snowpack

BECOME INVISIBLE

Séminaire: Quelles technologies pour assurer la confiance numérique

VIPN: Challenges and use cases for the Internet's first invisibility network without third party

Version : 1.0

04/06/2024

snowpack

Baptiste Polvé

TSP 2018, ESSI 2018

HEC Challenge + 2021

Participation to the creation of KerberINT @TSP2016
Part-time teacher on Network Security (35h) @Ecole Hexagone since 2022

Project Manager & Research Engineer @CEA List 2018-2021 (NIDS)

***Co-founder & CTO @Snowpack** since 2021*

snowpack | Snowpack in a nutshell

#Innovative #Deeptech #Cybersecurity #European #Start-up

CEA* spin-off
created in Q2 2021

Headquarters in Paris-Saclay
Offices in Paris & Vienna

Technology based on seven years of R&D and protected by 4 international patents

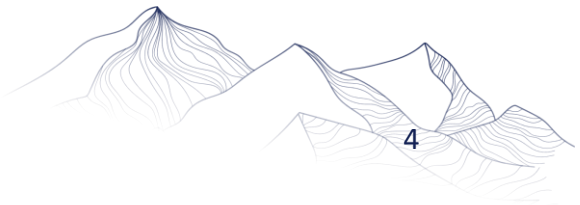
+2 M€ Seed
financing in 2022

Ecosystem
#cybersecurity #innovation

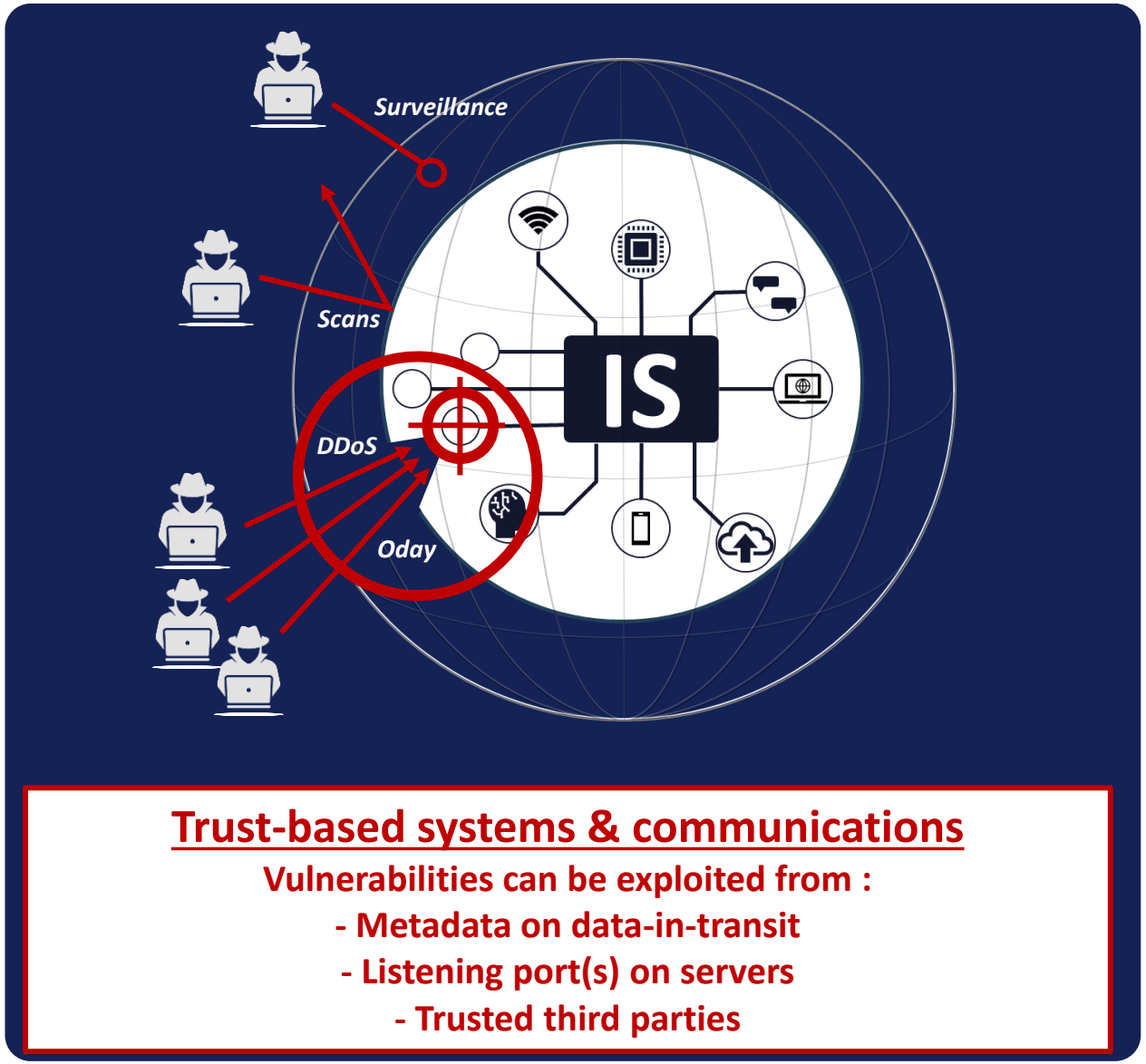
** Commissariat à l'Energie Atomique et aux énergies alternatives (French Atomic Energy Commission): French largest applied research center*

GRAND PRIX
PRIX DE LA START-UP IN CYBER FORUM

snowpack | If hackers can’t see you, they can’t attack you!



snowpack | If hackers can't see you, they can't attack you!



