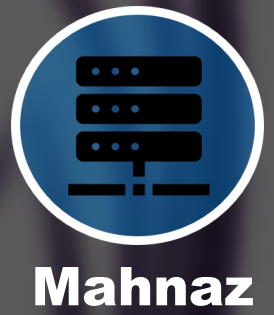

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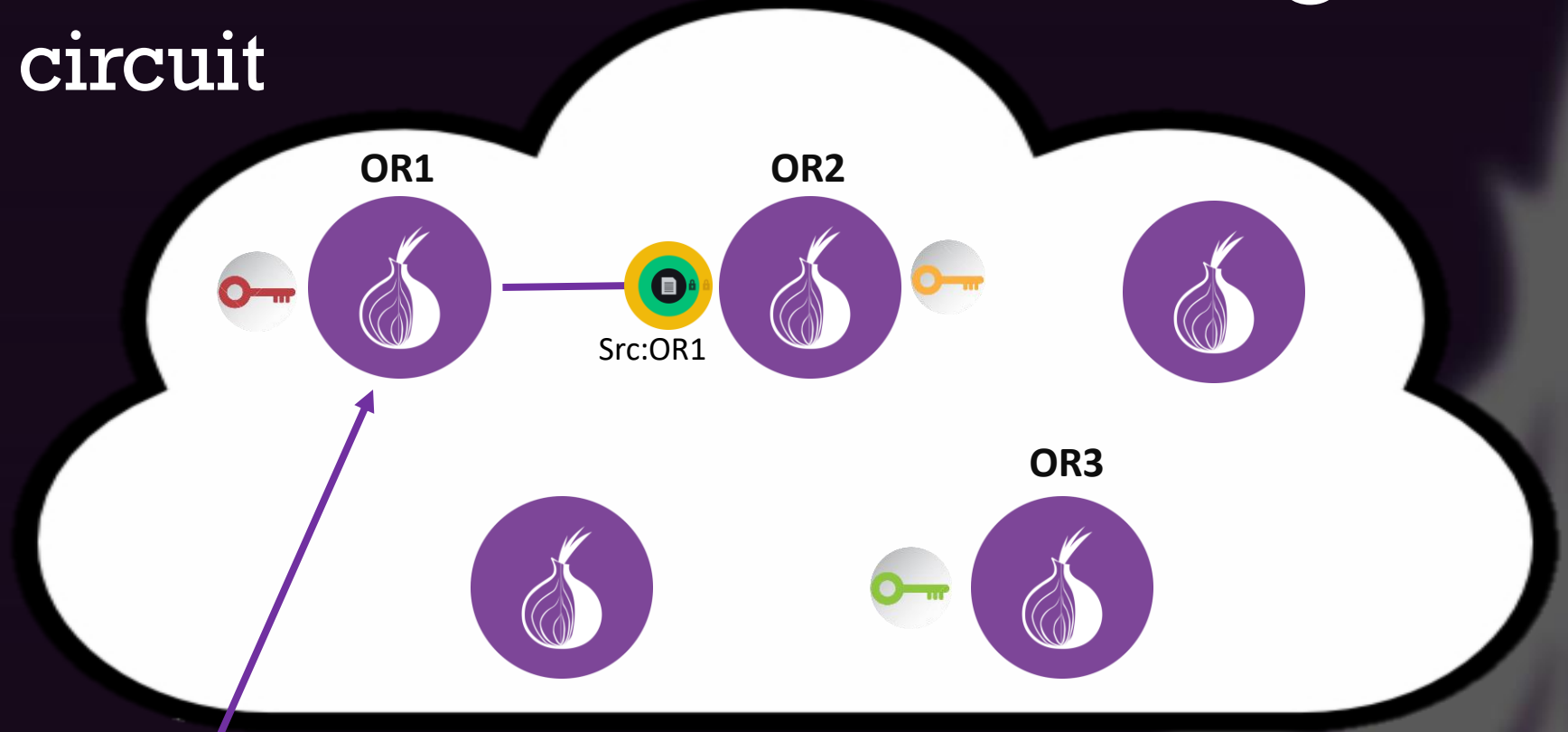

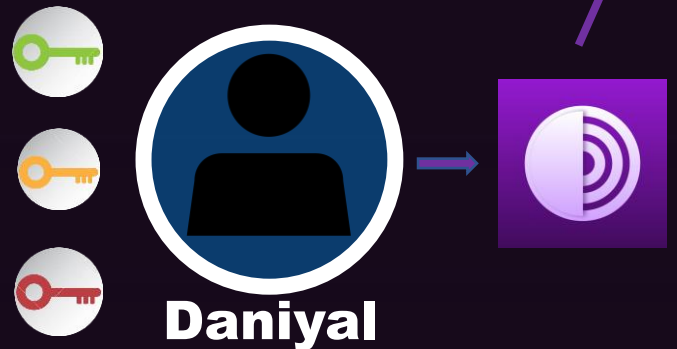

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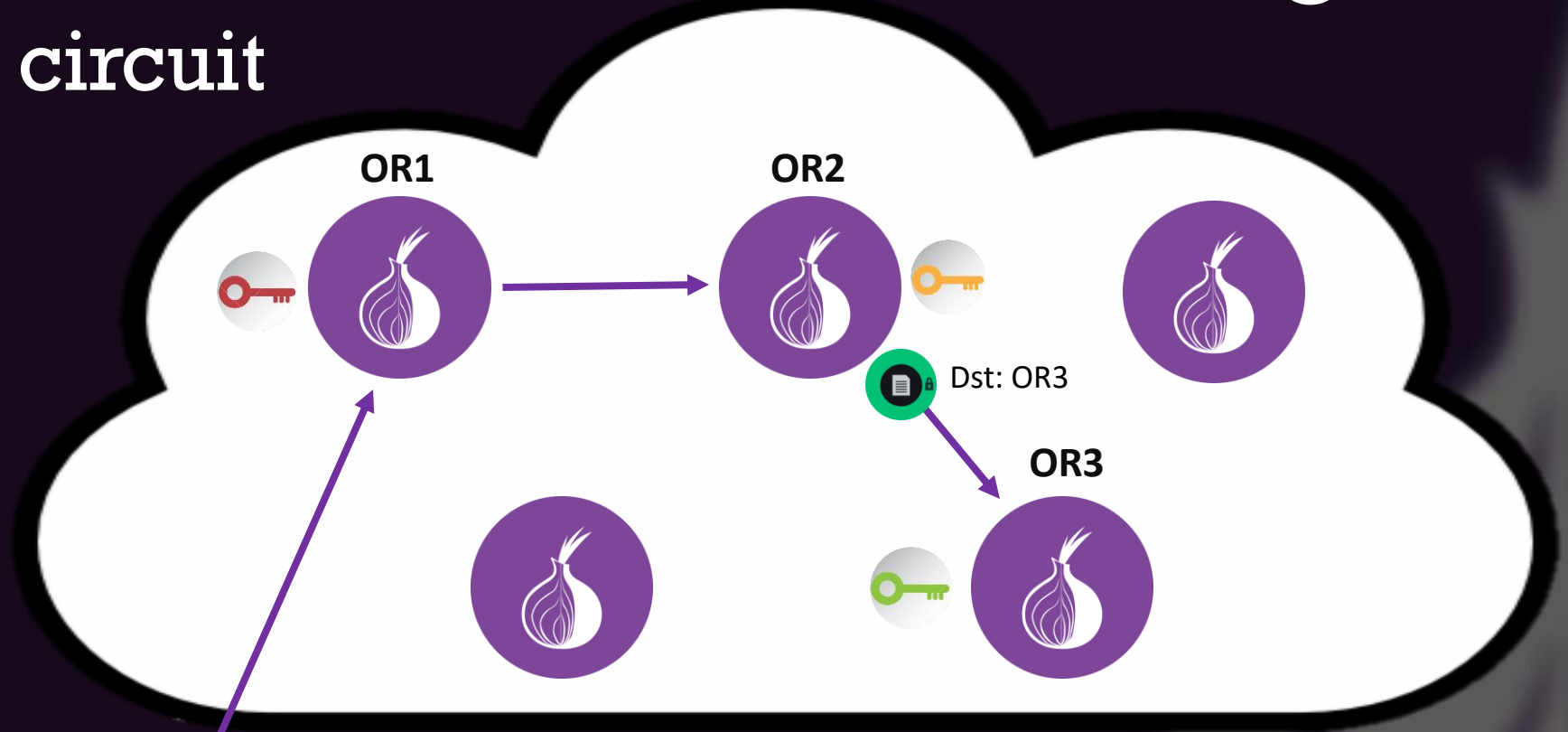

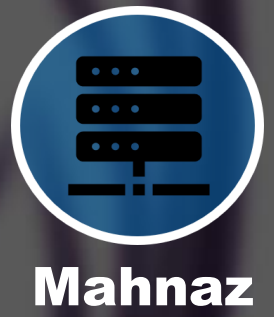

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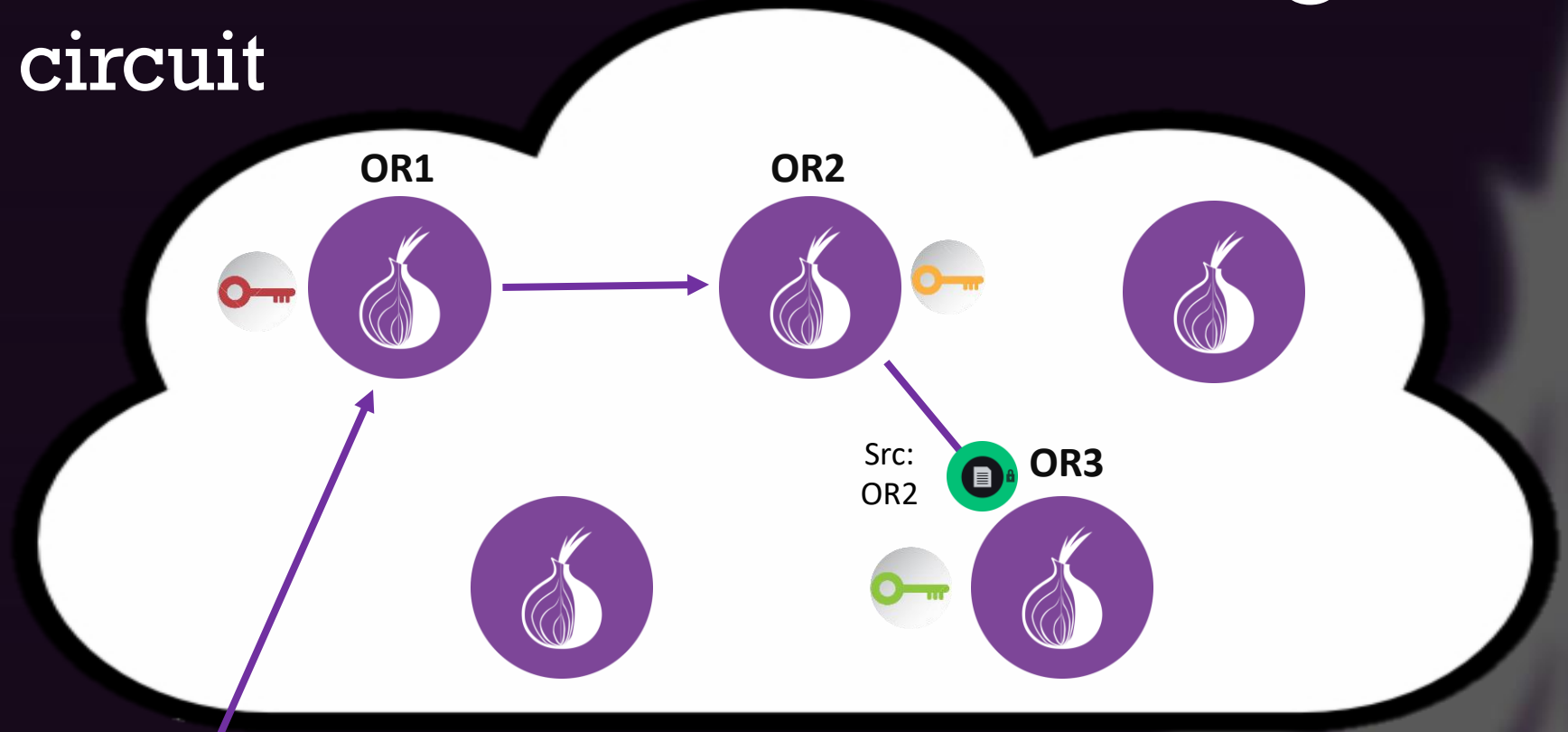

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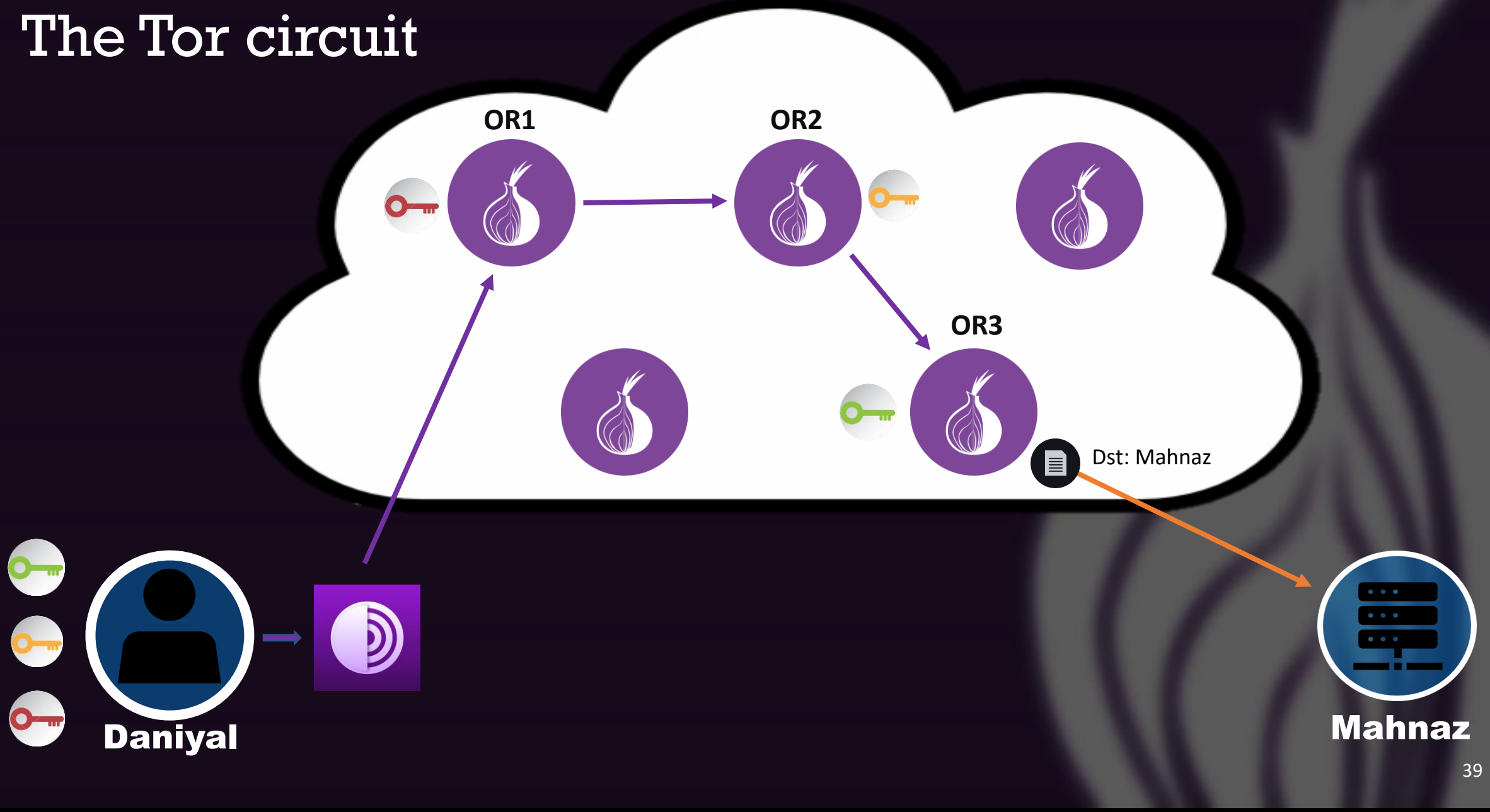

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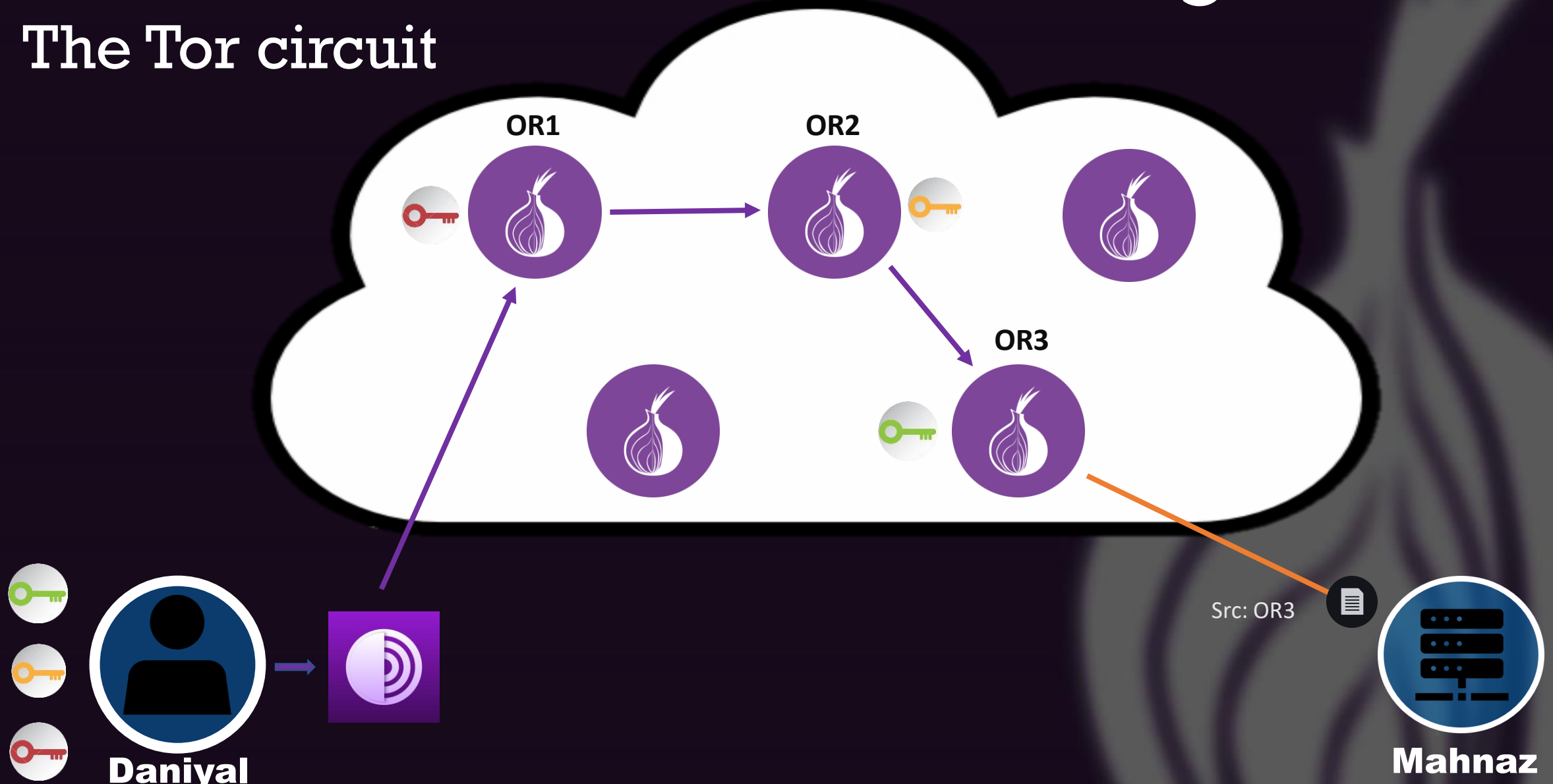

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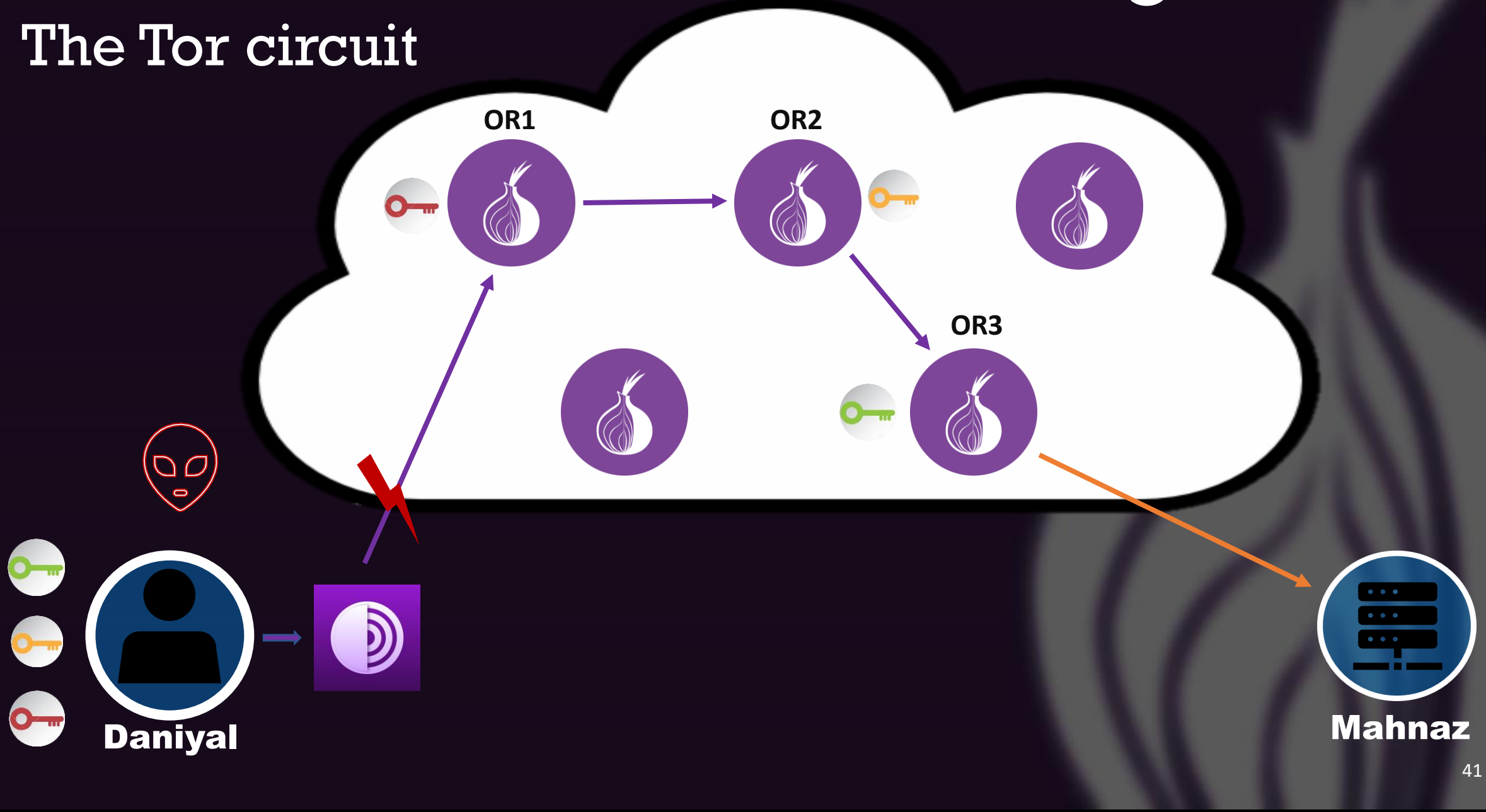

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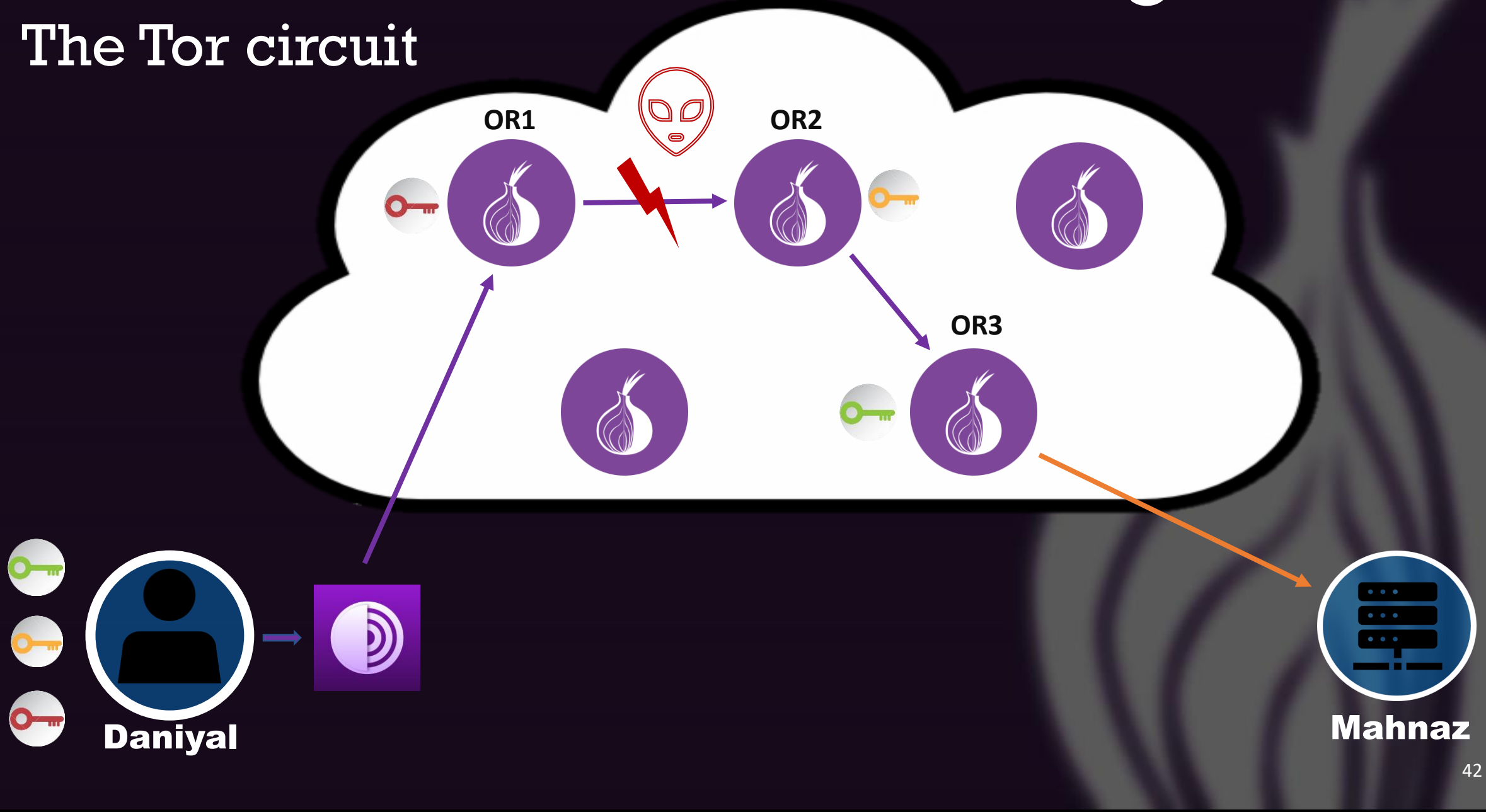

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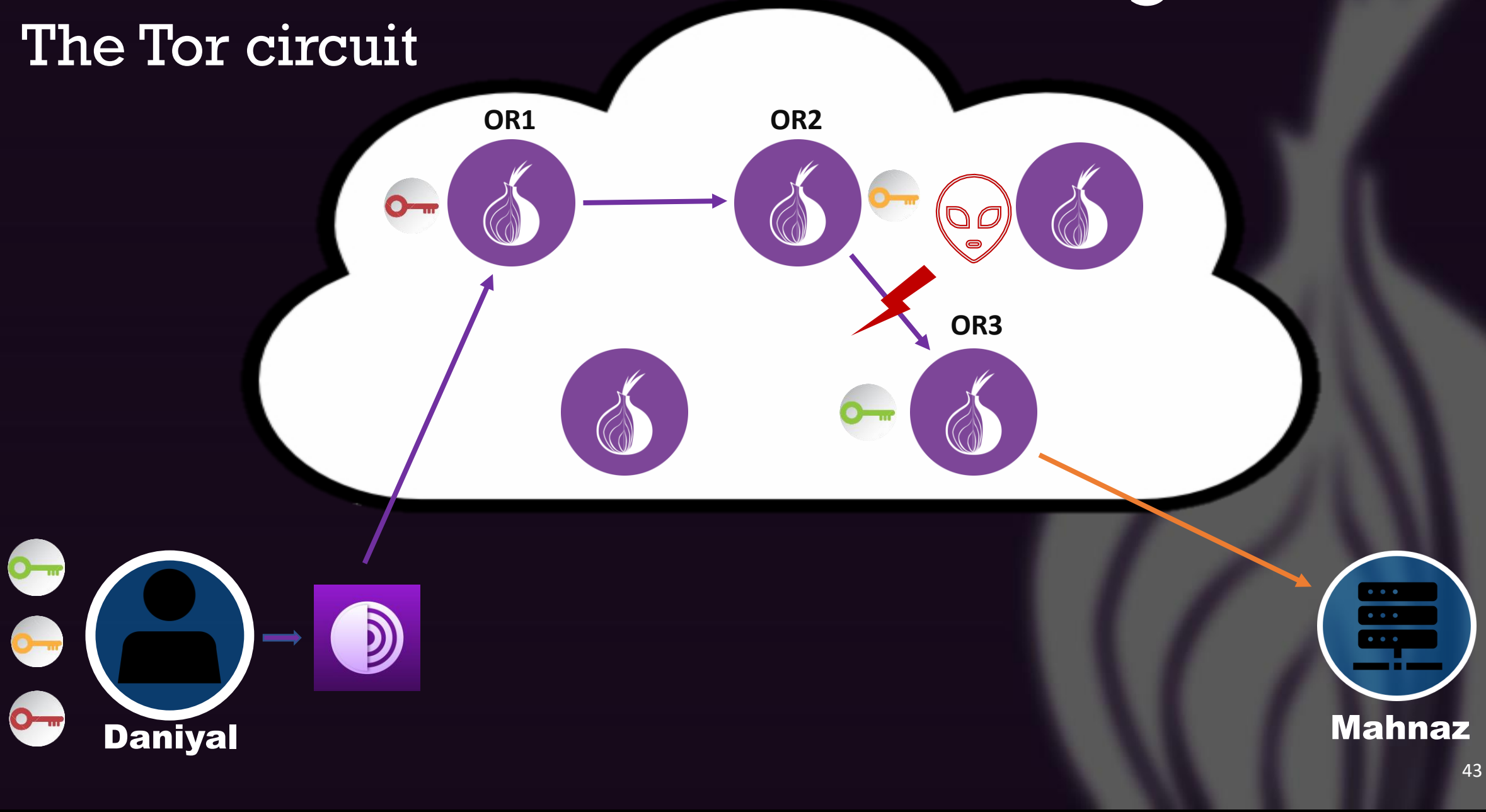

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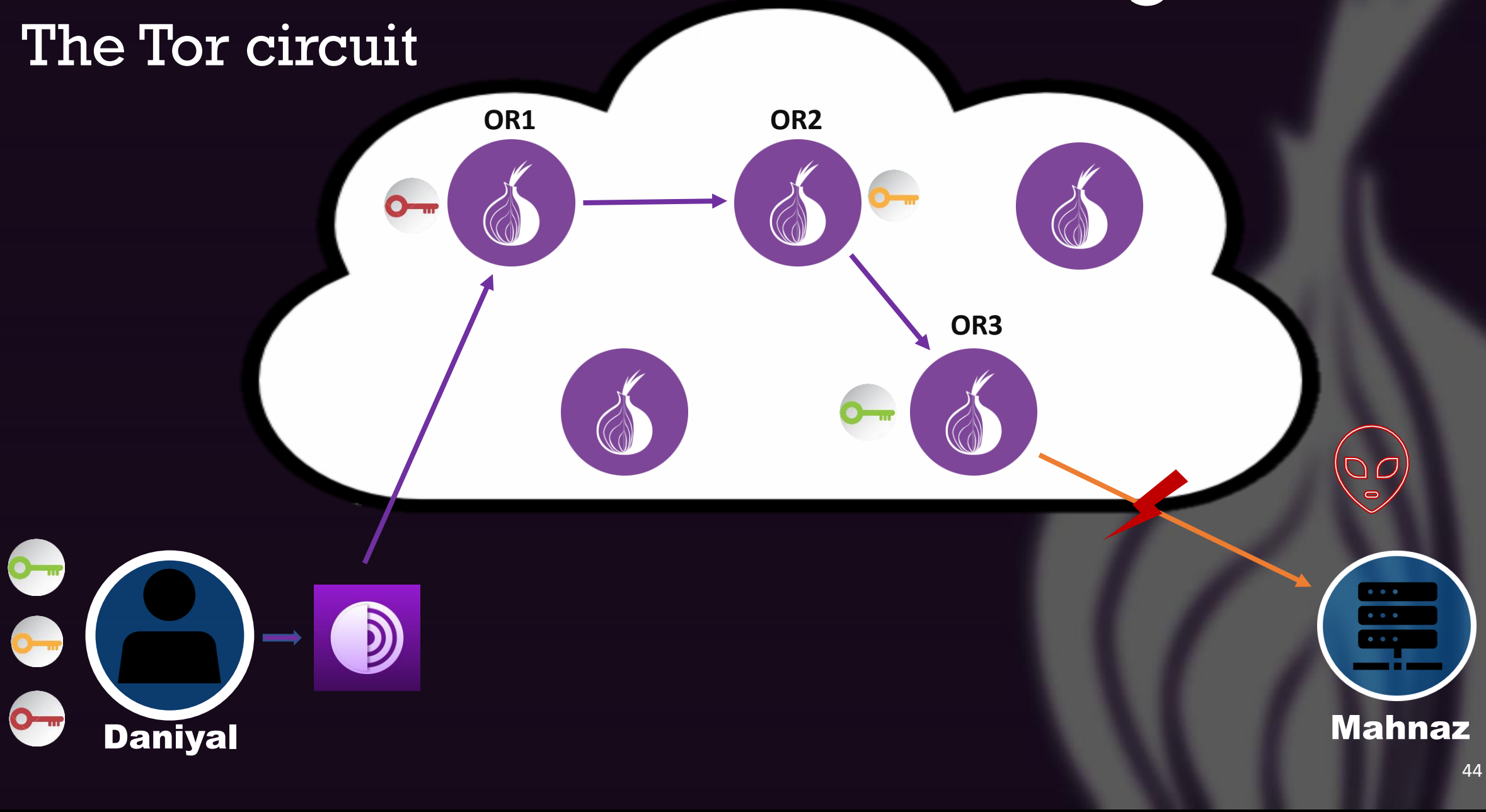
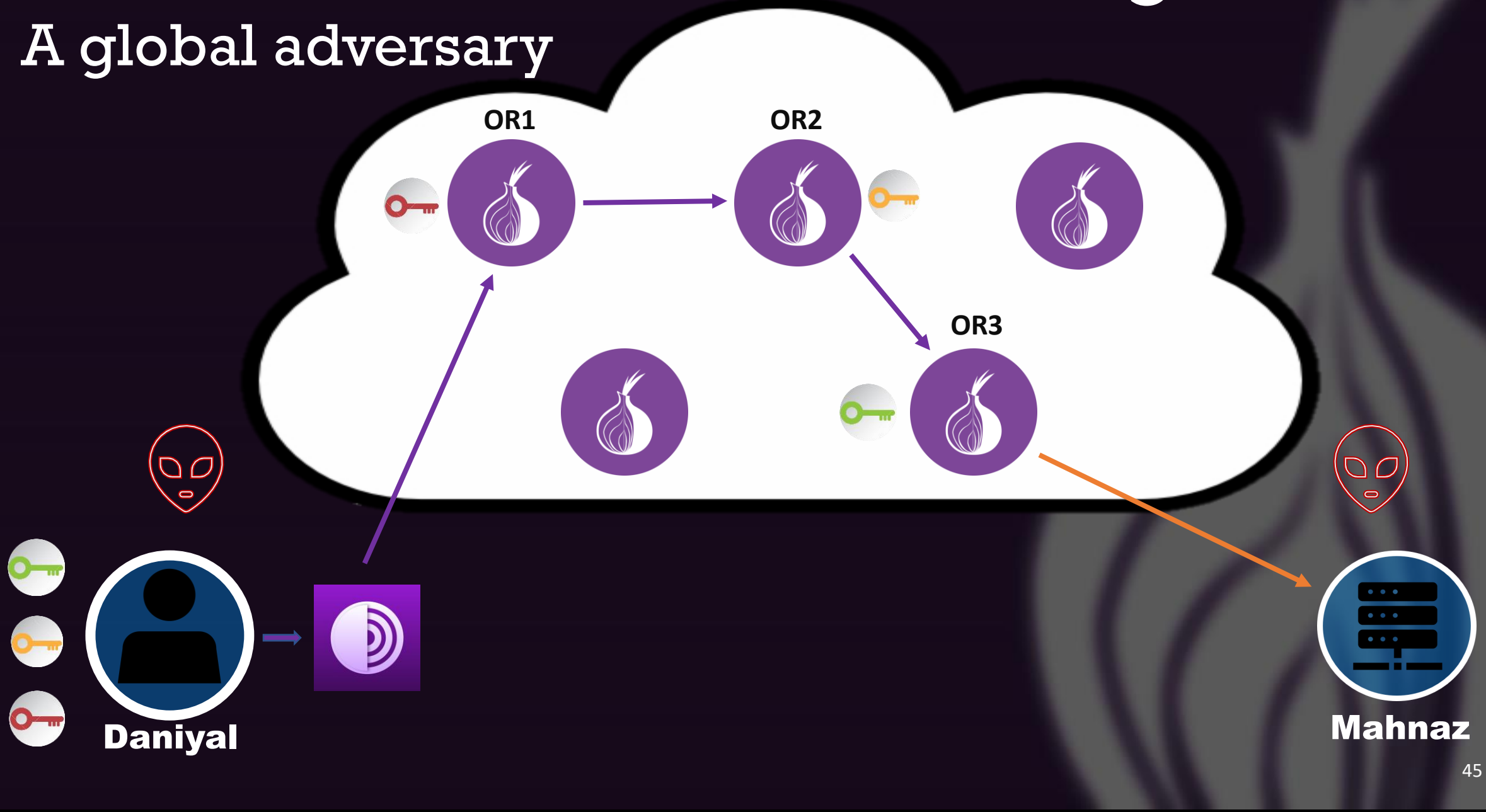


An internet connection through Tor

A global adversary



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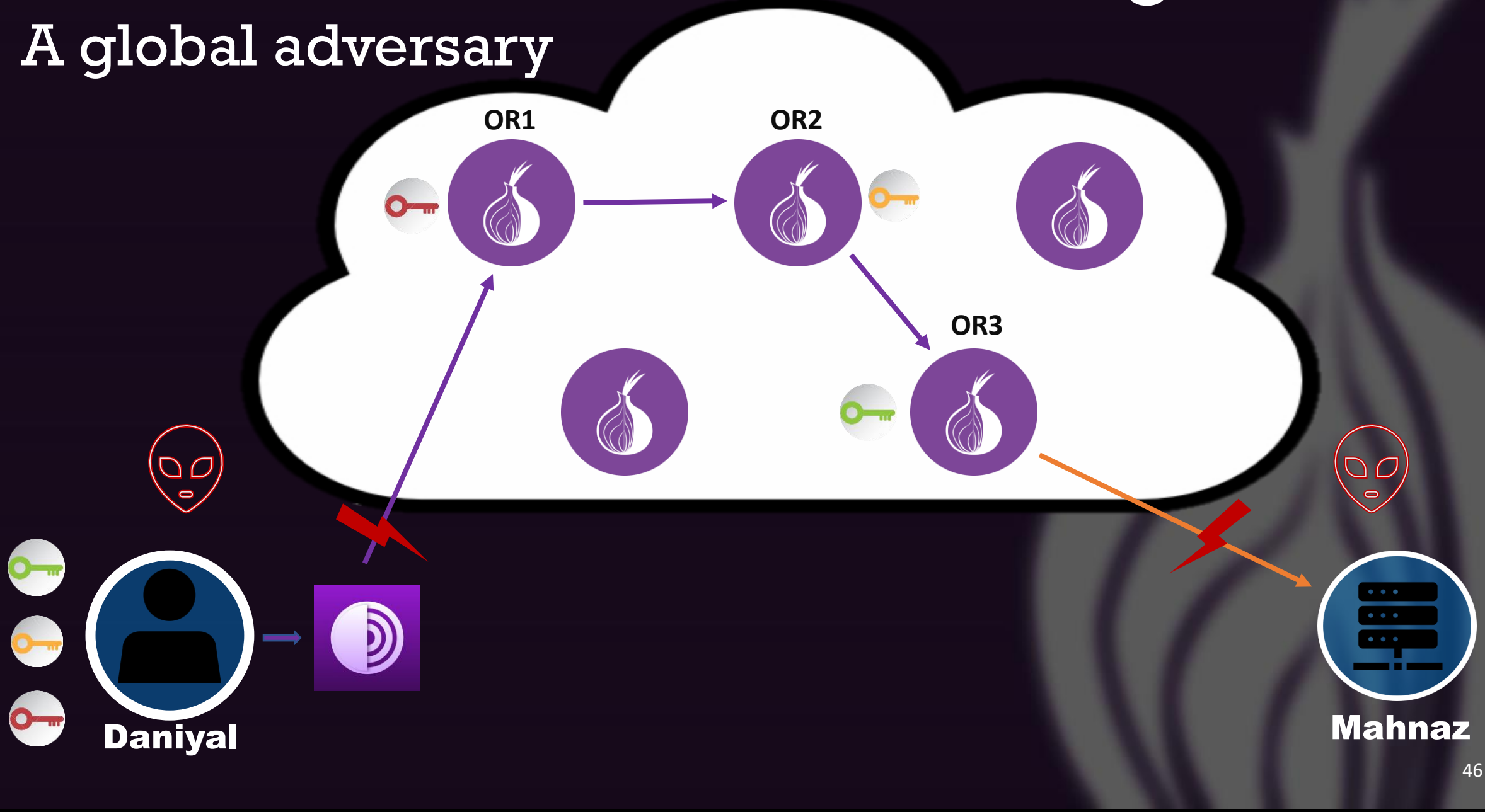
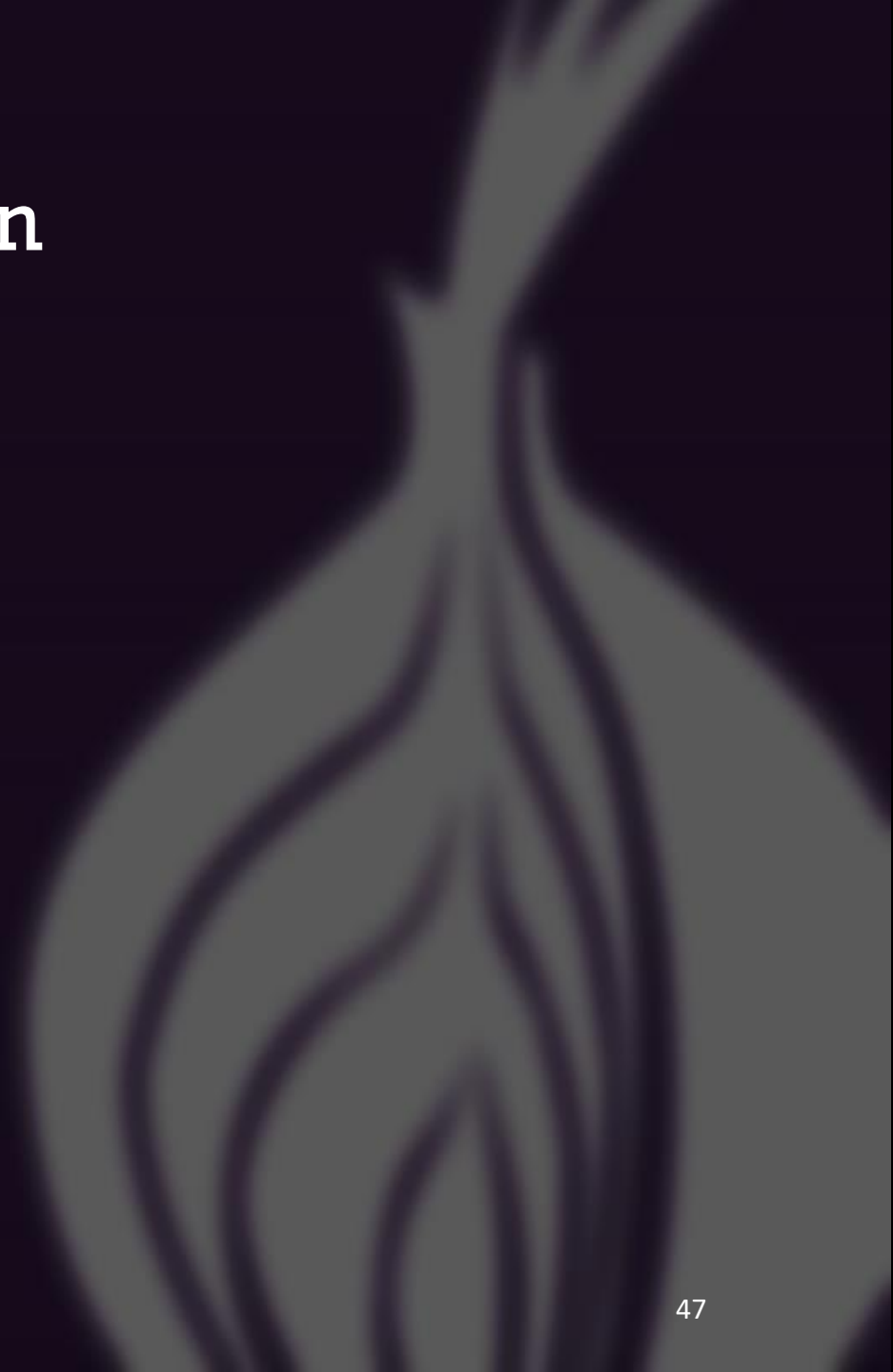