Trust-based systems & communications

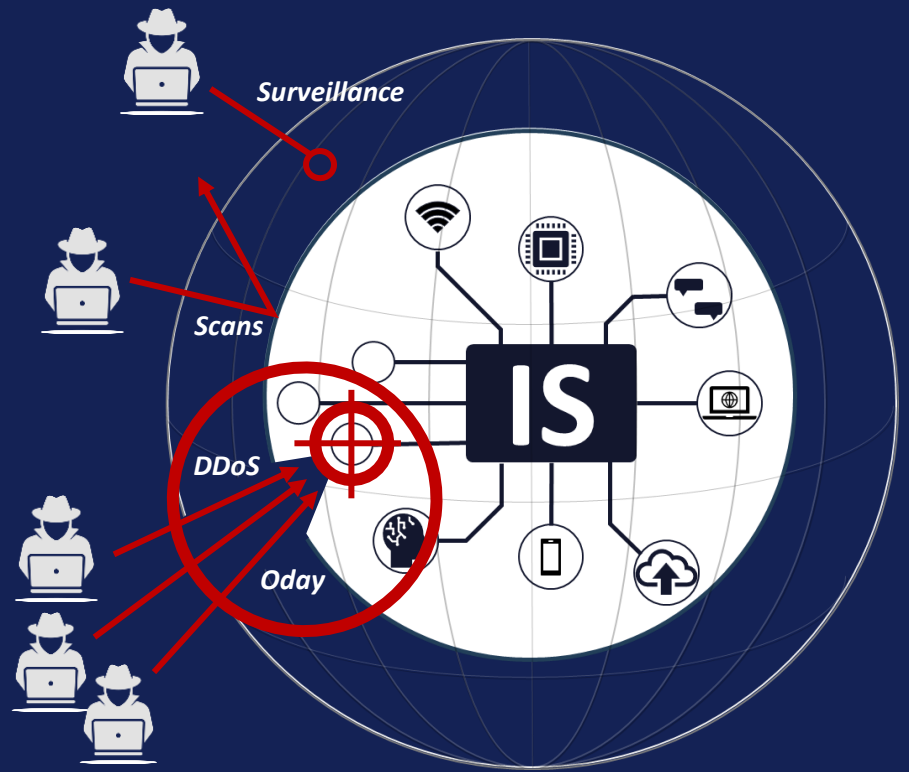
Vulnerabilities can be exploited from :

- Metadata on data-in-transit

- Listening port(s) on servers

- Trusted third parties

snowpack | If hackers can't see you, they can't attack you!



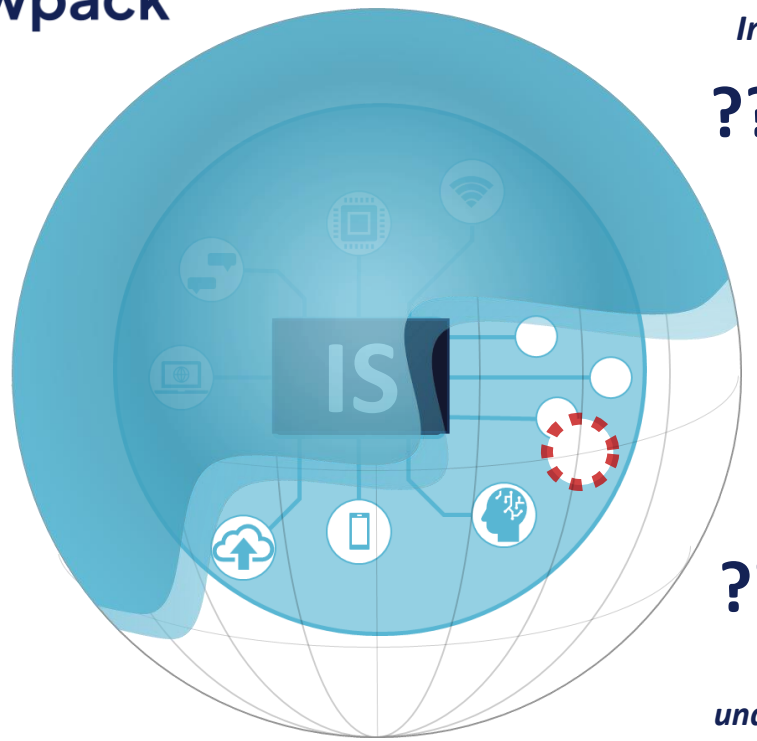
Trust-based systems & communications

Vulnerabilities can be exploited from :