Differences

Tor vs. A regular internet connection



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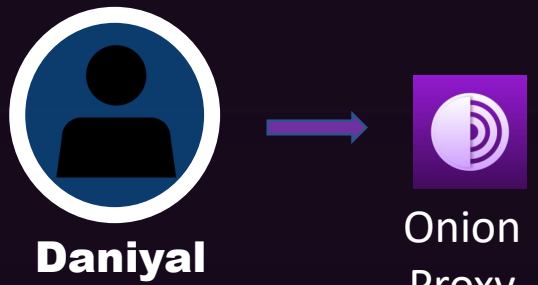

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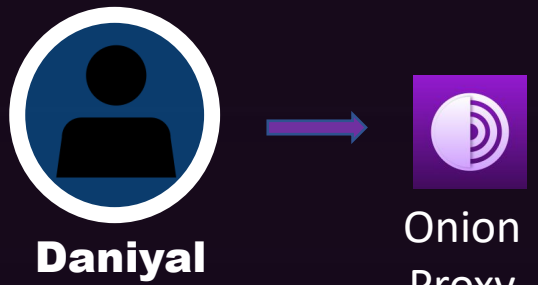

An Onion Proxy needs to be set up to route traffic through Tor:

- Use a regular browser configured to route traffic
- Use the Tor browser which comes preconfigured with the Tor proxy

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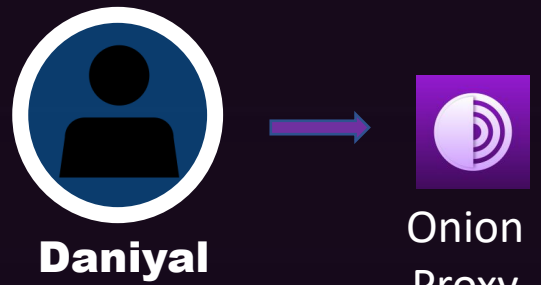

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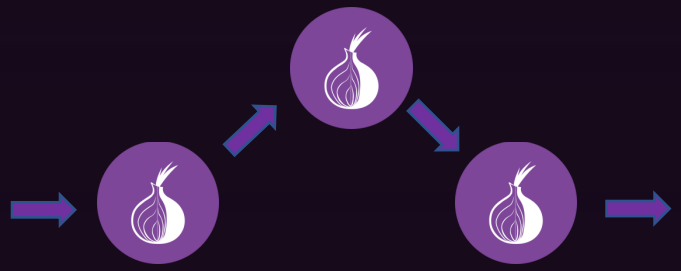

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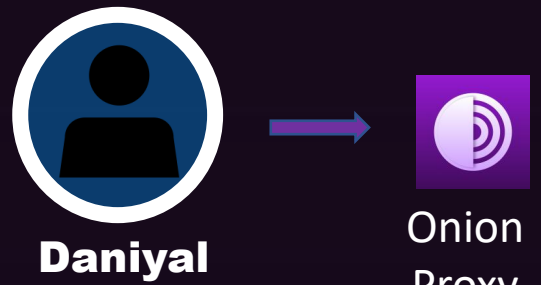

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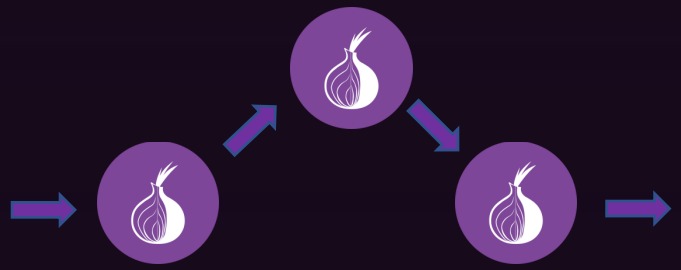

- Setting up a Tor circuit
- Network traffic is routed through a minimum of three Onion routers which are volunteered owned and operated

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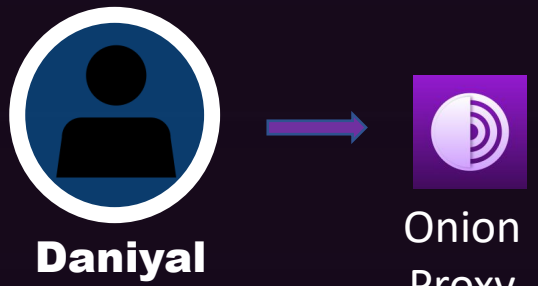

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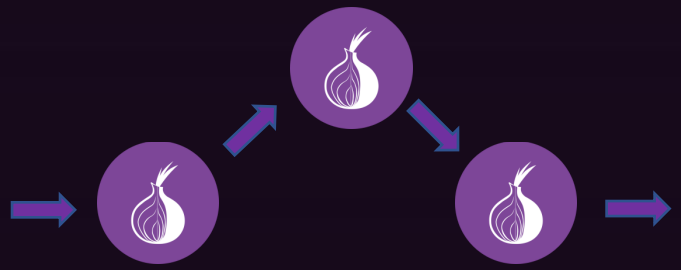

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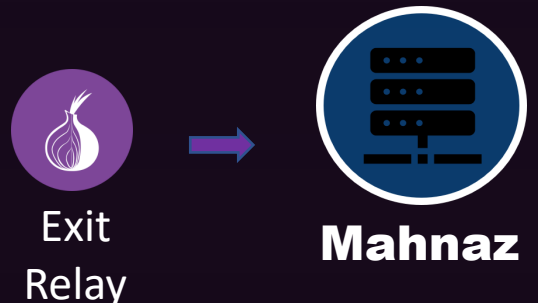

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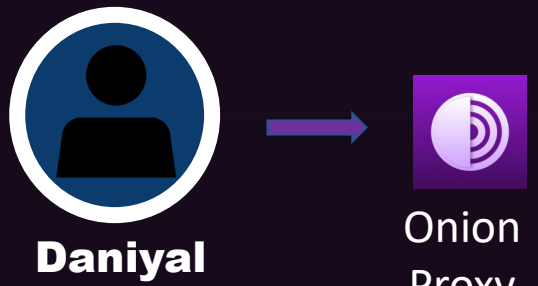

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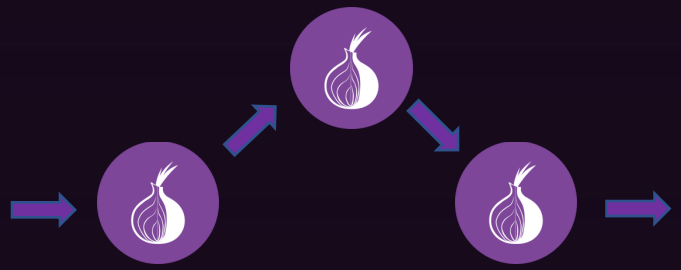

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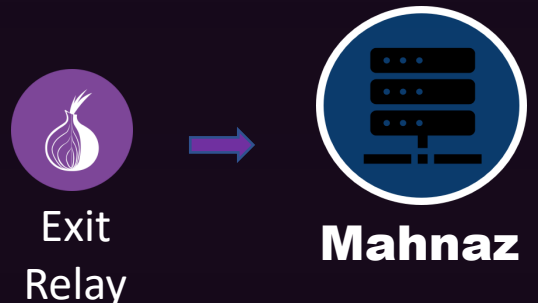
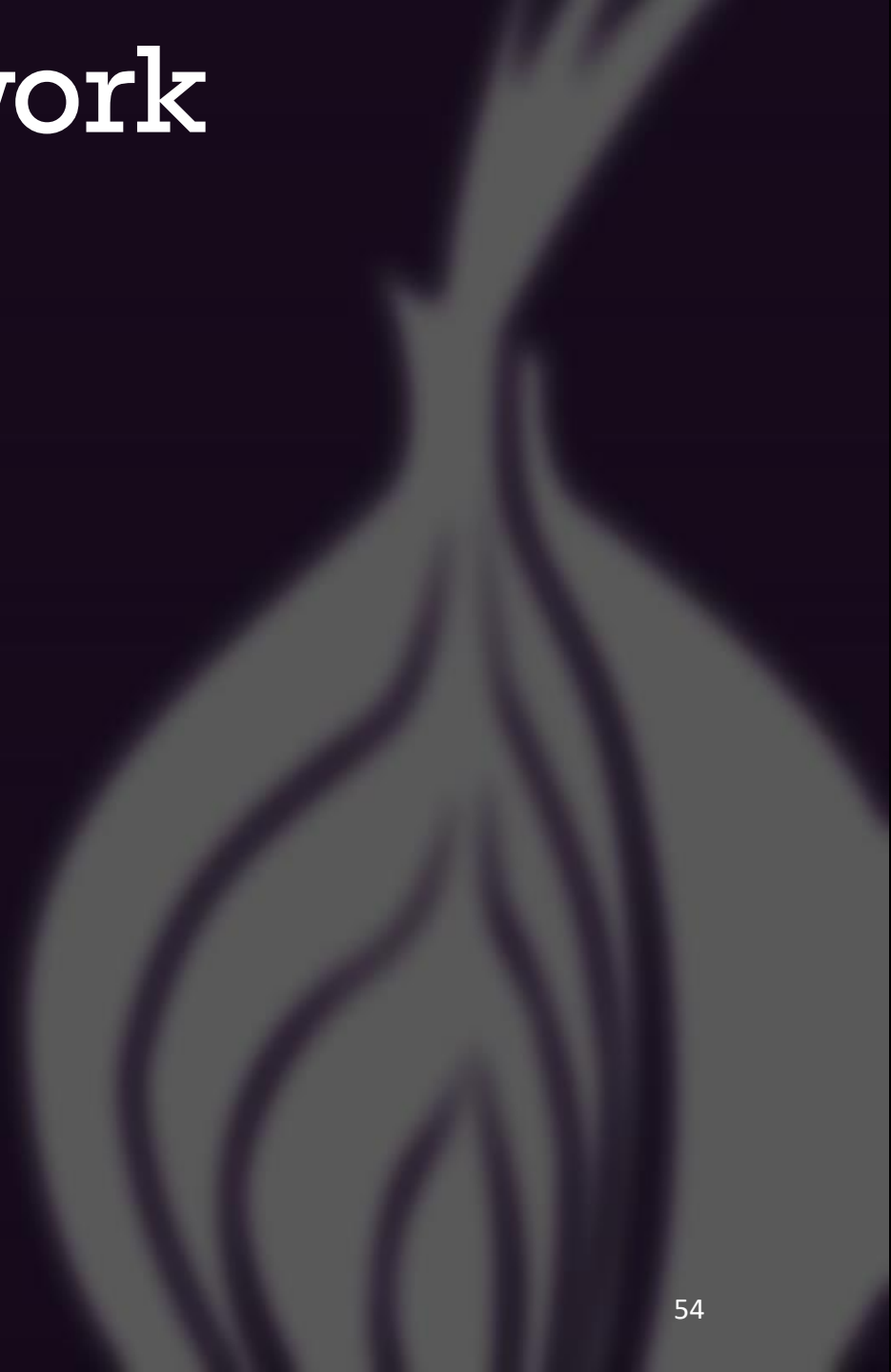


- The end server (Mahnaz) sees the traffic coming from the Exit Relay instead of the sender (Daniyal)

The Utility of the Tor Network



The Utility of the Tor Network

- The number of people who can successfully access the Tor network as compared to the number of people trying to access the Tor network

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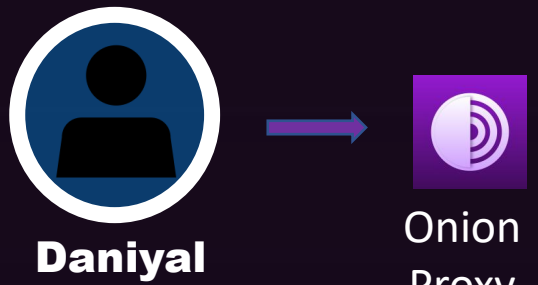

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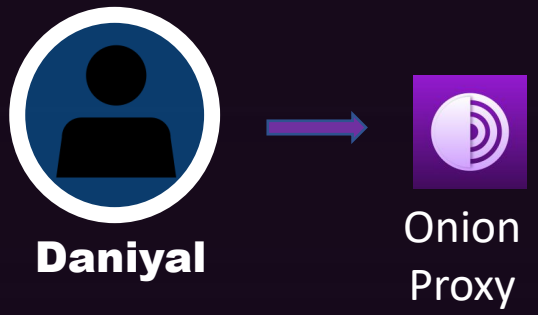

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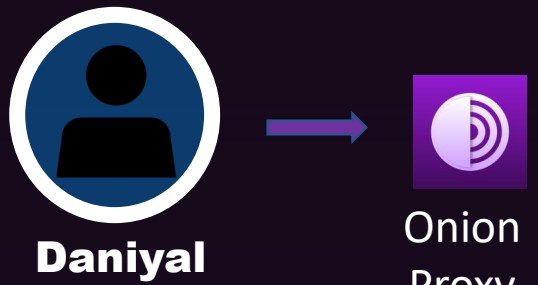

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Challenge	Category label
Broken Functionality	Broken websites
	Reduced productivity
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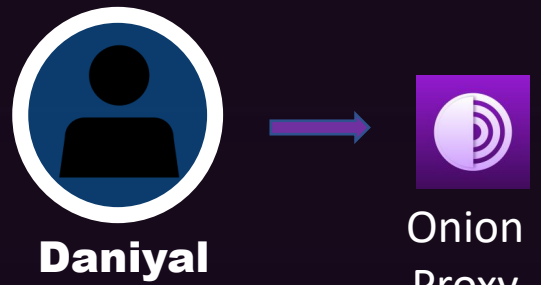

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- Access blocked to the Tor Project's website
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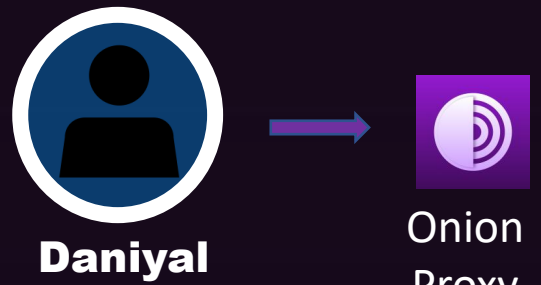

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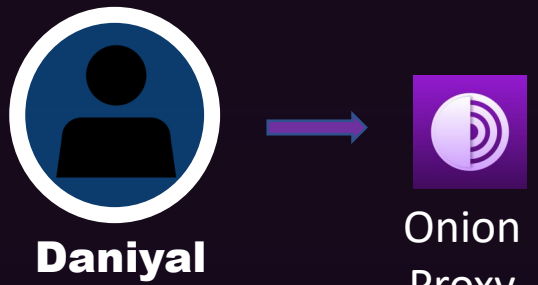

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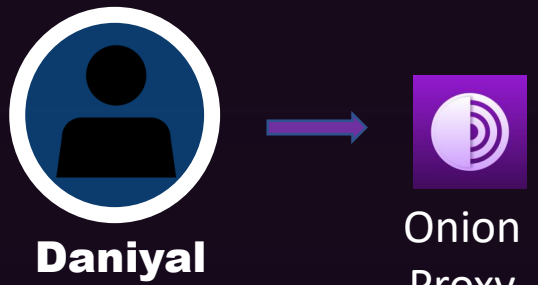

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USABILITY

Peeling the Onion's User Experience Layer: Examining Naturalistic Use of the Tor Browser

Kevin Gallagher, New York University, kevin.gallagher@nyu.edu
Sameer Patil, Indiana University Bloomington, patil@indiana.edu
Brendan Dolan-Gavitt, New York University, brendandg@nyu.edu

- 50% of all participants report some type of functional hindrance
- Biggest issues were latency and functionality breaks
- Users also reported lack of trust due to unrefined UX of the browser

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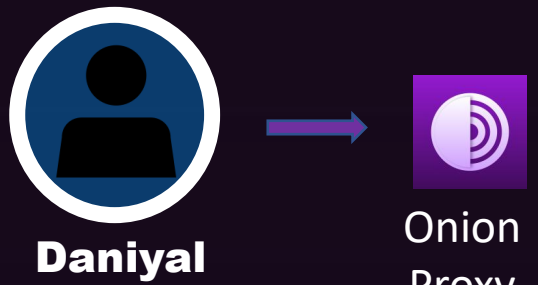

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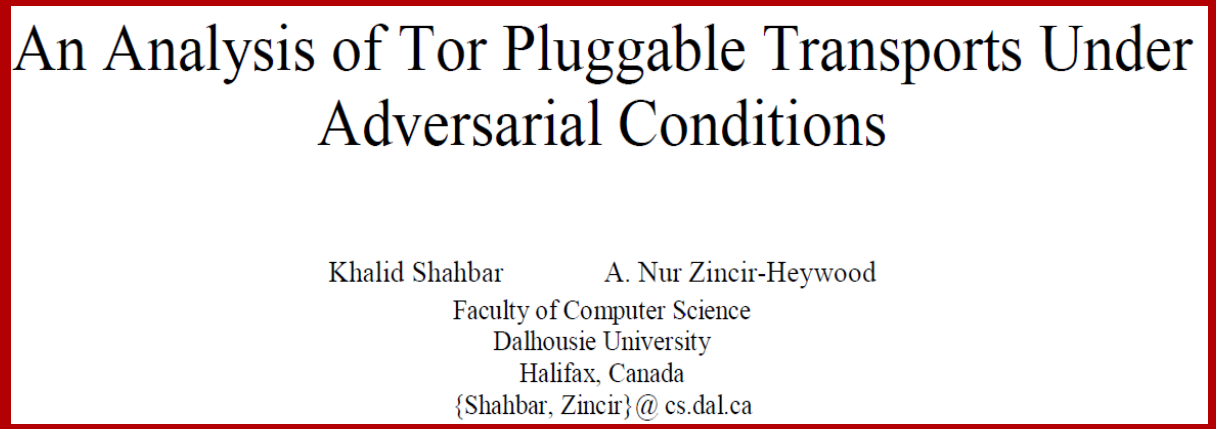
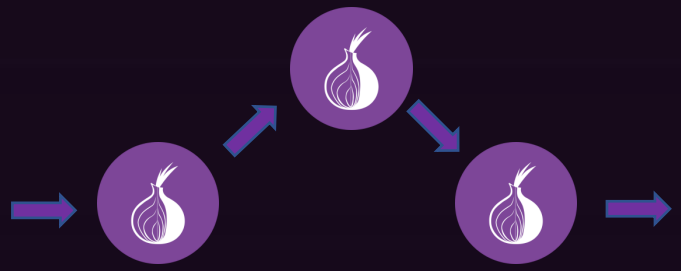


An Analysis of Tor Pluggable Transports Under Adversarial Conditions

Khalid Shahbar A. Nur Zincir-Heywood
Faculty of Computer Science
Dalhousie University
Halifax, Canada
{Shahbar, Zincir}@ cs.dal.ca

- Tor traffic is identifiable by censors due to certain unique characteristics
- Methods to hide Tor traffic are ineffective
- Tor traffic can be identified with an accuracy of > 90% even if it is made to look like any other protocol's traffic

The extra latency and bandwidth challenges that Tor users experience as compared to an individual trying to access web resources over the regular internet



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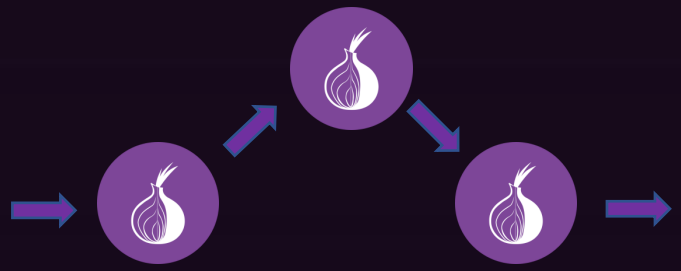

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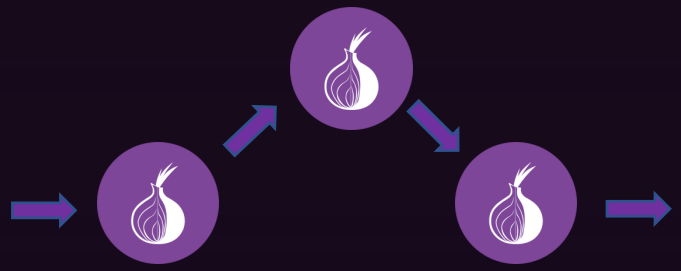

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Tor Circuit setup

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Traffic routing through Tor relays

- User's traffic is routed through at least 3 Tor relays before it reaches the end server adding extra latency
- The Tor relays are volunteer owned and operated network resources and are hence limited in number

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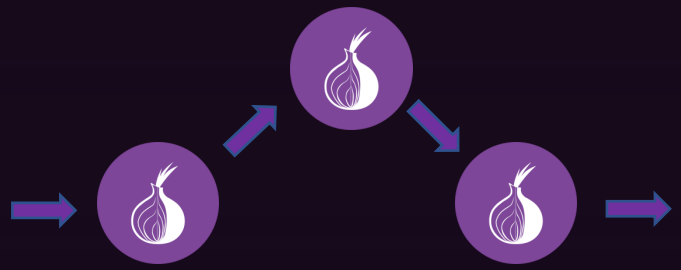

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LATENCY

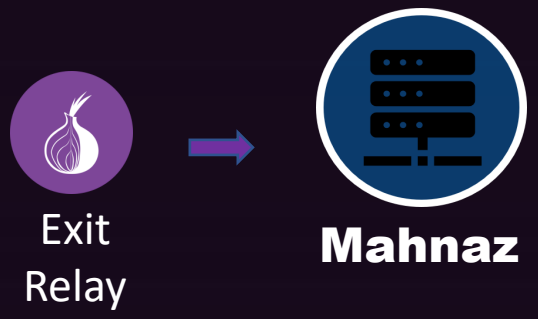
NavigaTor: Finding Faster Paths to Anonymity

Robert Annessi*
Institute of Telecommunications, TU Wien
Gusshausstr. 25/E389, 1040 Vienna, Austria
robert.annessi@nt.tuwien.ac.at
**Corresponding author*

Martin Schmiedecker
SBA Research
Favoritenstraße 16, 1040 Vienna, Austria
mschmiedecker@sba-research.org

- Tor is slower than regular traffic due to the very nature of the network itself
- Evaluating circuit build times and congestion awareness can reduce the latency experienced by a user
- There is a tradeoff between anonymity and latency

The number of web resources on the regular internet that a Tor user can access



- The end server (Mahnaz) sees the traffic coming from the Exit Relay instead of the sender (Daniyal)

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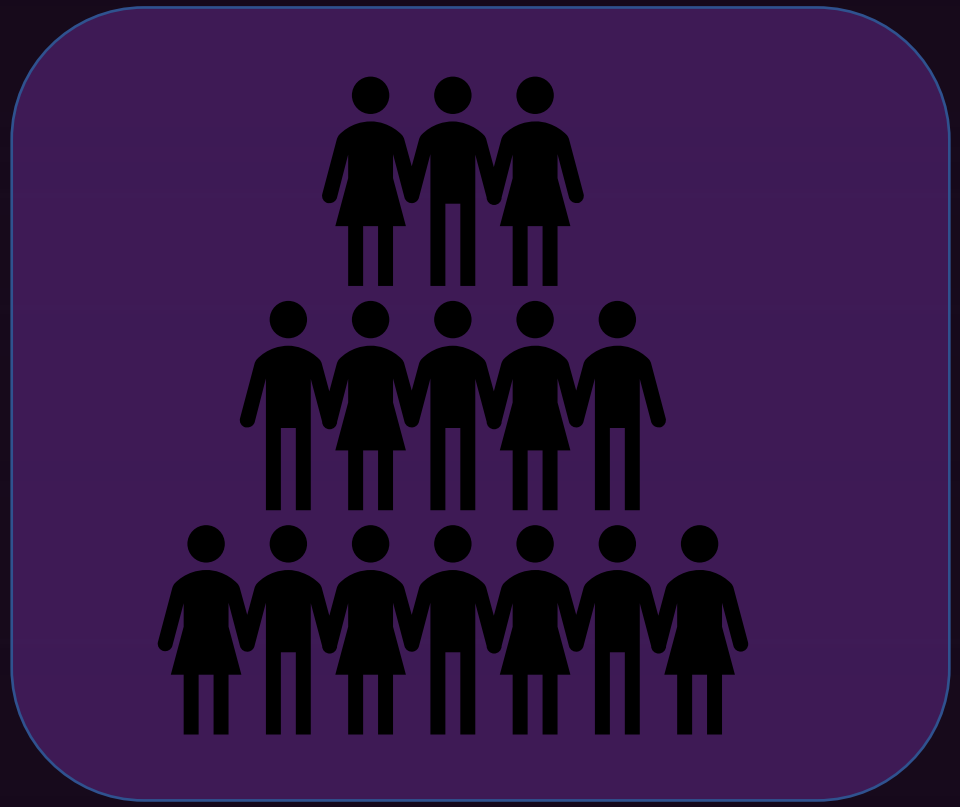
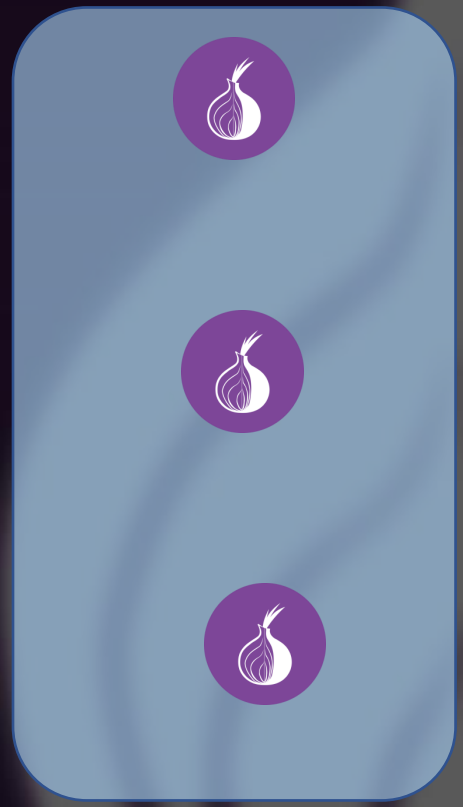
Fate Sharing



Tor users



Tor relays

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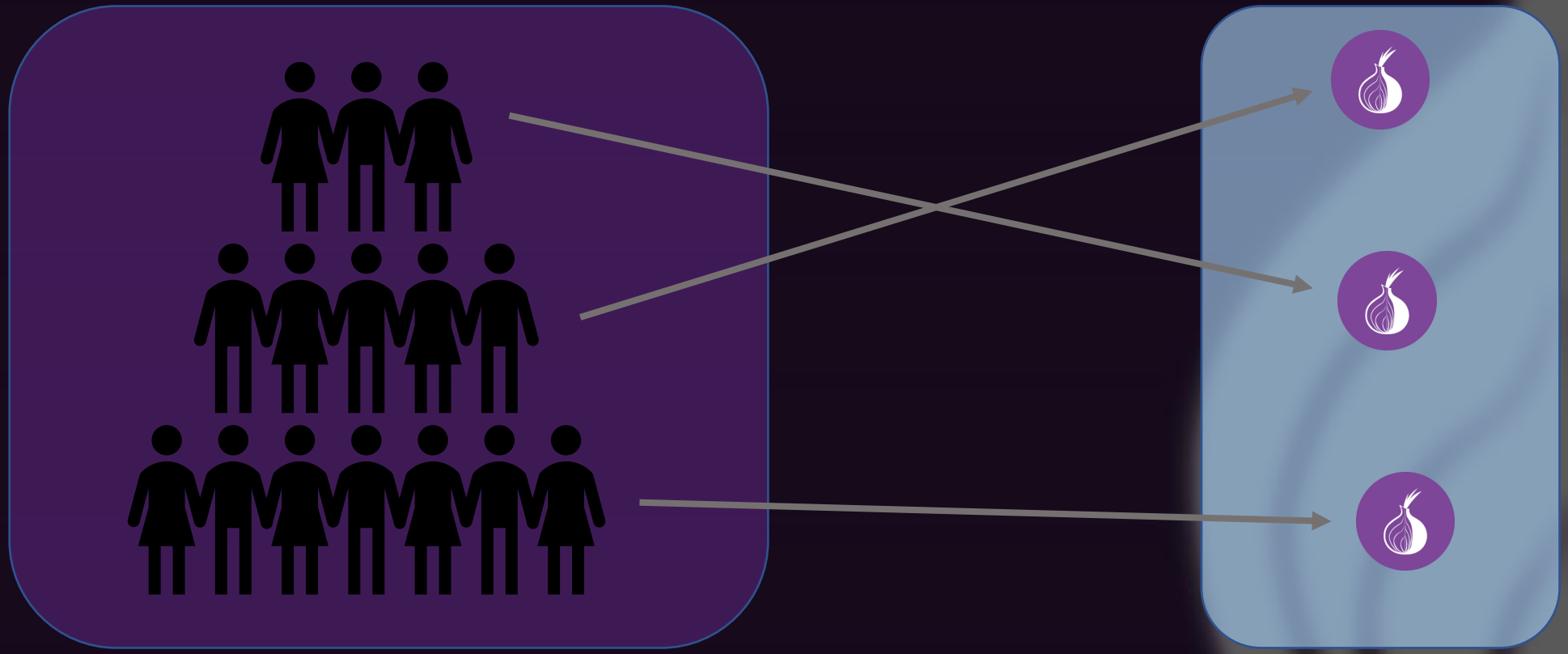

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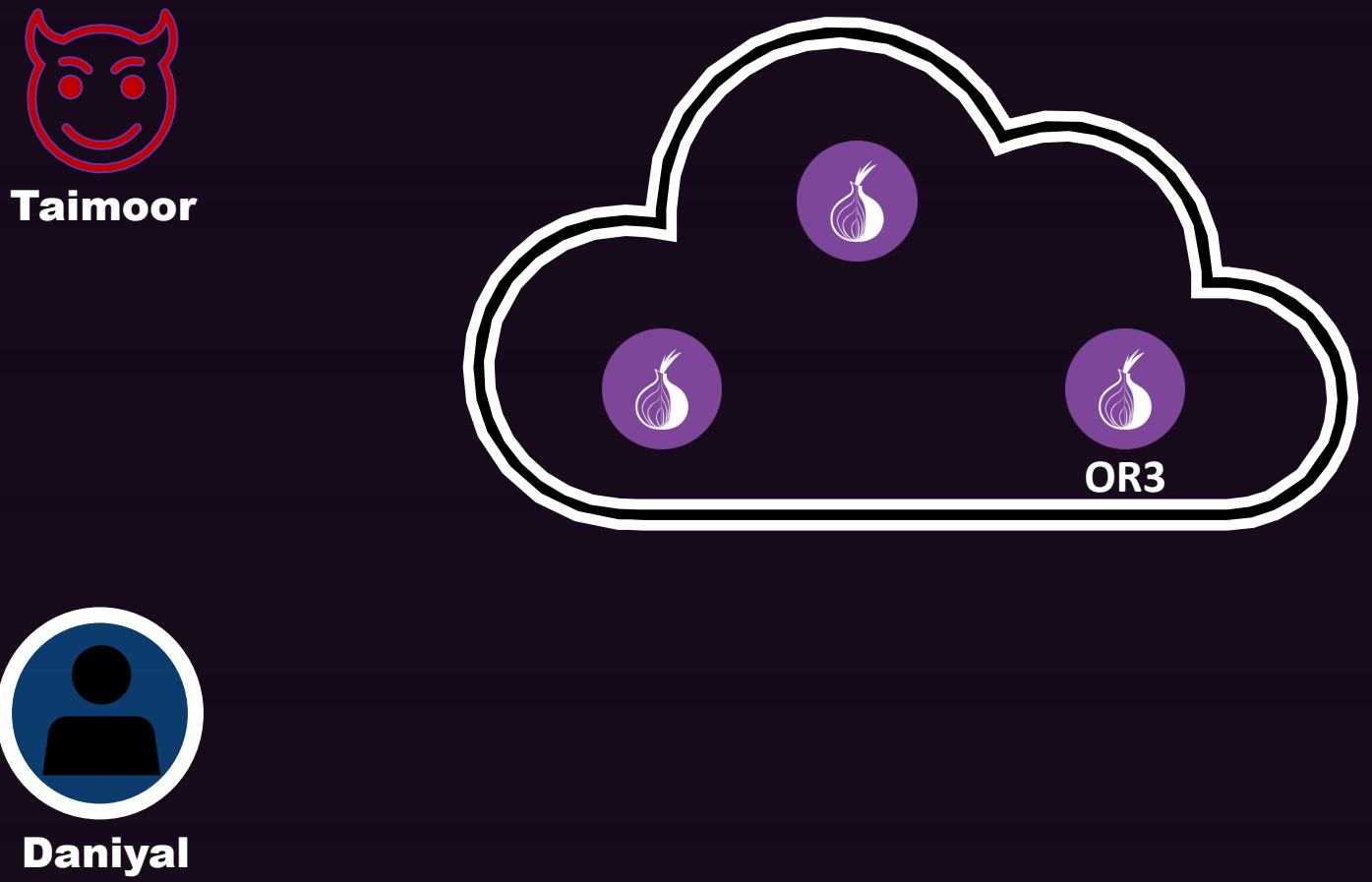

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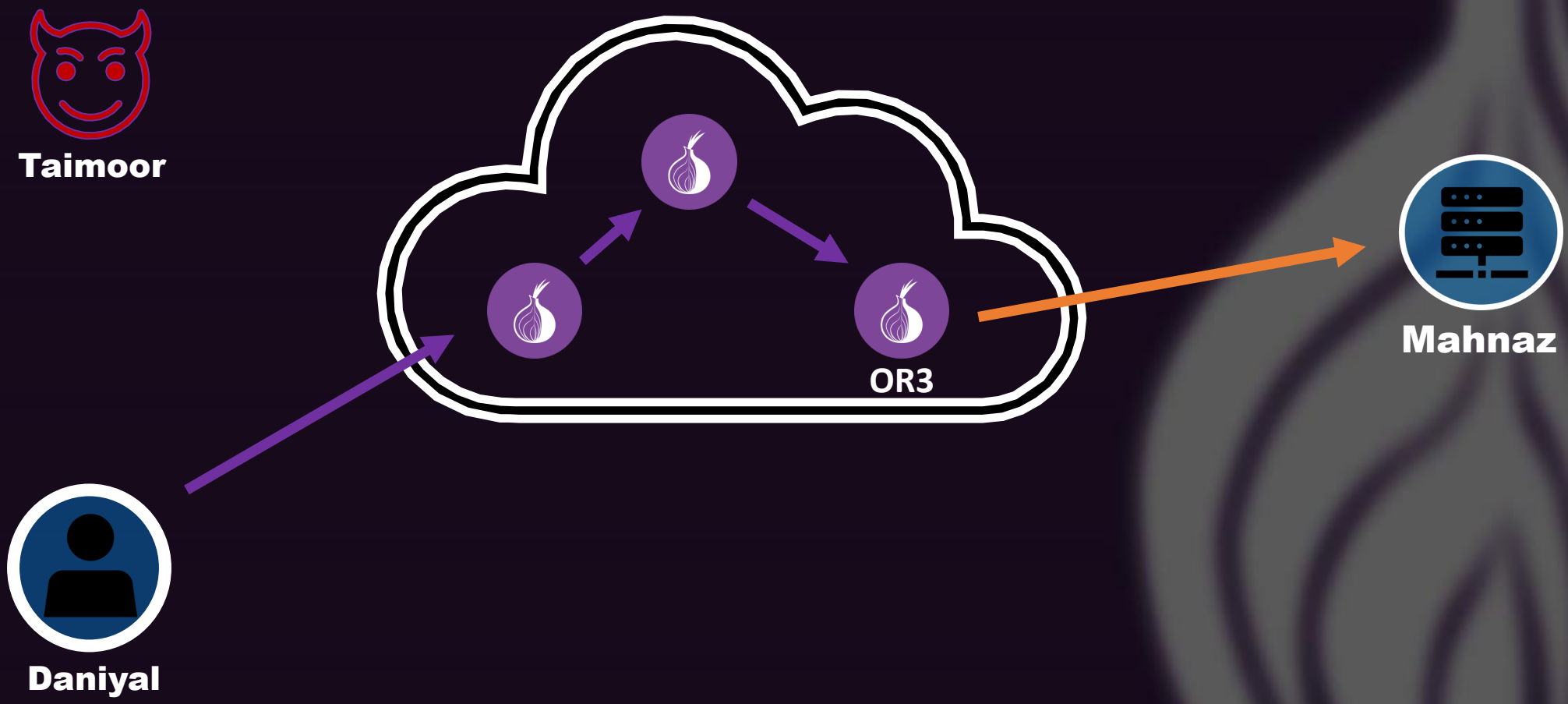

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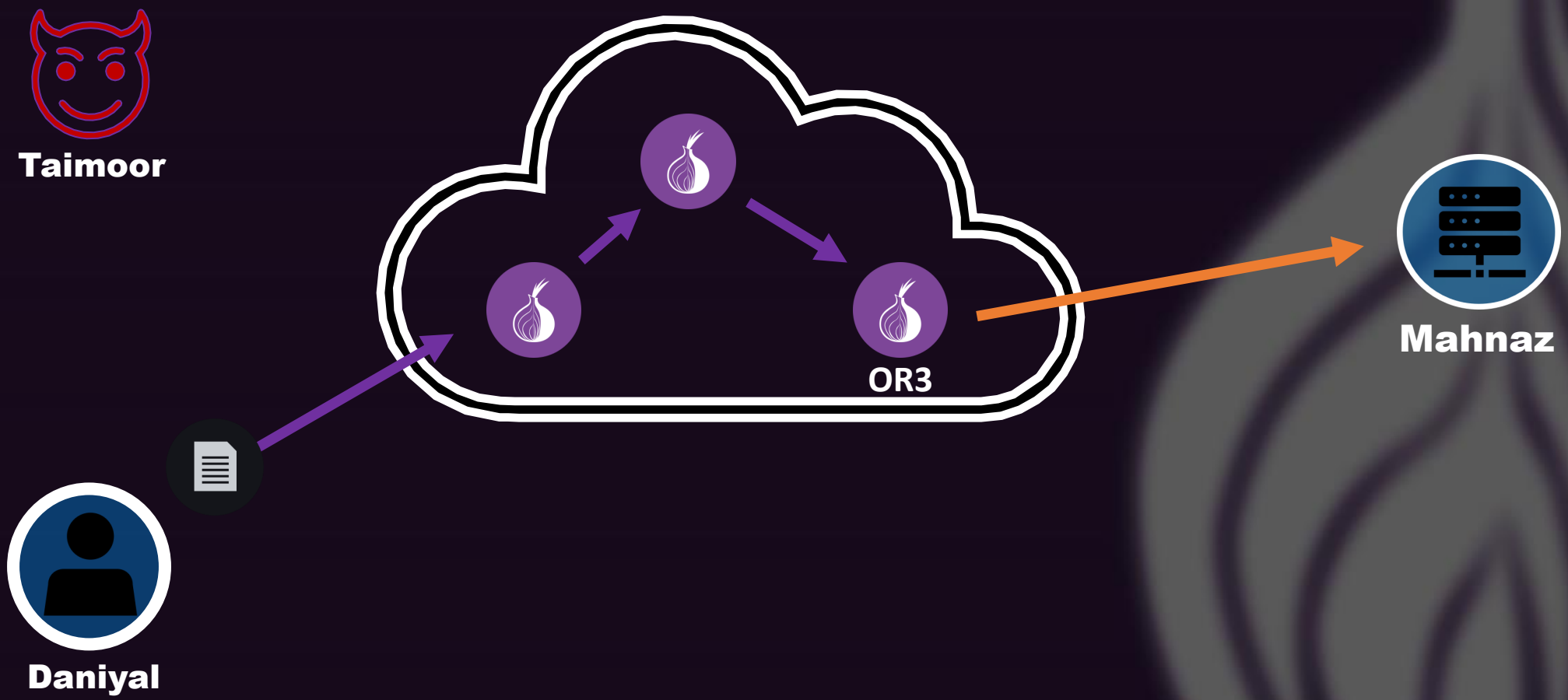

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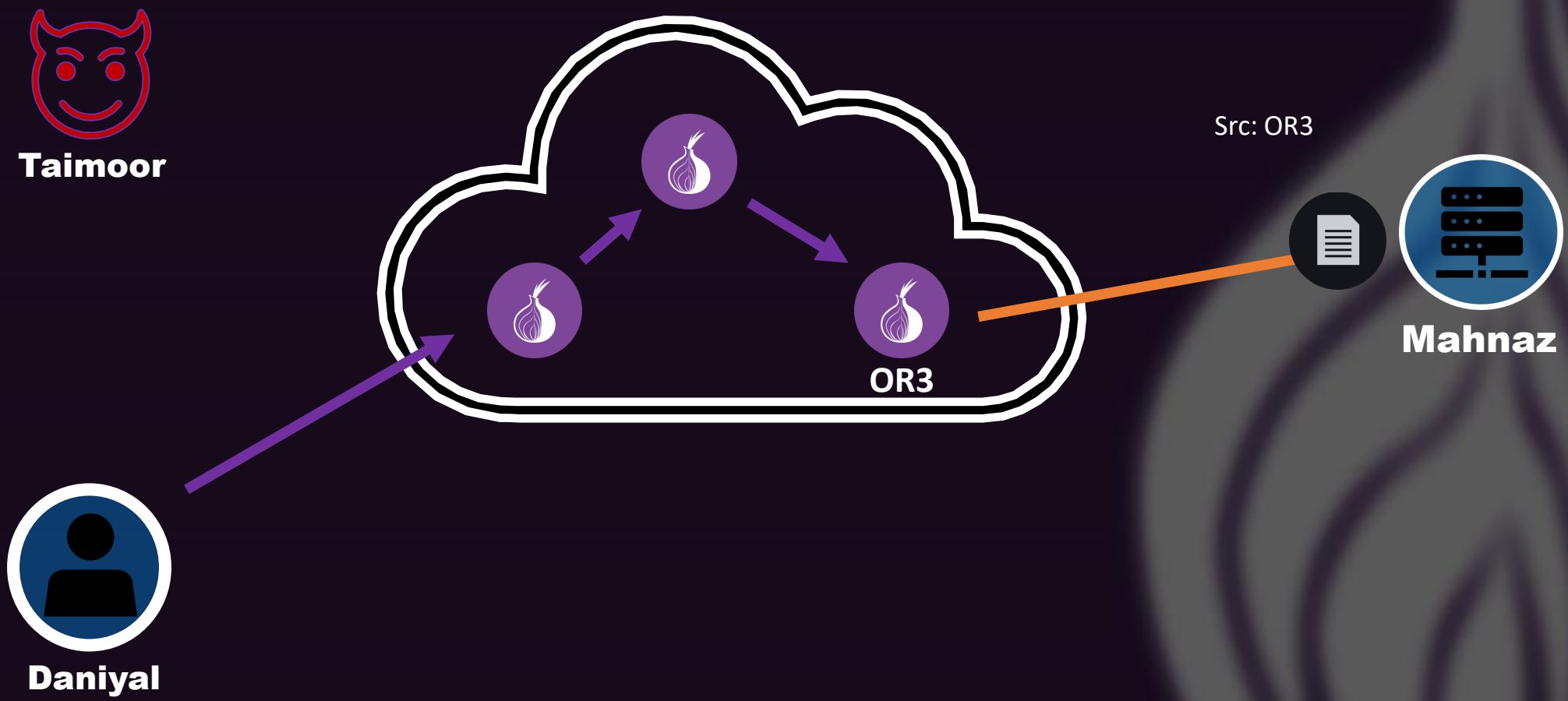

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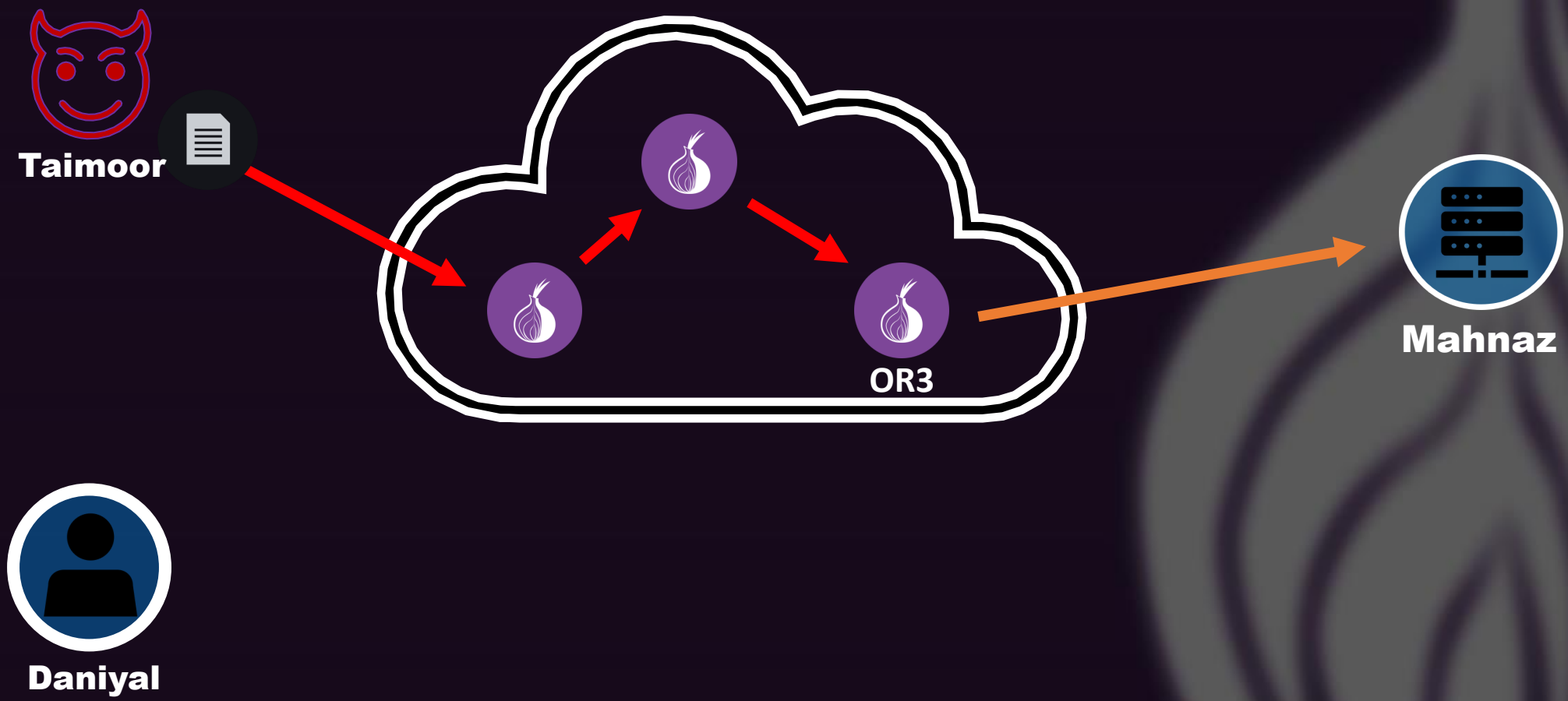