- Metadata on data-in-transit

- Listening port(s) on servers

- Trusted third parties



Invisible systems & communications

No vulnerability exploitation from Internet :

- No Metadata

- No listening port

- No trusted third party

snowpack | 1 baseline technology, 3 offers for 3 purposes

Our Virtual & Invisible Private Network (VIPN) hides & protects your activities

Plug into our solution & become invisible

Invisible Access

Access Internet without any trace

Browse Clear, Deep & Darkweb truly anonymously & without any trusted third party

Invisible Services

Protect your web services

Make your sensitive web services exposed on the internet invisible from hackers

Invisible Infra

Hide your company attack surface

Cloak your IT endpoints & data-in-transit from hackers and prevent vulnerabilities & traces exploitation

*Also available through "**Secured by Snowpack**" API for integration in your own softwares & systems*

snowpack | How does it work ?

4 patents

2017 2019
2021 2023

4 patented key principles to guarantee invisibility, anonymity & independence

snowpack | How does it work ?

4 patents

2017 2019
2021 2023

4 patented key principles to guarantee invisibility, anonymity & independence

1. Distributed network overlay (SNO)

snowpack | How does it work ?

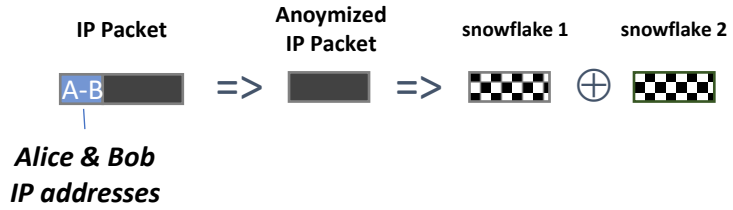
4 patents

2017 2019
2021 2023

4 patented key principles to guarantee invisibility, anonymity & independence

1. Distributed network overlay (SNO)

2. Packets fragmentation into anonymized noise (snowflakes)



snowpack | How does it work ?

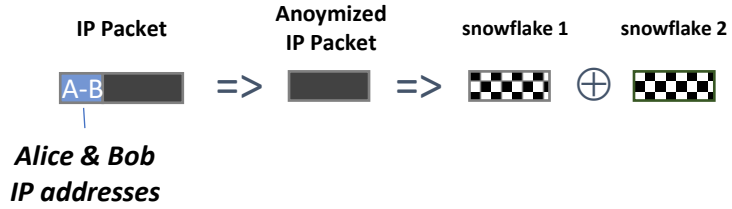
4 patents

2017 2019
2021 2023

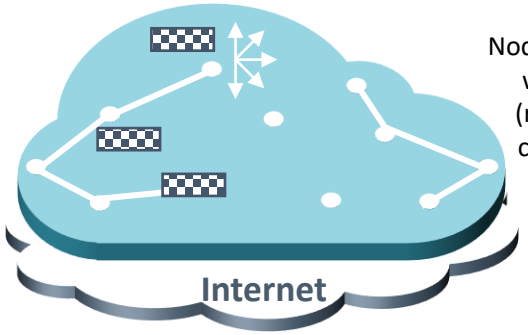
4 patented key principles to guarantee invisibility, anonymity & independence

1. Distributed network overlay (SNO)

2. Packets fragmentation into anonymized noise (snowflakes)



3. Split of information into routes, nodes autodiscovery mechanism



Nodes cannot know the whole route/path (regardless of their computing power)

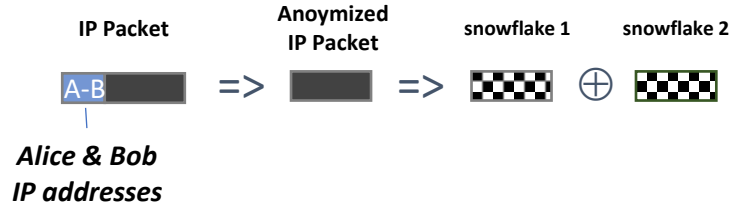
snowpack | How does it work ?

4 patents
2017 2019
2021 2023

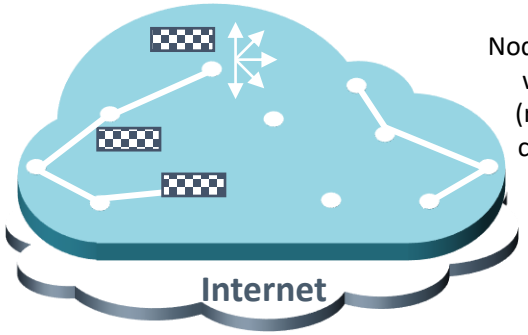
4 patented key principles to guarantee invisibility, anonymity & independence