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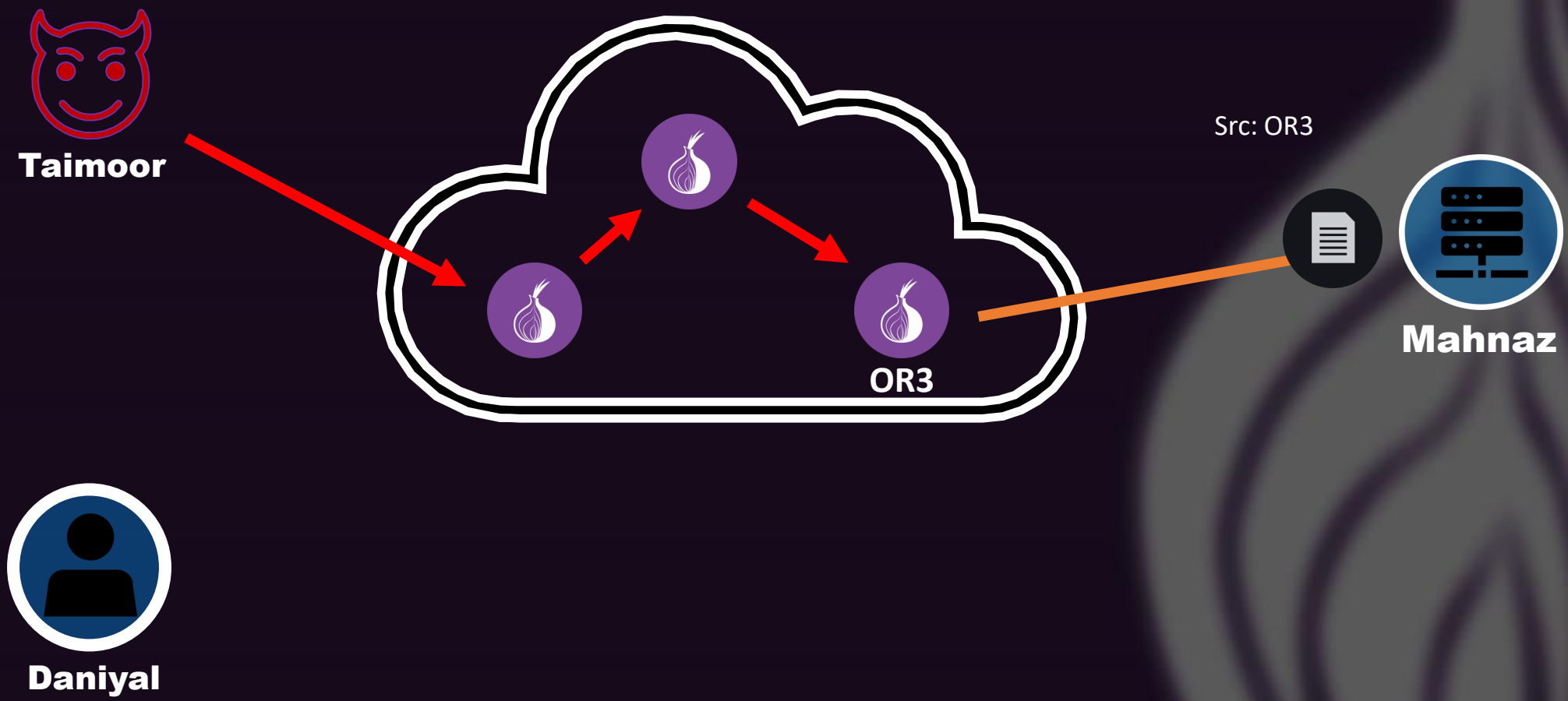

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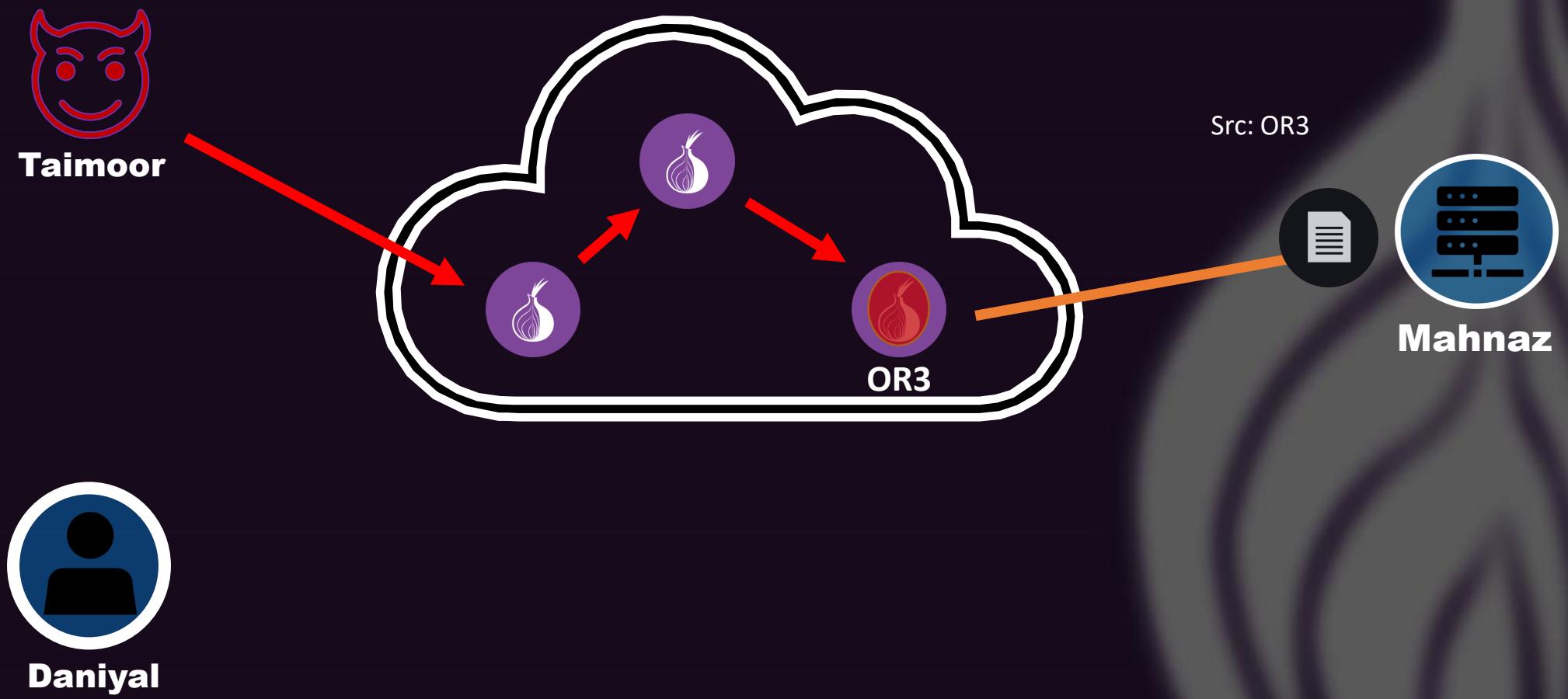

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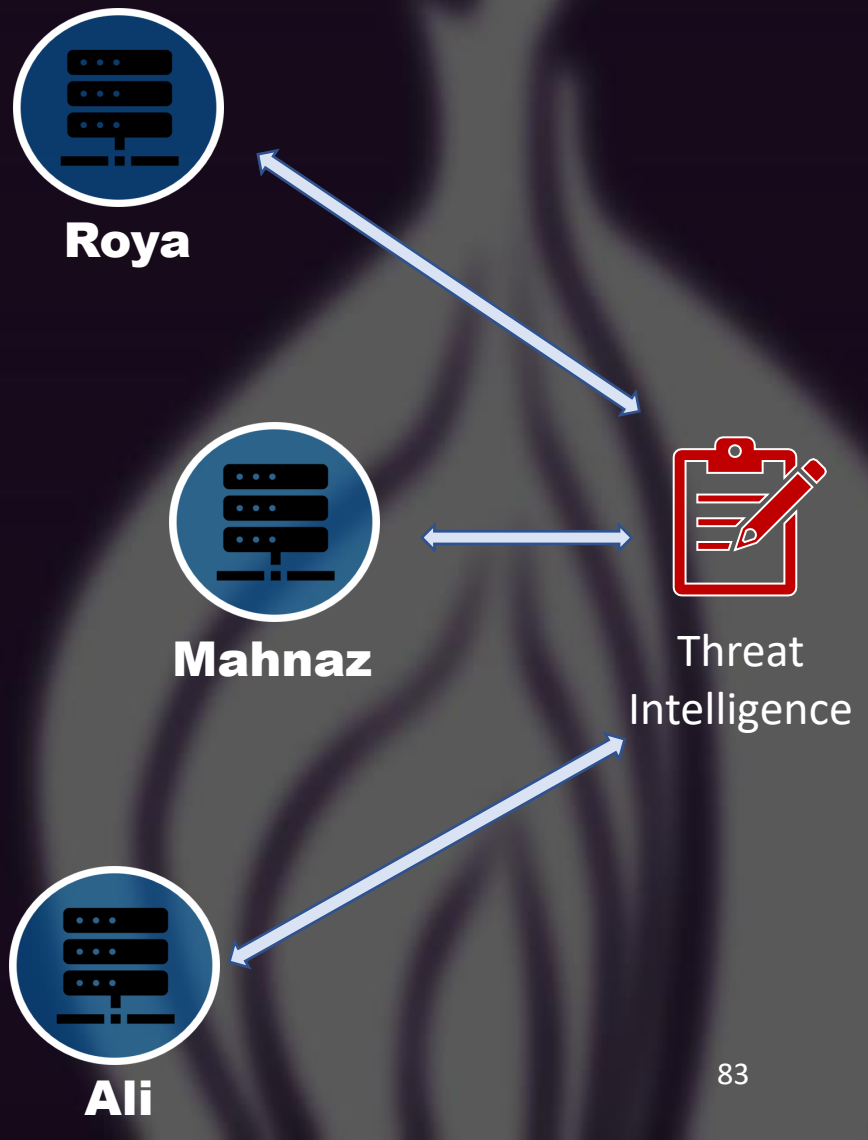

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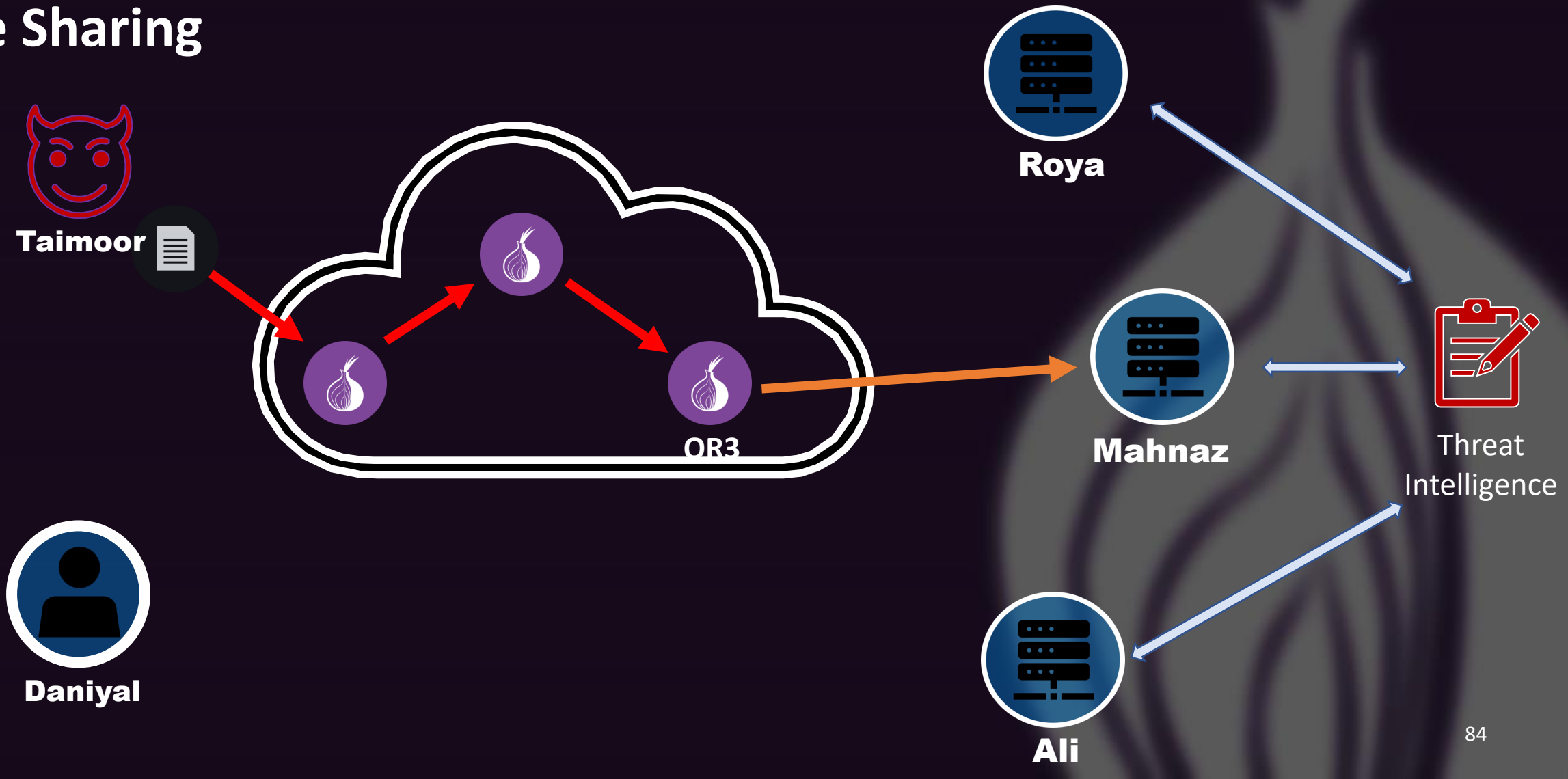

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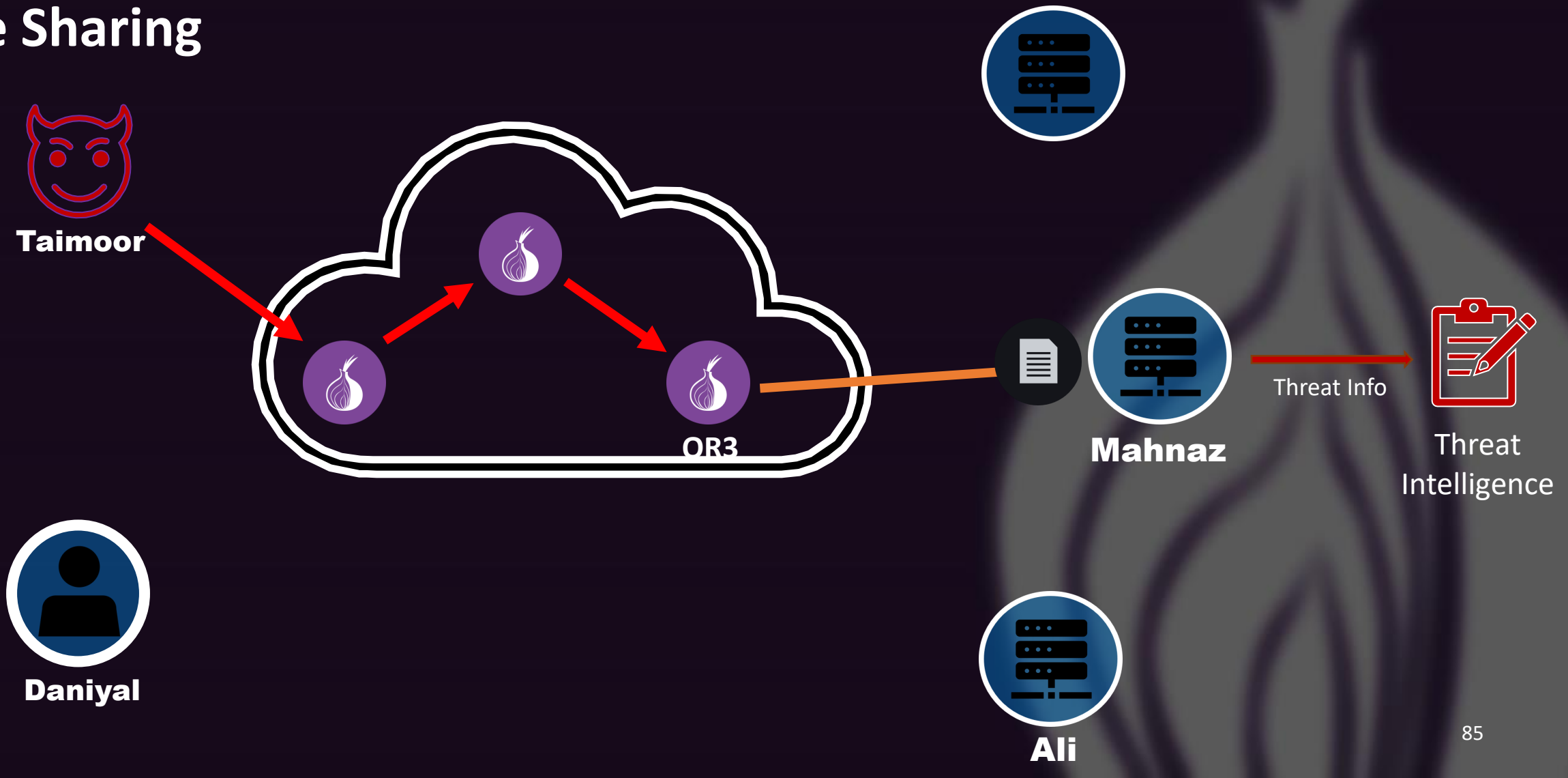

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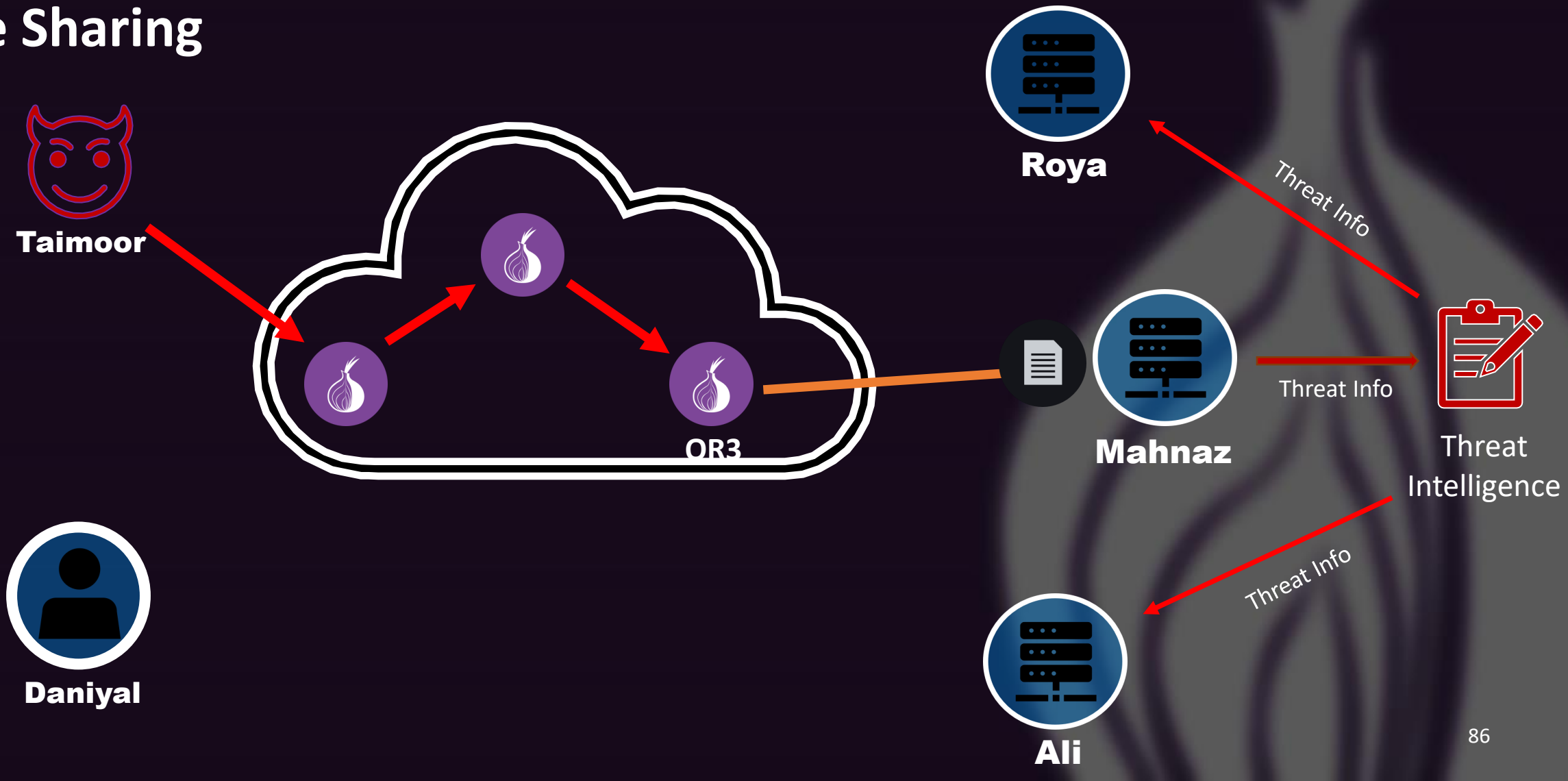