1. Distributed network overlay (SNO)

2. Packets fragmentation into anonymized noise (snowflakes)

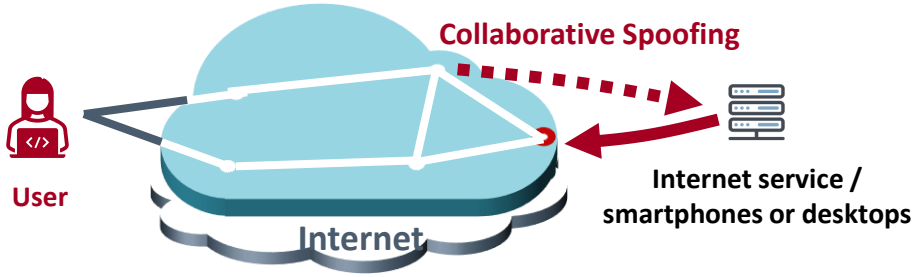


3. Split of information into routes, nodes autodiscovery mechanism



Nodes cannot know the whole route/path (regardless of their computing power)

4. Distributed exit nodes



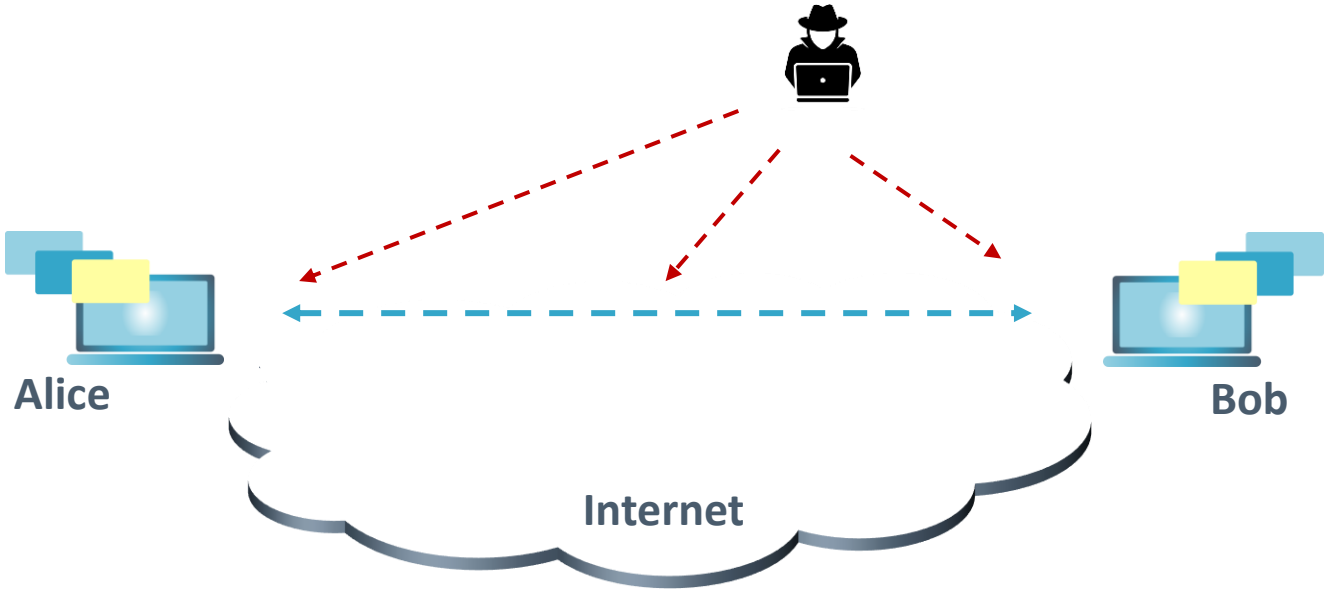
No SNO element can have full knowledge of {Sender, Receiver, Content}