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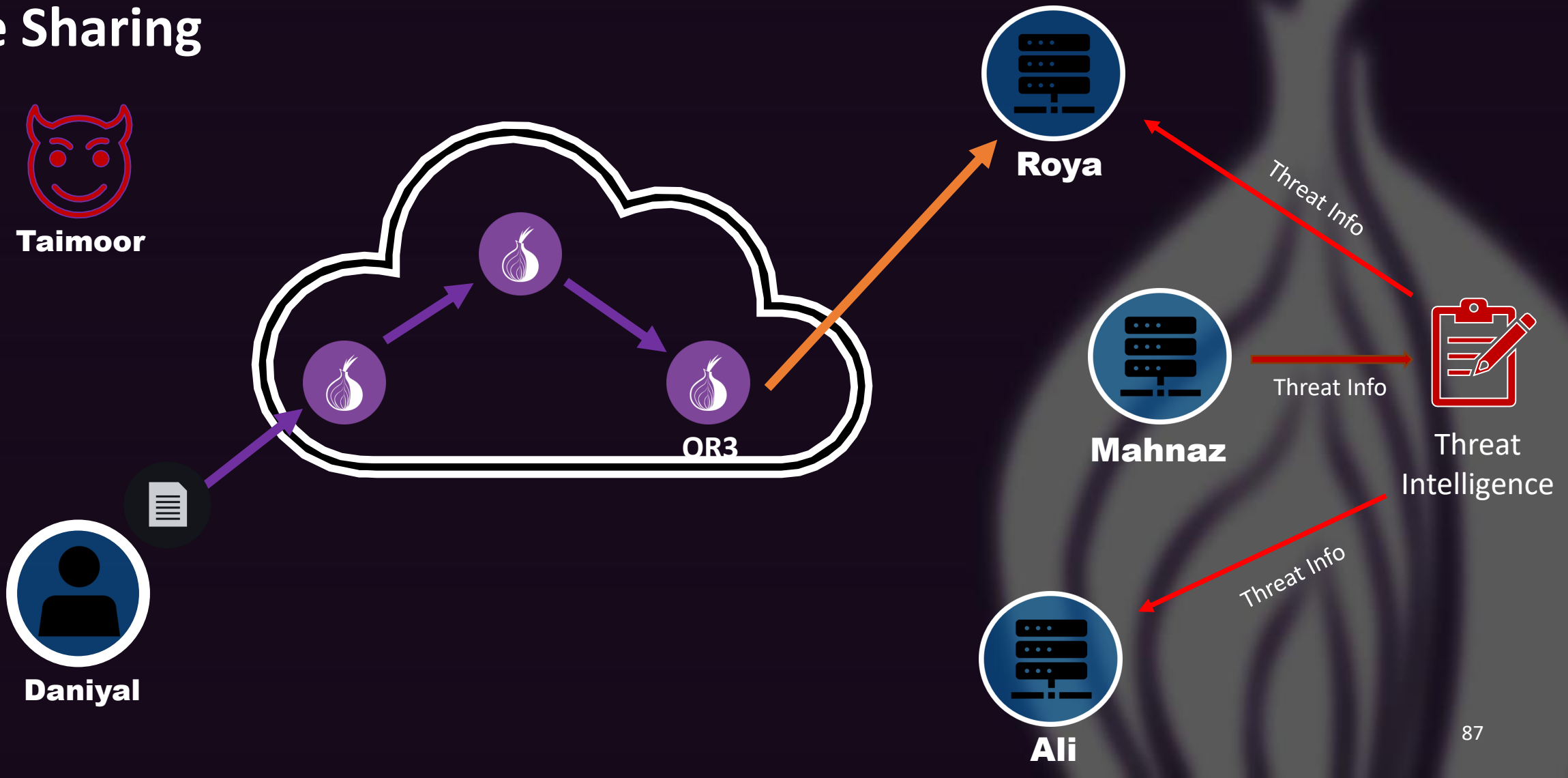

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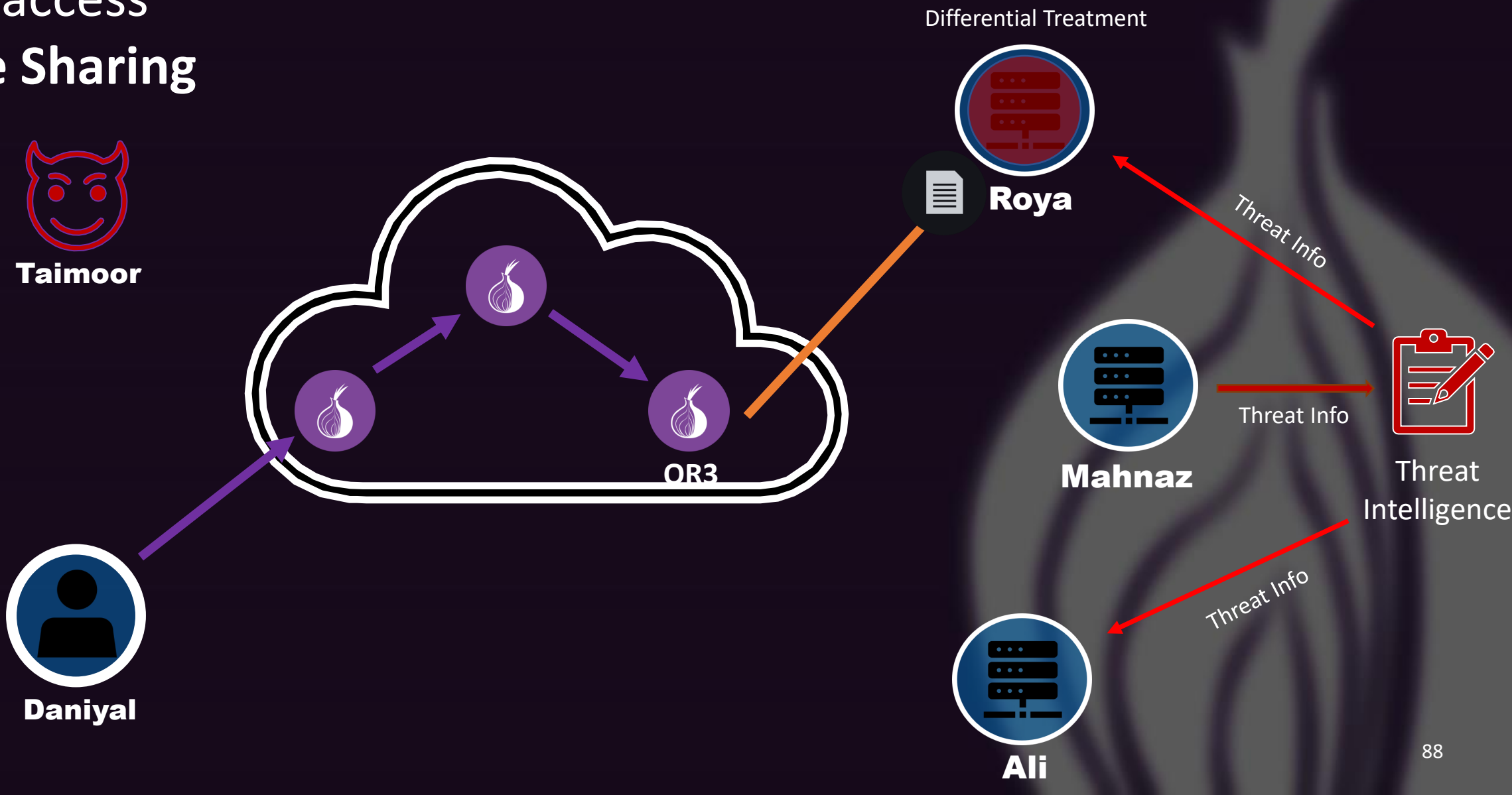

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Characterizing the Nature and Dynamics of Tor Exit Blocking

Rachee Singh[1], Rishab Nithyanand[2], Sadia Afroz[3,4]
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Key goals

- Analyzing the extent of server-side discrimination faced by Tor users
- Analyzing the undesired traffic sent through Tor relays
- Analyzing whether the Tor network is blocked “reactively” or “proactively”

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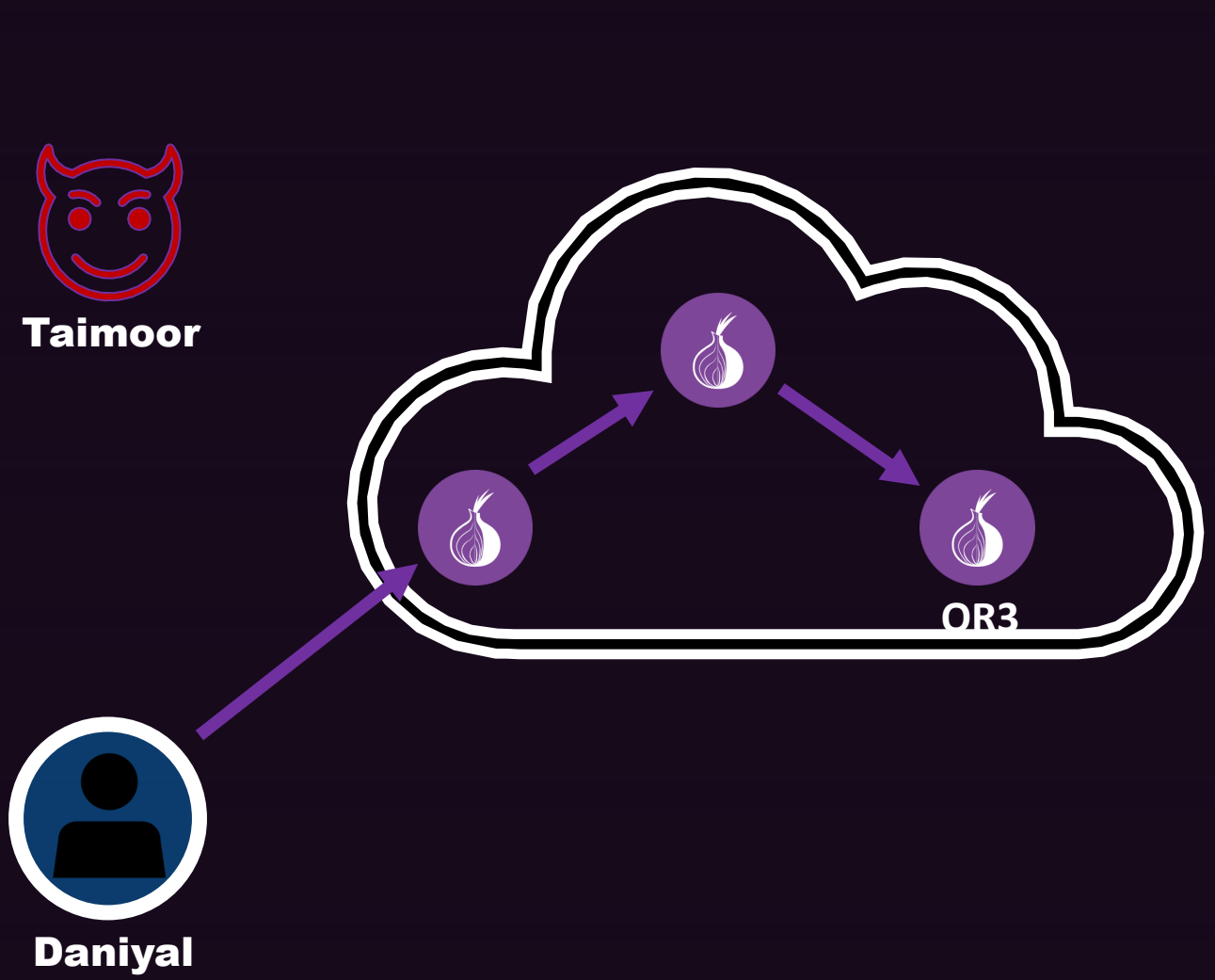

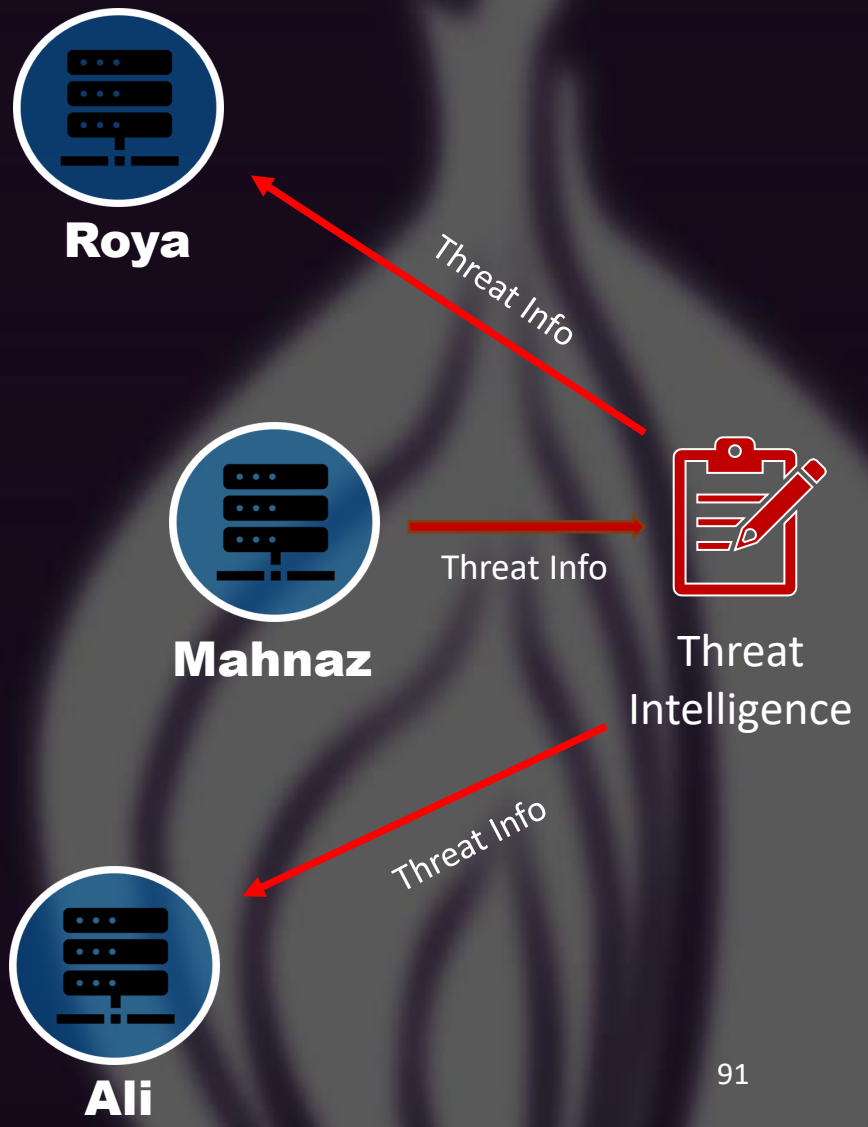

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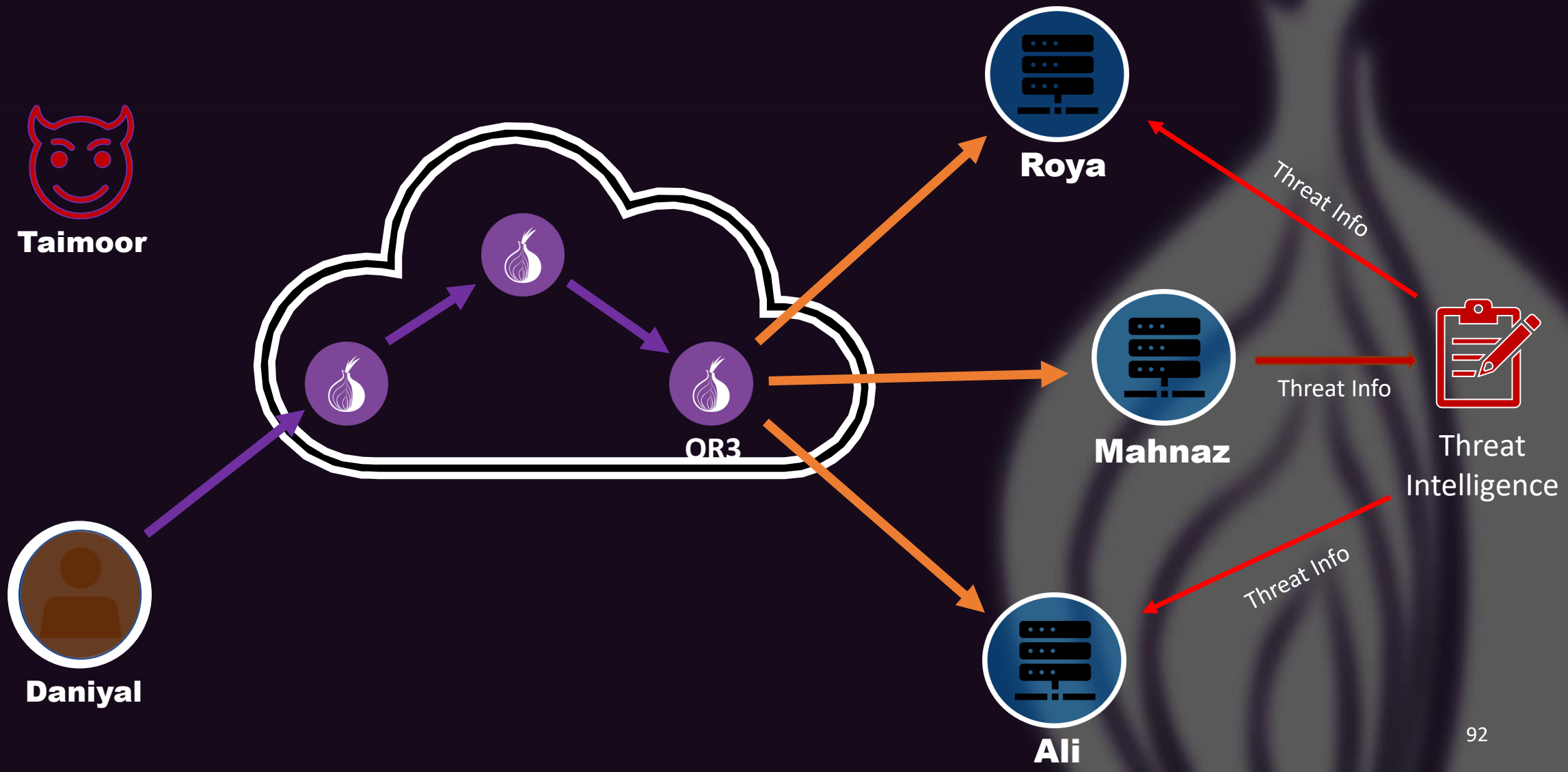

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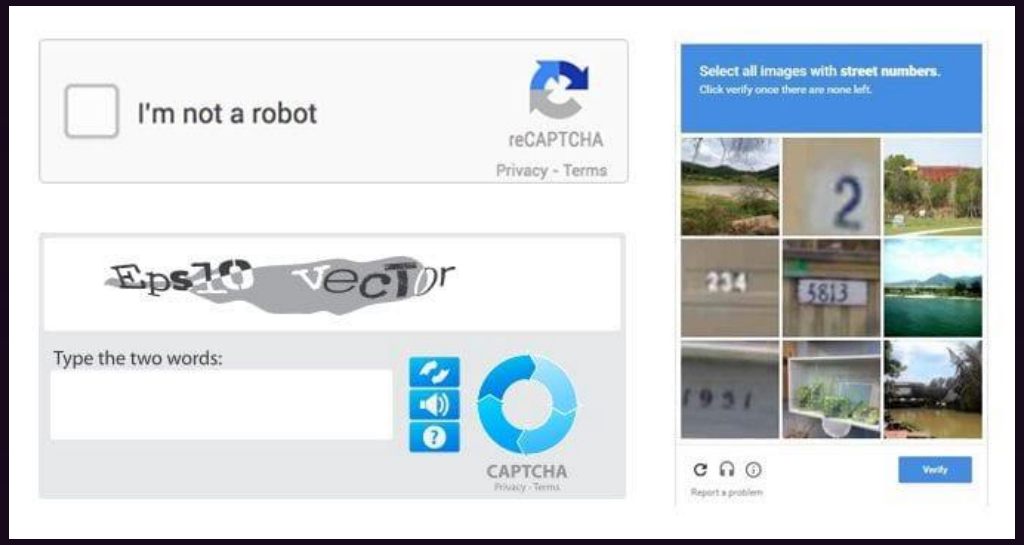
- The crawler visited the Alexa top 500 websites
  - Collected HAR files
  - Recorded screenshots of all pages visited

Analyzing the extent of server-side discrimination faced by Tor users

Types of discrimination



CAPTCHAs

Analyzing the extent of server-side discrimination faced by Tor users

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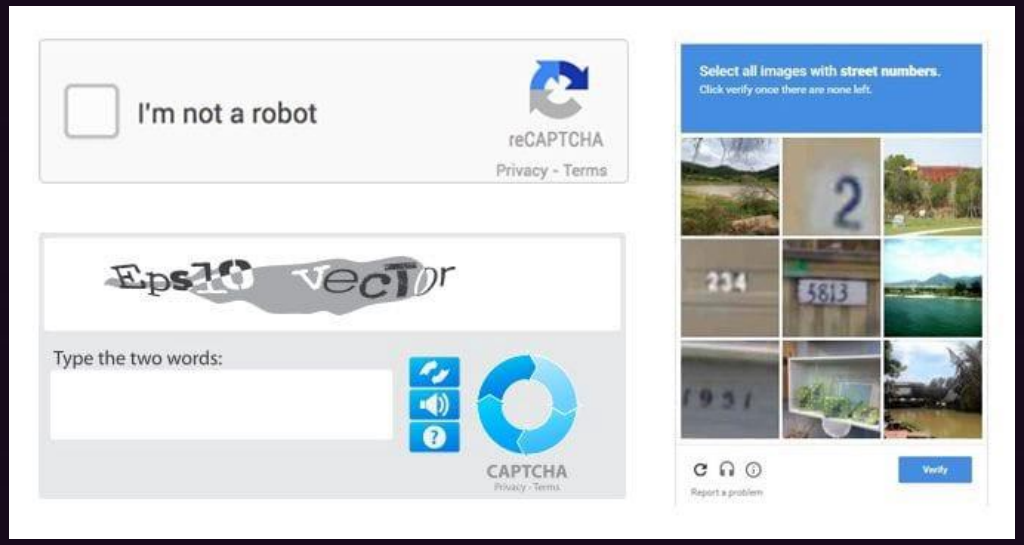