snowpack | In summary …

4 patents

2017 2019
2021 2023

| *VIPN = SNO (Snowpack Network Overlay) + Connectors*



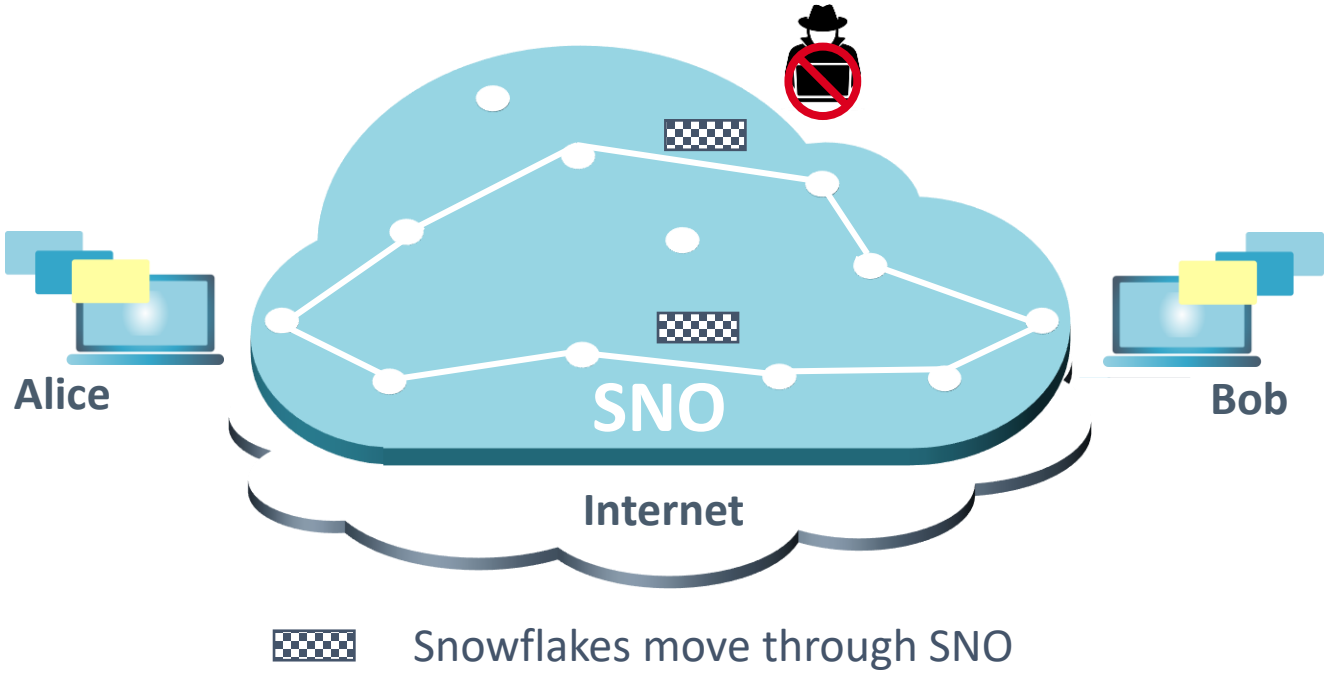
snowpack | In summary …

| *VIPN = SNO (Snowpack Network Overlay) + Connectors*

4 patents

cea

2017 2019
2021 2023



Strengths of our solutions

- No MITM attack possible
- No trusted third party
- Infrastructure & Services cloaking
- High quality of service & resilience
- Verifiable quality of security & independence

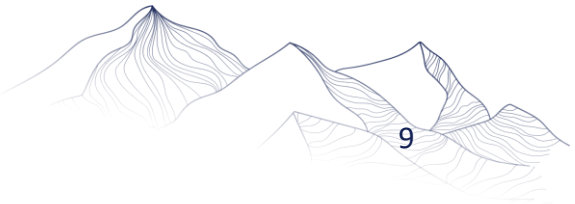
snowpack

Browse anonymously

Solutions and interest of VIPN

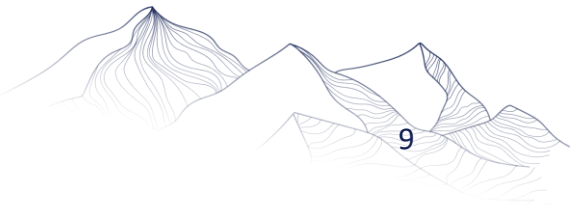
snowpack | Why people need anonymity ?

- Personal Privacy protection
  - no targeted advertising, bypassing geo-blocking, …
  - dating, beliefs, sexual orientation, …
  - health (critical condition or disease, addiction…)



snowpack | Why people need anonymity ?

- Personal Privacy protection
  - no targeted advertising, bypassing geo-blocking, …
  - dating, beliefs, sexual orientation, …
  - health (critical condition or disease, addiction…)
- Business Privacy protection
  - clients & suppliers (price, negotiation power, lawyer, …)
  - sources (journalists), …



snowpack | Why people need anonymity ?

- ❑ Personal Privacy protection
  - no targeted advertising, bypassing geo-blocking, …
  - dating, beliefs, sexual orientation, …
  - health (critical condition or disease, addiction…)
- ❑ Business Privacy protection
  - clients & suppliers (price, negotiation power, lawyer, …)
  - sources (journalists), …
- ❑ Human rights
  - Freedom of expression vs. censorship/dictatorship
  - Journalists, Whistleblowers,…

snowpack | Why people need anonymity ?

- ❑ Personal Privacy protection
  - no targeted advertising, bypassing geo-blocking, …
  - dating, beliefs, sexual orientation, …
  - health (critical condition or disease, addiction…)
- ❑ Business Privacy protection
  - clients & suppliers (price, negotiation power, lawyer, …)
  - sources (journalists), …
- ❑ Human rights
  - Freedom of expression vs. censorship/dictatorship
  - Journalists, Whistleblowers,…
- ❑ Other needs
  - Expression
  - Communication
  - Access to information
  - Geolocalization

snowpack | A bit of legal implications

- Privacy & anonymity are fundamental rights
  - Art. 9 Code Civil
  - Art. 8 European Convention on human rights
  - Sapin 2: protection of whistleblowers (with some exceptions)

snowpack | A bit of legal implications

- Privacy & anonymity are fundamental rights
  - Art. 9 Code Civil
  - Art. 8 European Convention on human rights
  - Sapin 2: protection of whistleblowers (with some exceptions)

- **Drawbacks**: espionage, radicalism, terrorism, criminal activities…

snowpack | A bit of legal implications

- ❑Privacy & anonymity are fundamental rights
  - Art. 9 Code Civil
  - Art. 8 European Convention on human rights
  - Sapin 2: protection of whistleblowers (with some exceptions)

- ❑**Drawbacks**: espionage, radicalism, terrorism, criminal activities…

- ❑Cannot be really “no log” for individuals ! Hopefully ?!
- ❑Legal Interception → Justice request
  - 15 days in Europe
  - 1 year in France

snowpack | A bit of legal implications

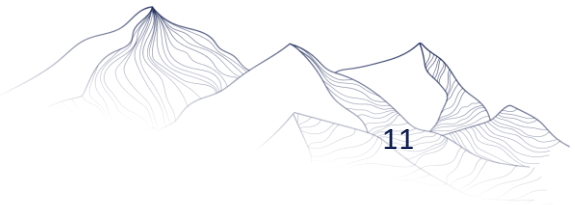
- Privacy & anonymity are fundamental rights
  - Art. 9 Code Civil
  - Art. 8 European Convention on human rights
  - Sapin 2: protection of whistleblowers (with some exceptions)

- **Drawbacks**: espionage, radicalism, terrorism, criminal activities…

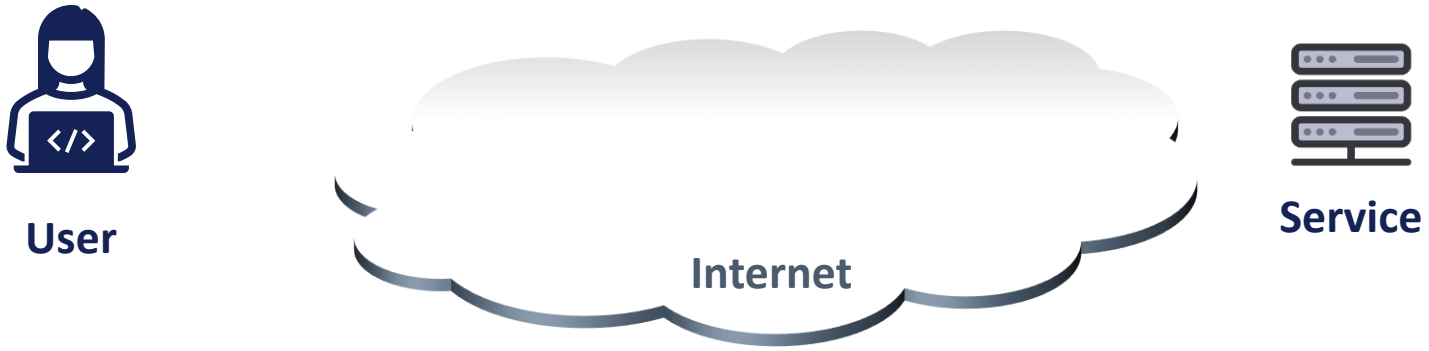
- Cannot be really “no log” for individuals ! Hopefully ?!
- Legal Interception → Justice request
  - 15 days in Europe
  - 1 year in France

- Alternatives generally used: mix of solutions under several legislation or geography to make really complex law application

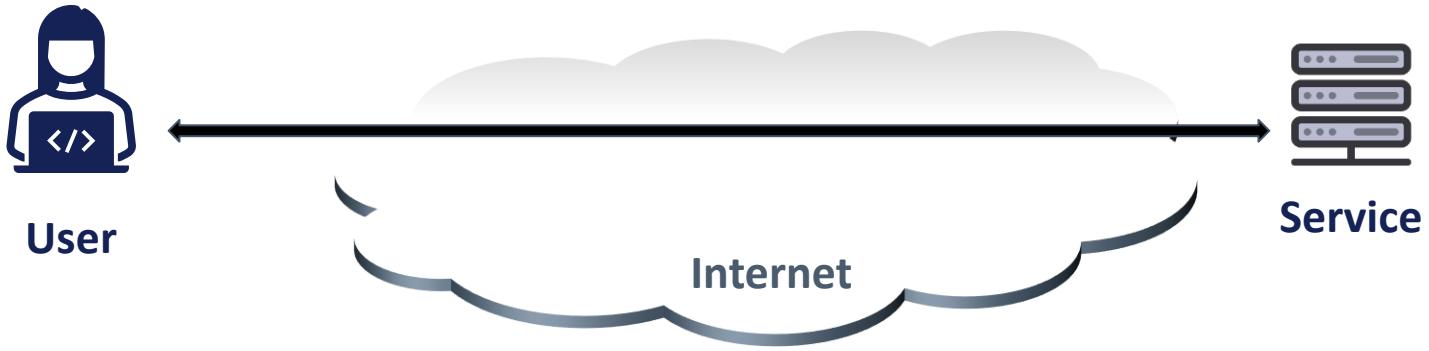
From classical networking to Anonymity Networks Problem