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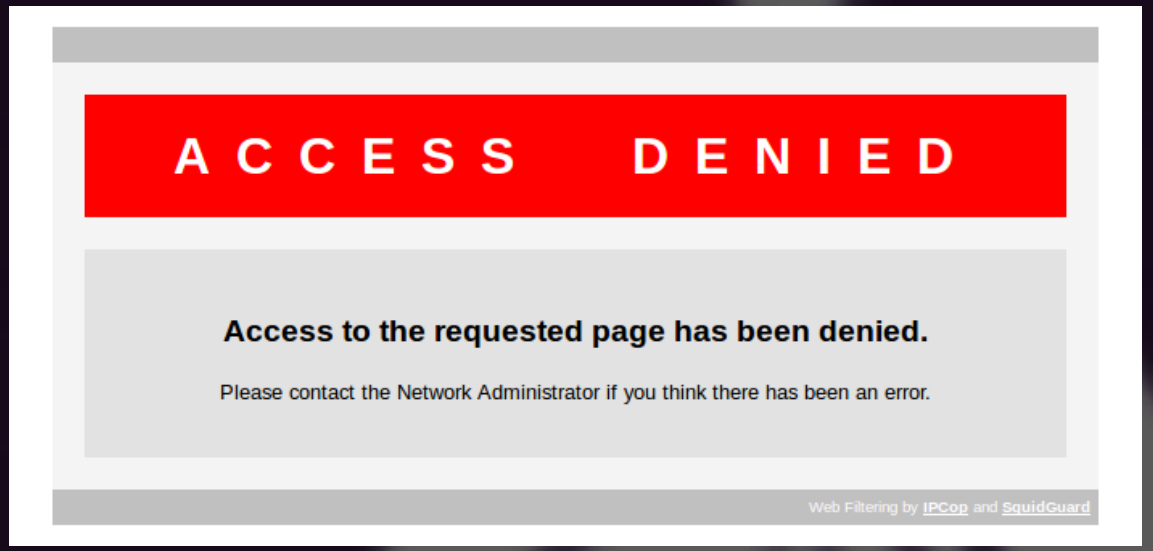
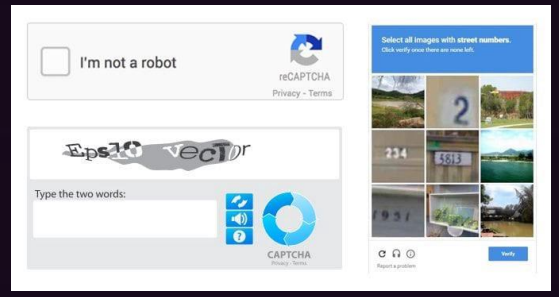


Block pages

Analyzing the extent of server-side discrimination faced by Tor users

Detecting Discrimination



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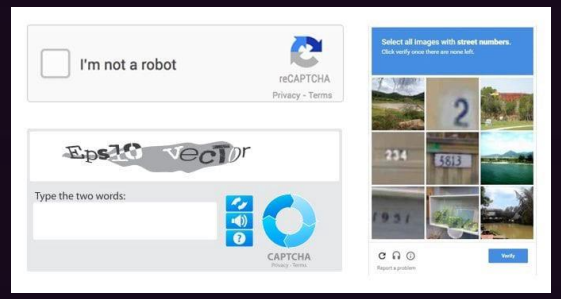

pHash

pHash

pHash

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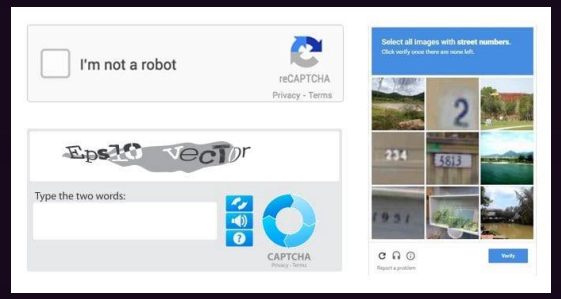

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Analyzing the extent of server-side discrimination faced by Tor users

Extent of Discrimination

Alexa Top 500

Analyzing the extent of server-side discrimination faced by Tor users

Extent of Discrimination

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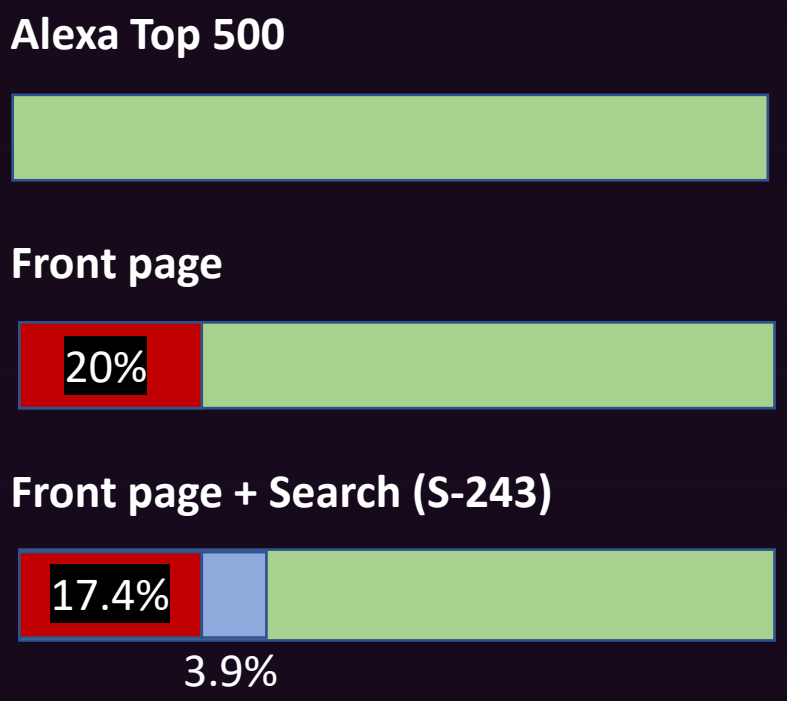
Front page

Analyzing the extent of server-side discrimination faced by Tor users

Extent of Discrimination



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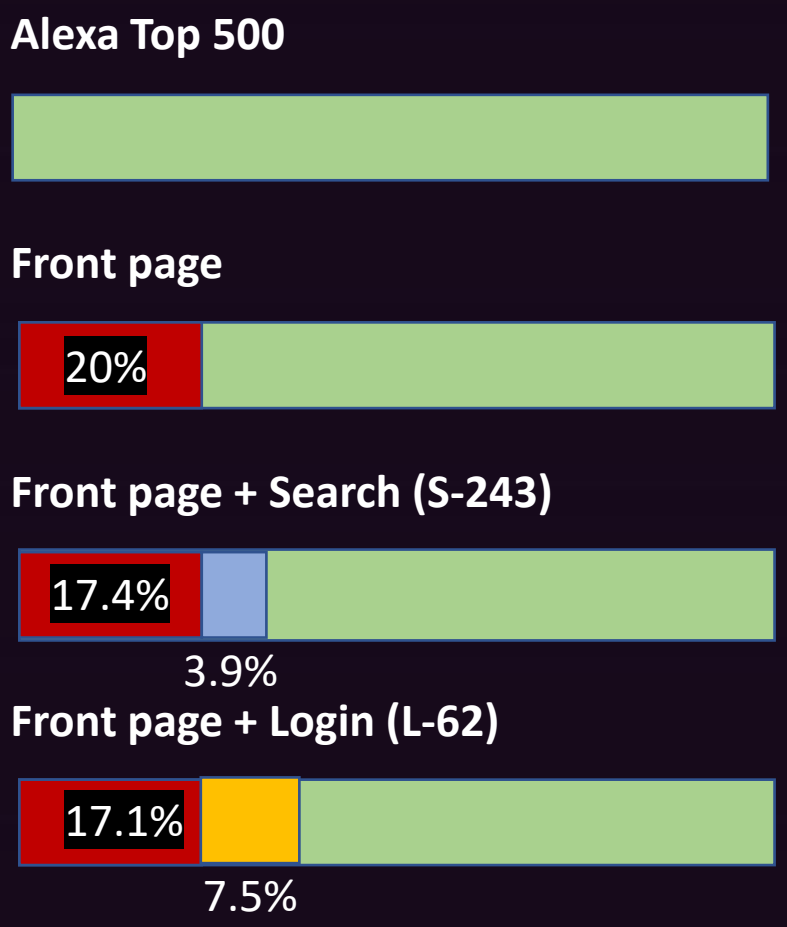

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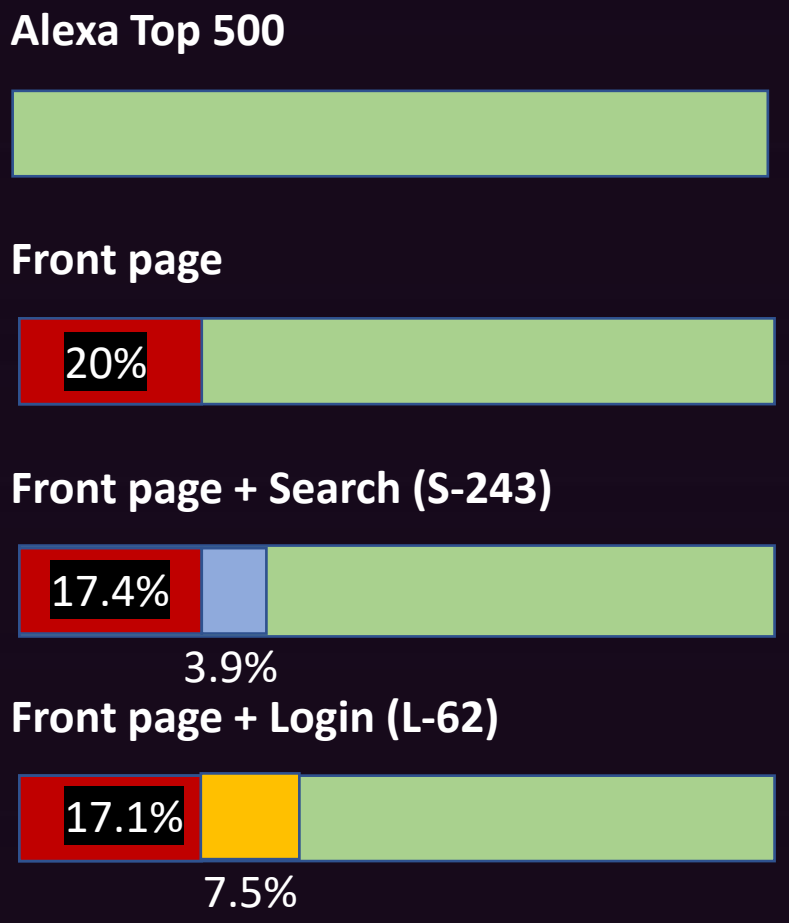


31% Of all Tor users face some form of differential treatment on the regular internet

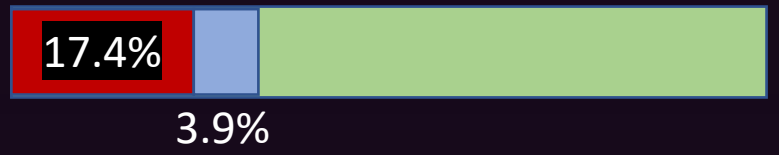
Analyzing the extent of server-side discrimination faced by Tor users

Extent of Discrimination

Alexa Top 500

Front page

Front page + Search (S-243)



Front page + Login (L-62)

31%

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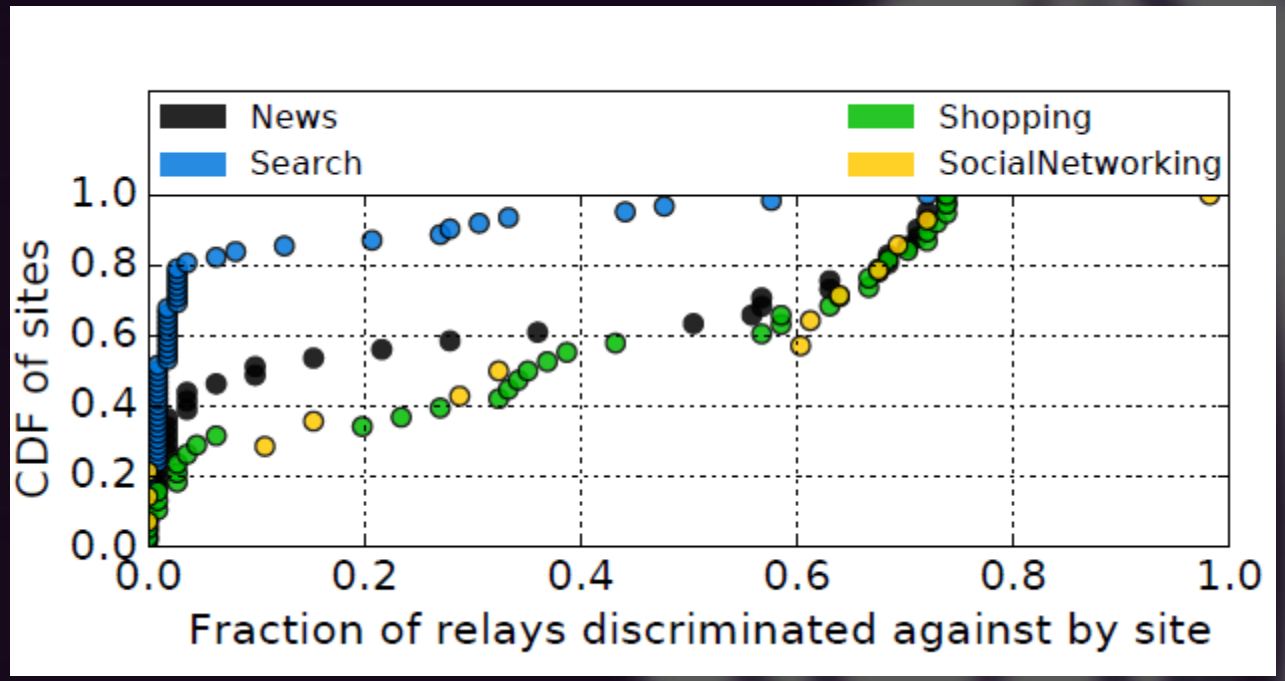
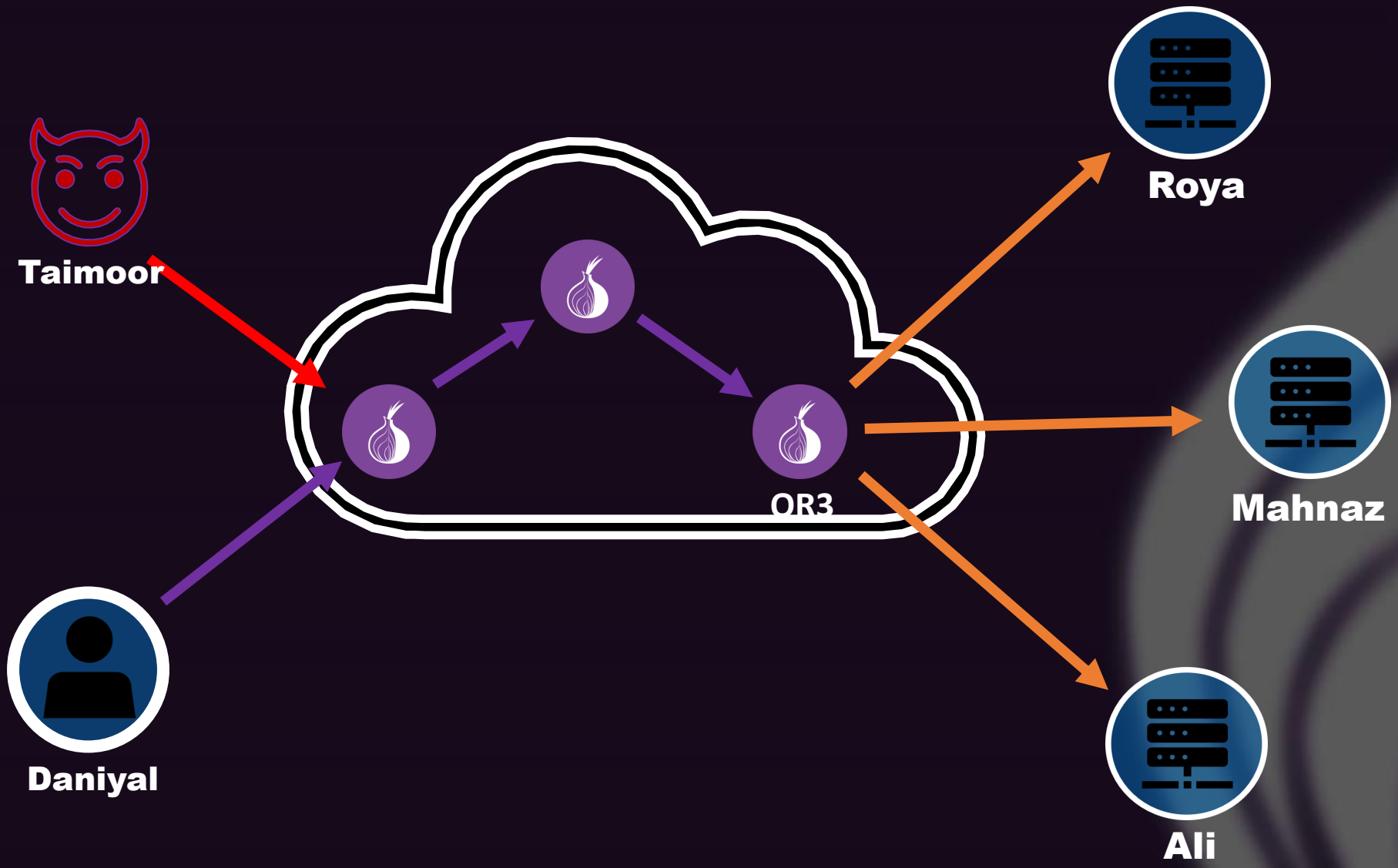


Analyzing the undesired traffic sent through Tor relays

Collection



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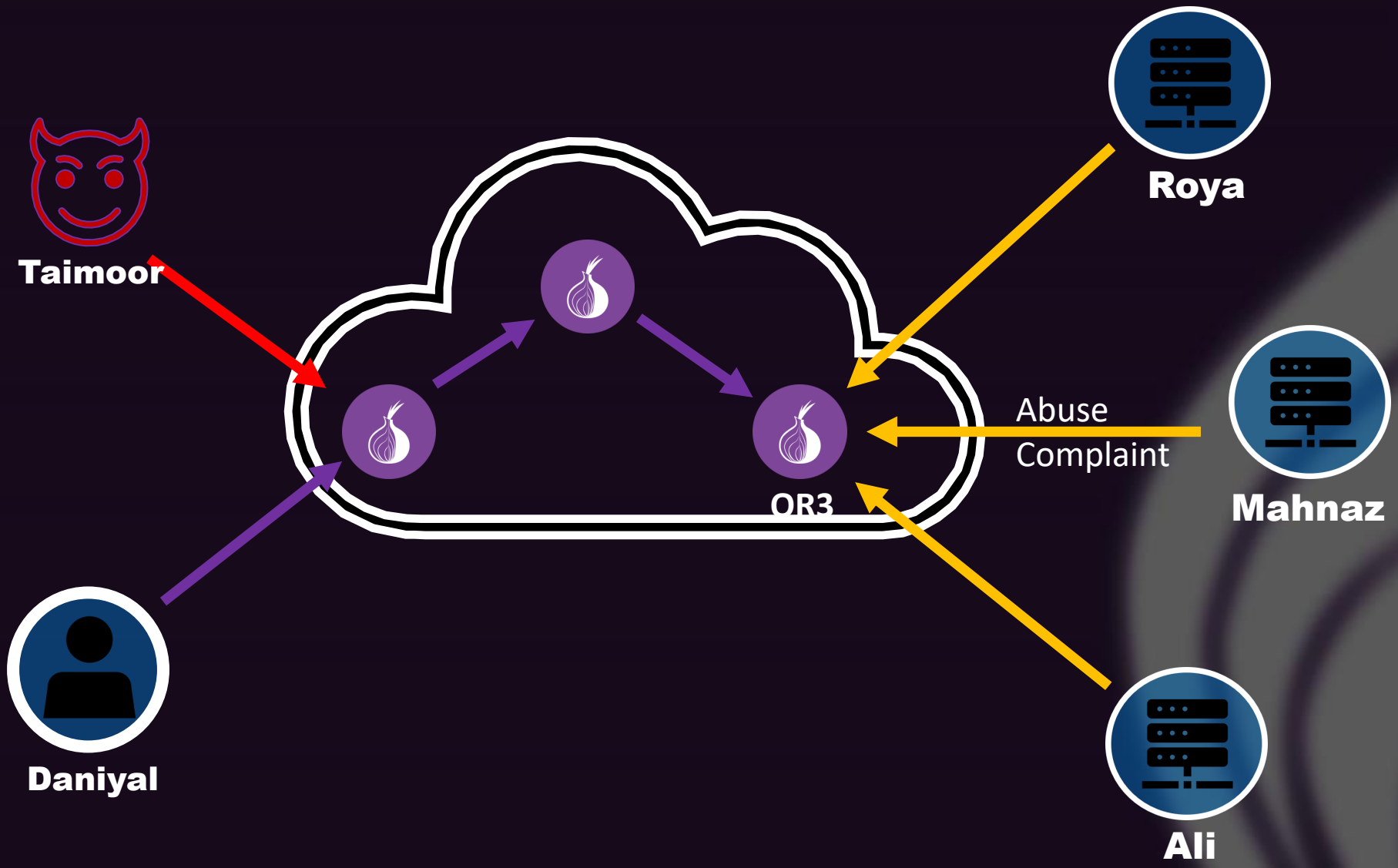

Analyzing the undesired traffic sent through Tor relays
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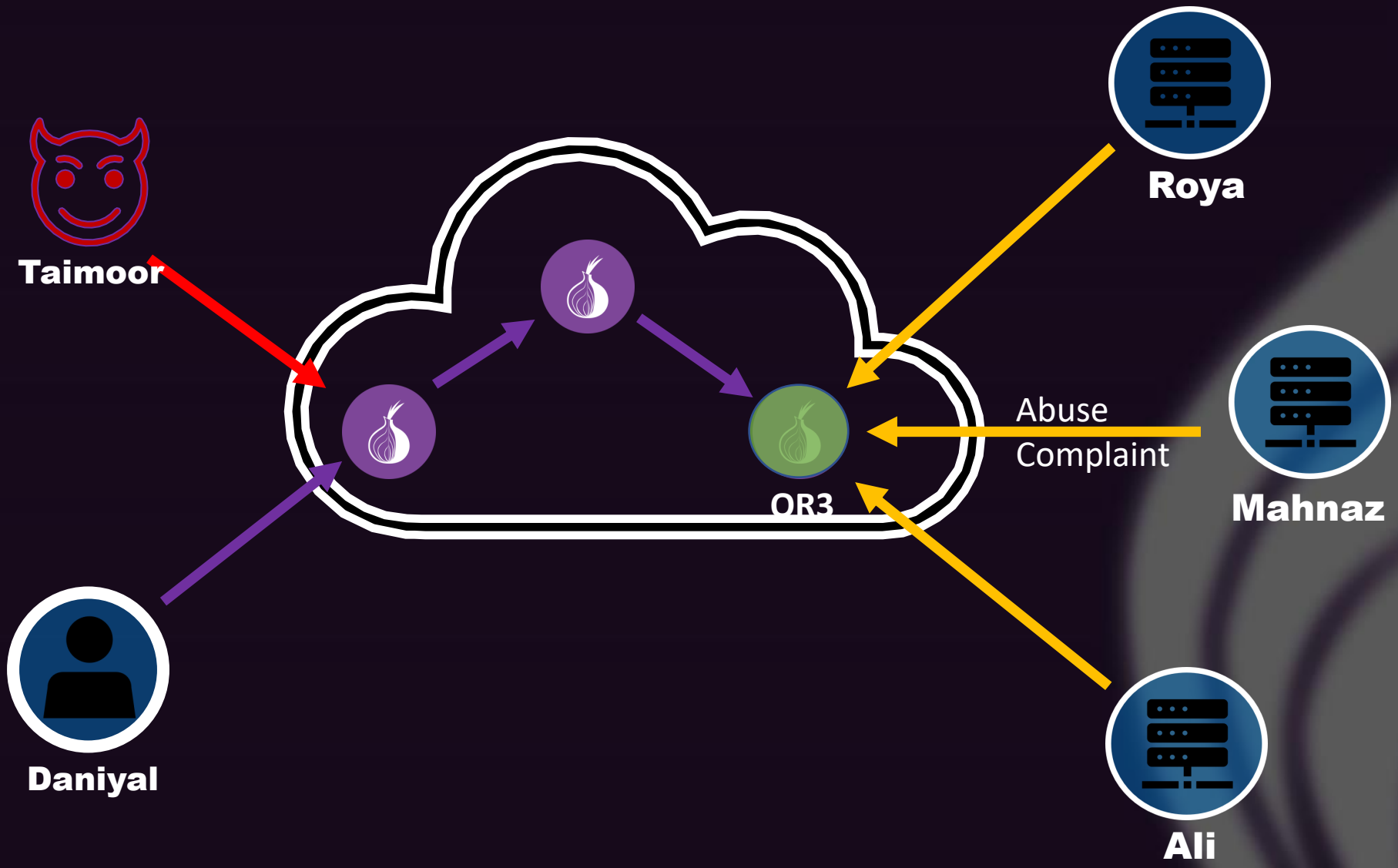

Analyzing the undesired traffic sent through Tor relays
Collection

- Abuse E-mails from 25 Tor relays
  - 10 relays run by themselves
  - 15 relays run by other individuals

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- 3 million emails
  - Collected over a period of ~6 years
  - Clustering to find similar complaints

Analyzing the undesired traffic sent through Tor relays
Results

- Abuse E-mails from 25 Tor relays
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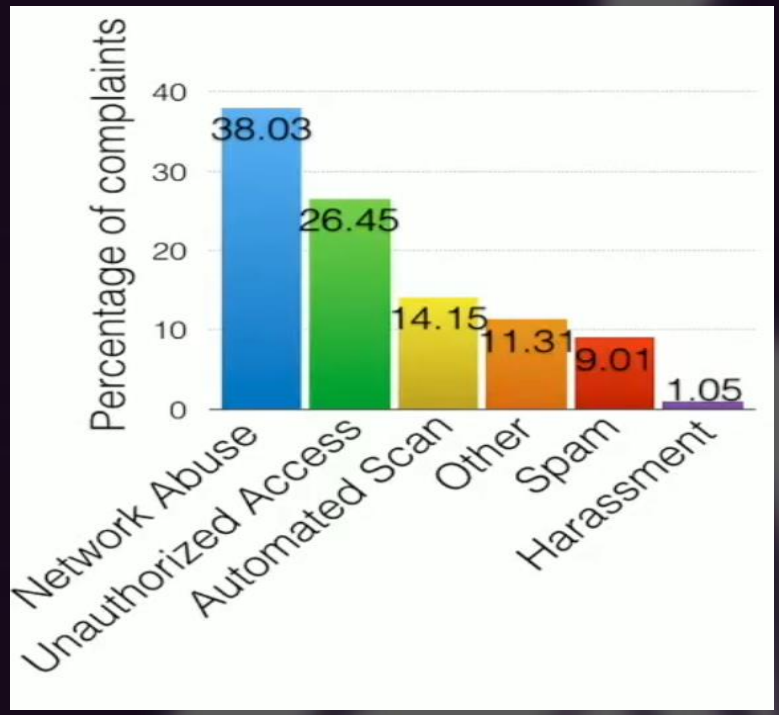

Exit Family	# Exits	% Tor Traffic	Email Dates	# Complaints	Top Complaint
Torservers.net	10–20	7.05%	2010/06–2016/04	2,987,017	DMCA Violation (99.74%)
apx	3	1.94%	2014/11–2016/05	293	Automated Scan (38.49%)
TorLand1	1	0.75%	2011/12–2016/10	307	Malicious Traffic (16.99%)
jahjah	1	0.17%	2016/1–2017/1	75	Unauthorized Login Attempts (34.15%)
Our exits	10	3.14%	2016/9–2017/2	650	Network Attack (48.68%)

Analyzing whether the Tor network is blocked “reactively” or “proactively”

- Threat Intelligence data from Facebook threat exchange
  - Contains 100+ commercially used blacklists
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      - “Matter of policy”

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- **Proactive Blocking**
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- **Reactive Blocking**
  - “Response to abuse”
  - If less than 30% of all Tor relays were listed within 24 hours

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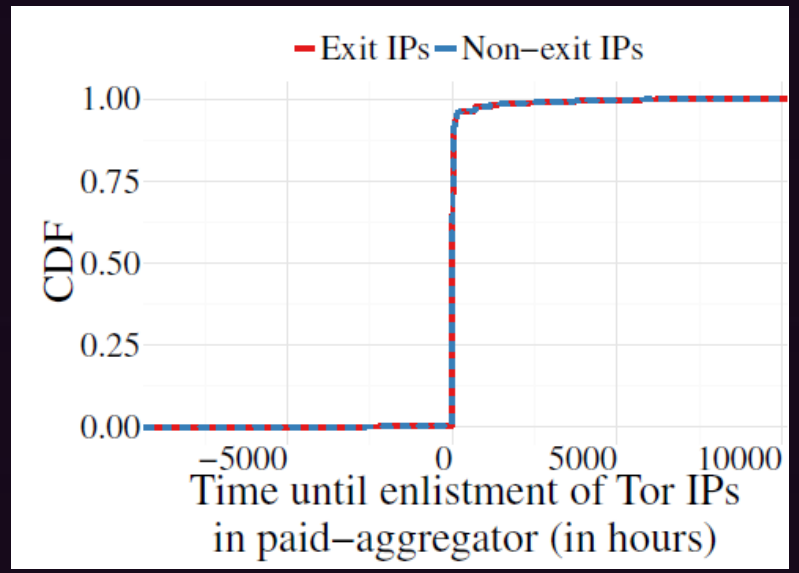

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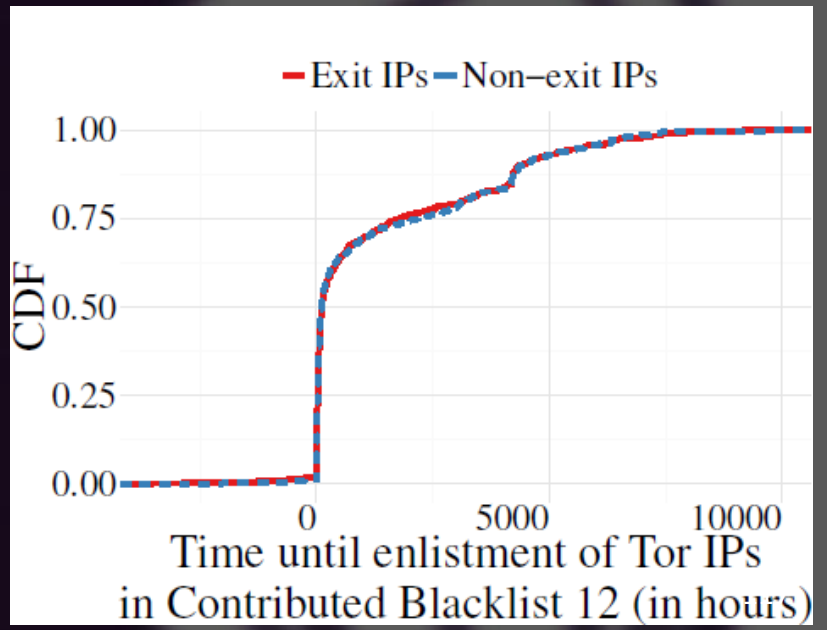

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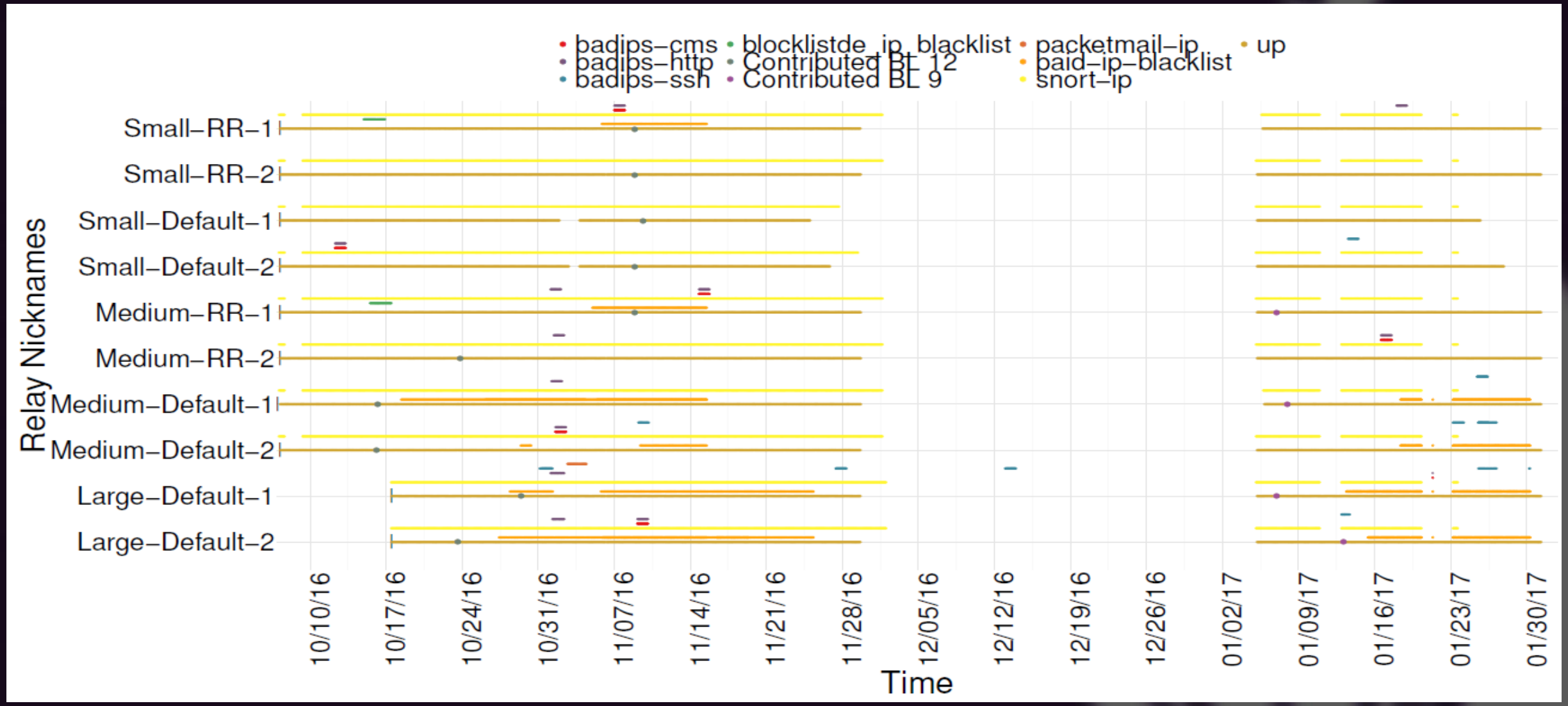

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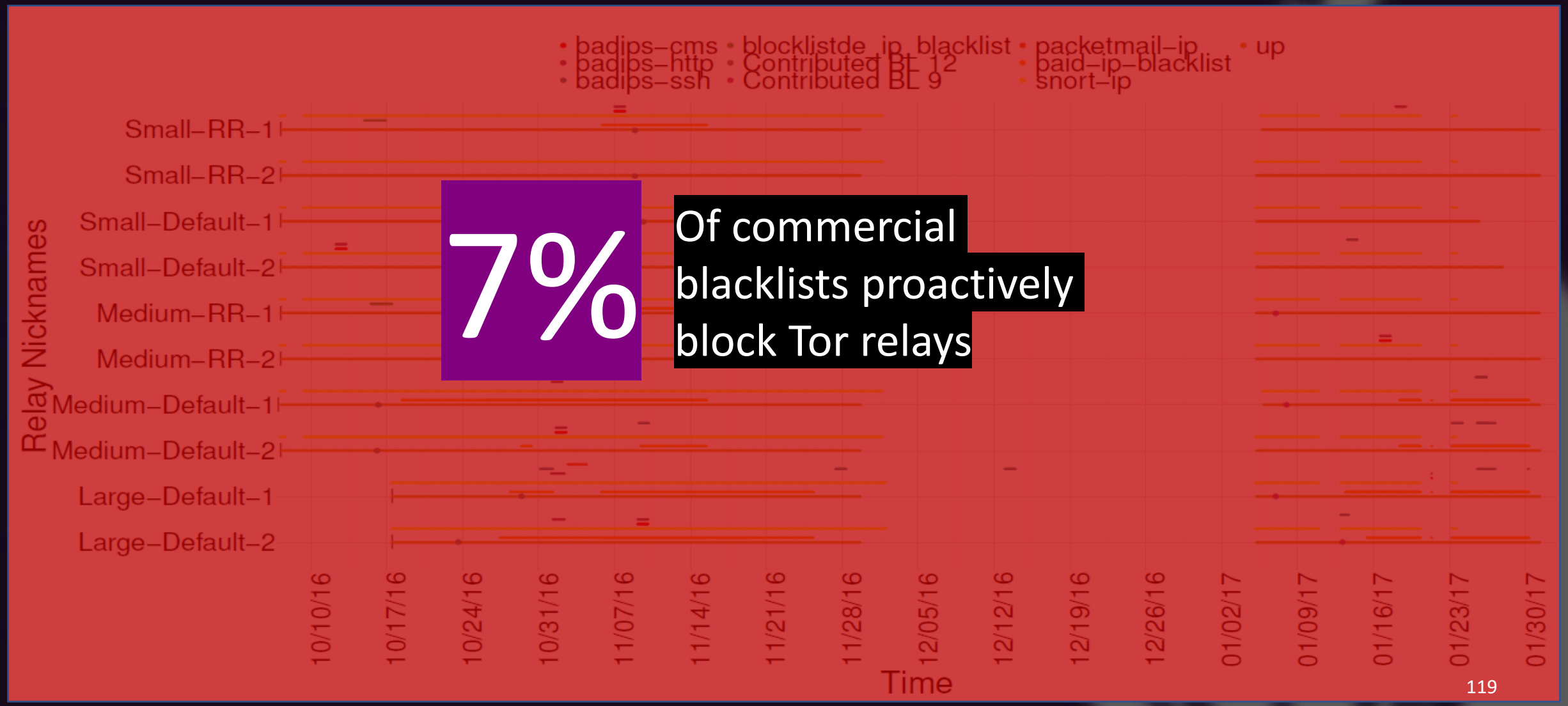


7%

Of commercial blacklists proactively block Tor relays

Putting it all together

- Individuals wanting to use the Tor network can not access it due to usability and censorship issues

- Users able to access the Tor network face issues of latency due to the very nature of the network itself

- Tor users are discriminated against by end servers

- These problems lead to the degradation of the utility of the Tor network

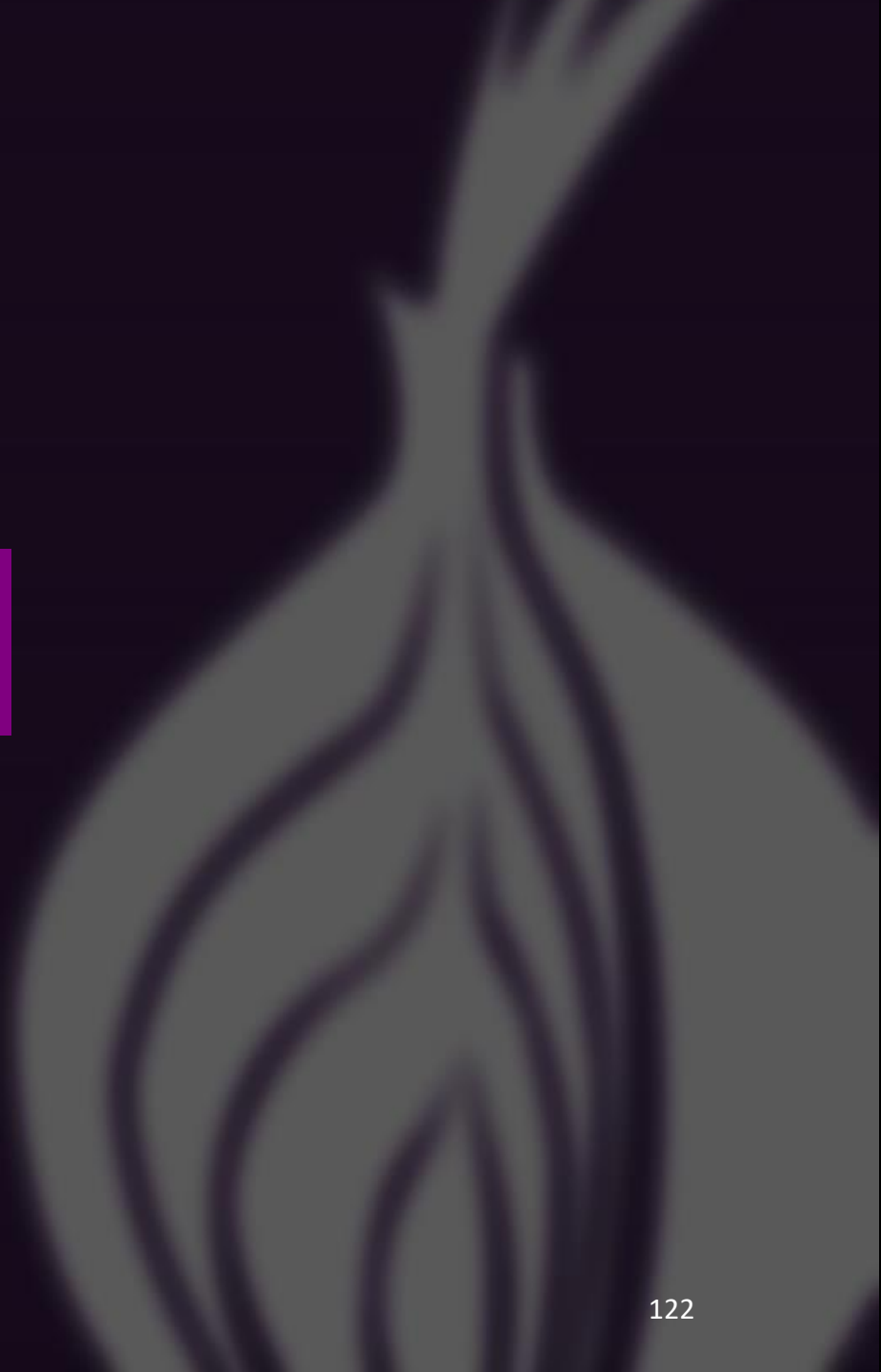
Future work

- Working on identifying users who send in malicious traffic without deanonymizing them

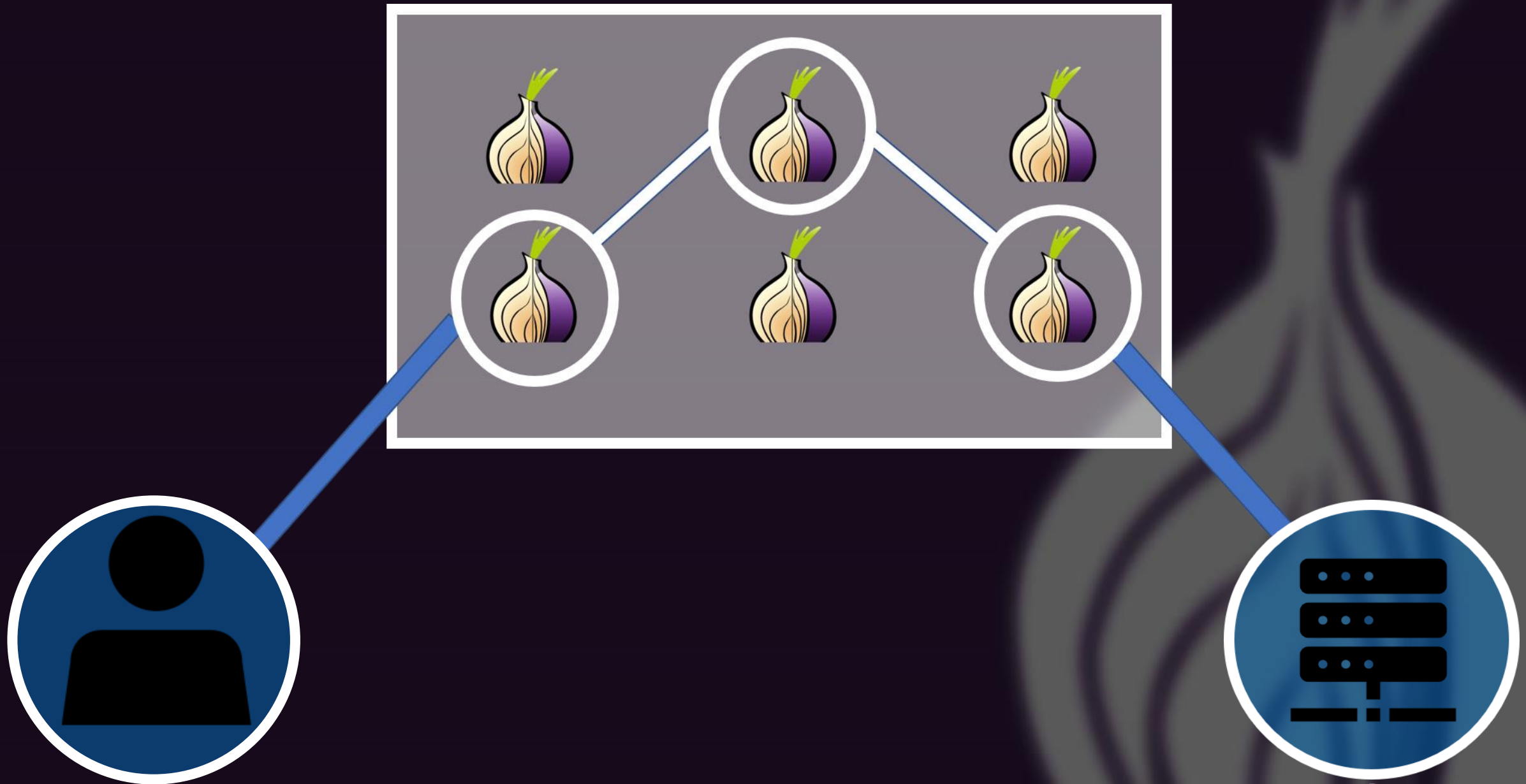
- Incentivizing more volunteers to set up Onion routers

- Spreading awareness about Tor enhancing the reputation of the network

THANK YOU!



THE Tor NETWORK



USER

Research Question:

The number of people who can actually access the Tor network over the number of people trying to access the Tor network

Problems

- Censorship
- Usability of the Tor Browser/Proxy

END SERVER

Research Question:

The number of web resources that an individual using the Tor network can access as compared to an individual using a regular browser

Problems

- Server side blocking