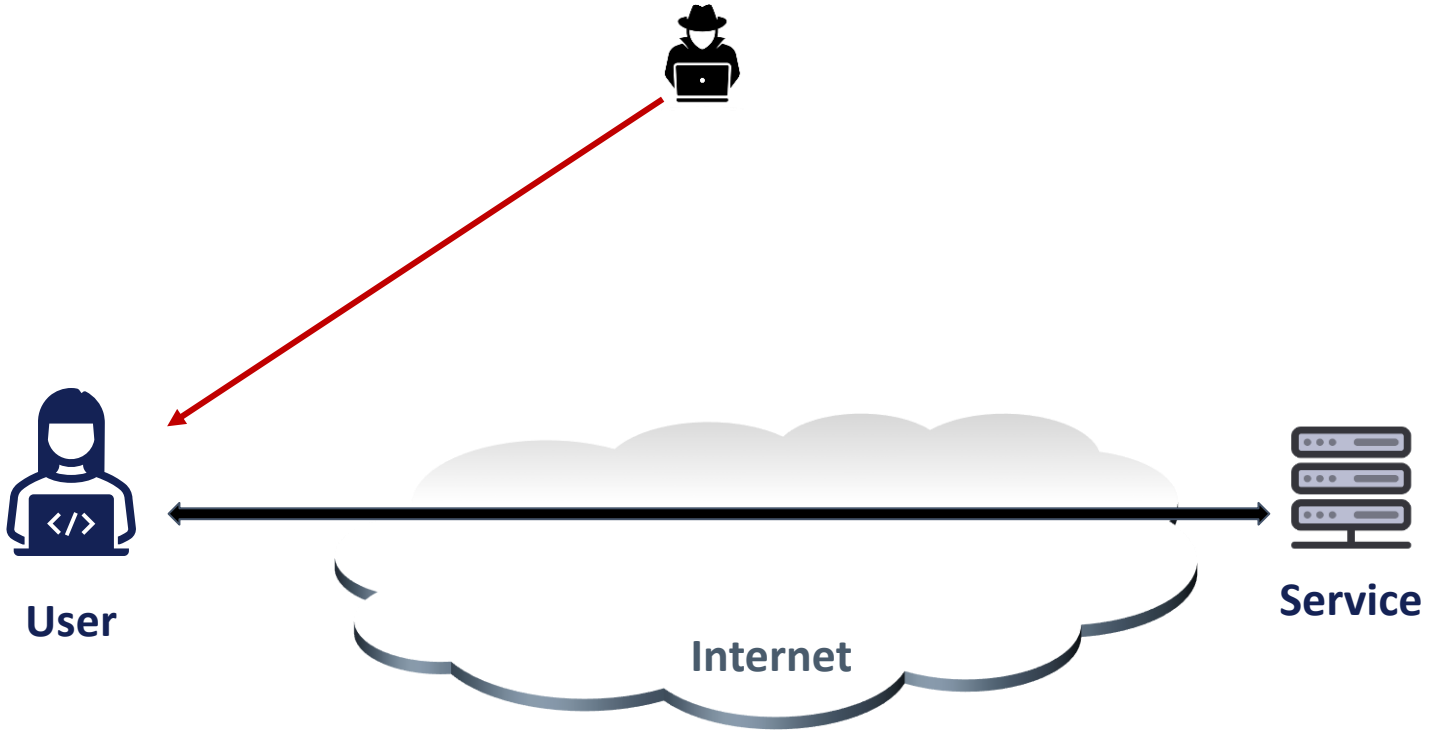
From classical networking to Anonymity Networks Problem



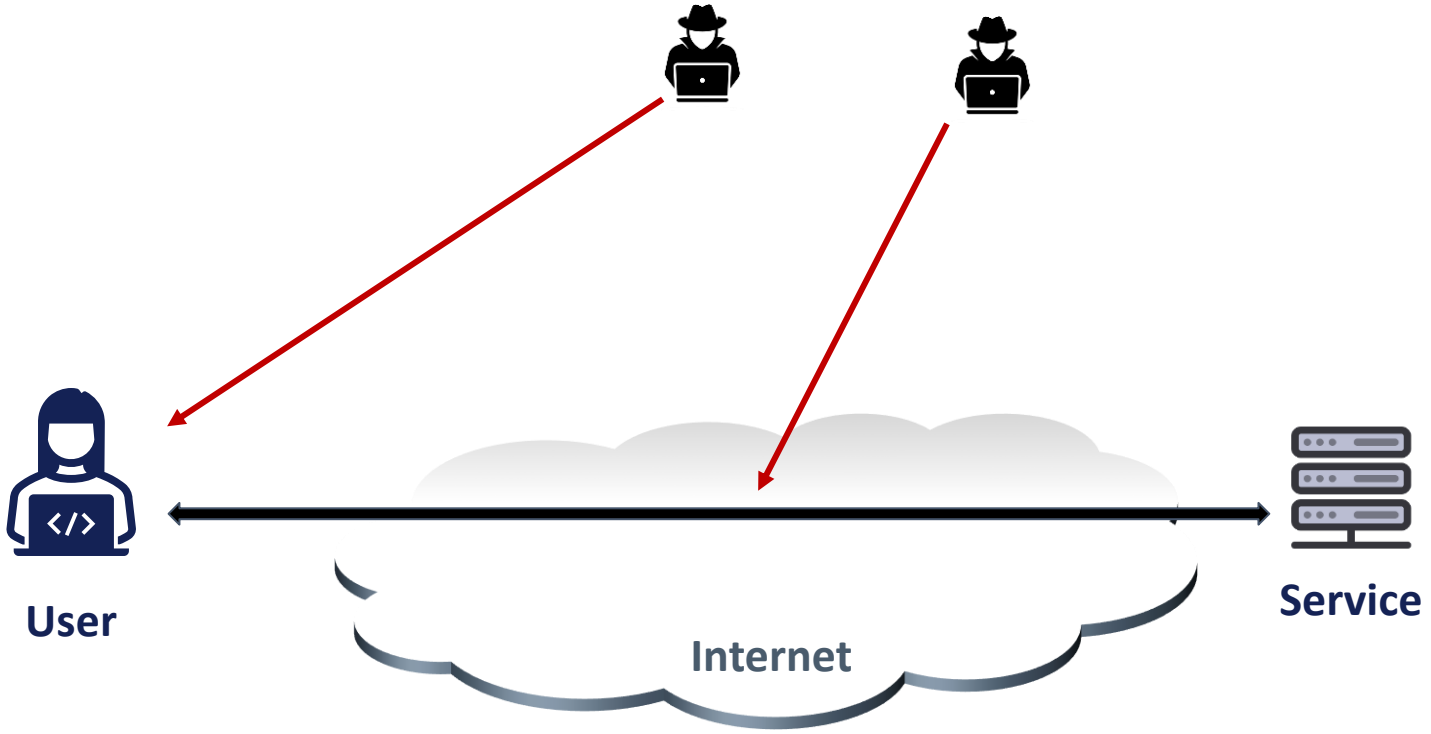
From classical networking to Anonymity Networks Problem



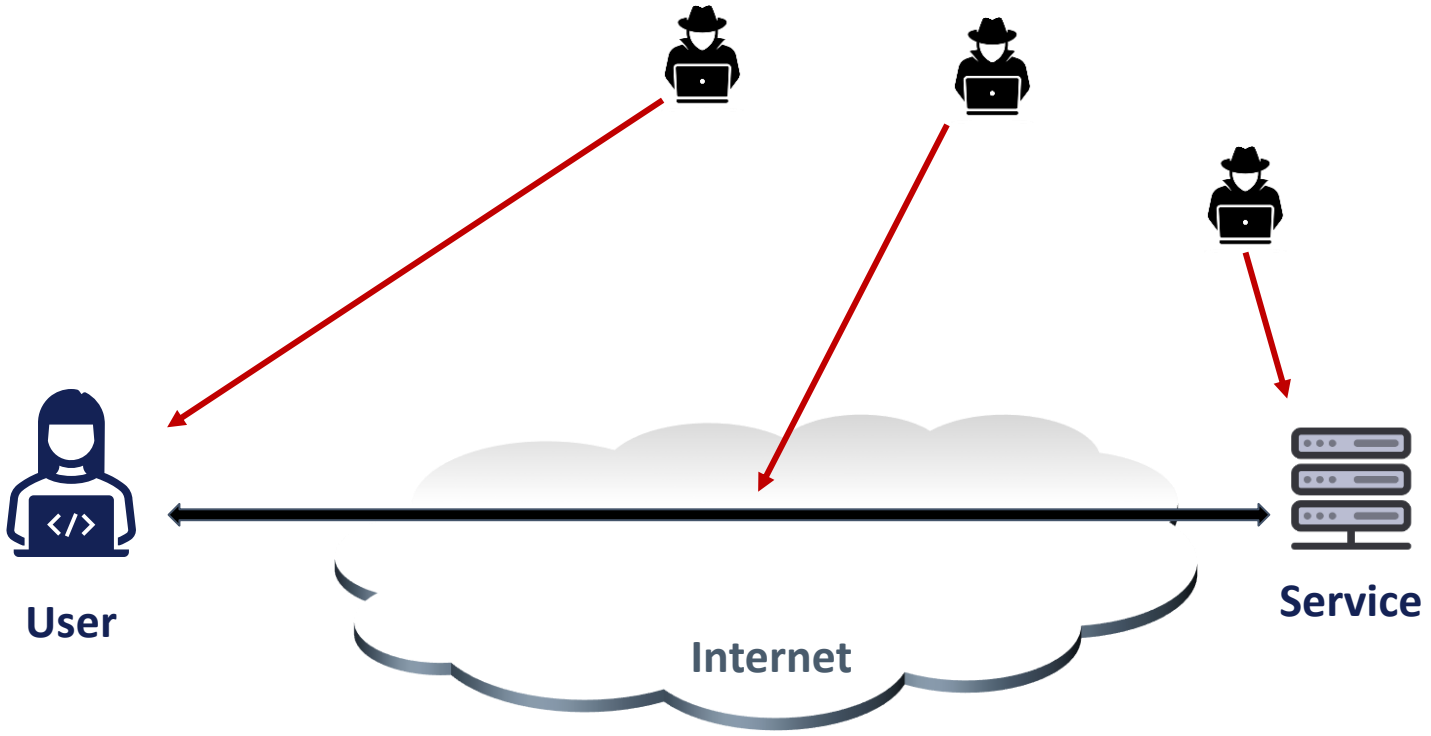
From classical networking to Anonymity Networks Problem



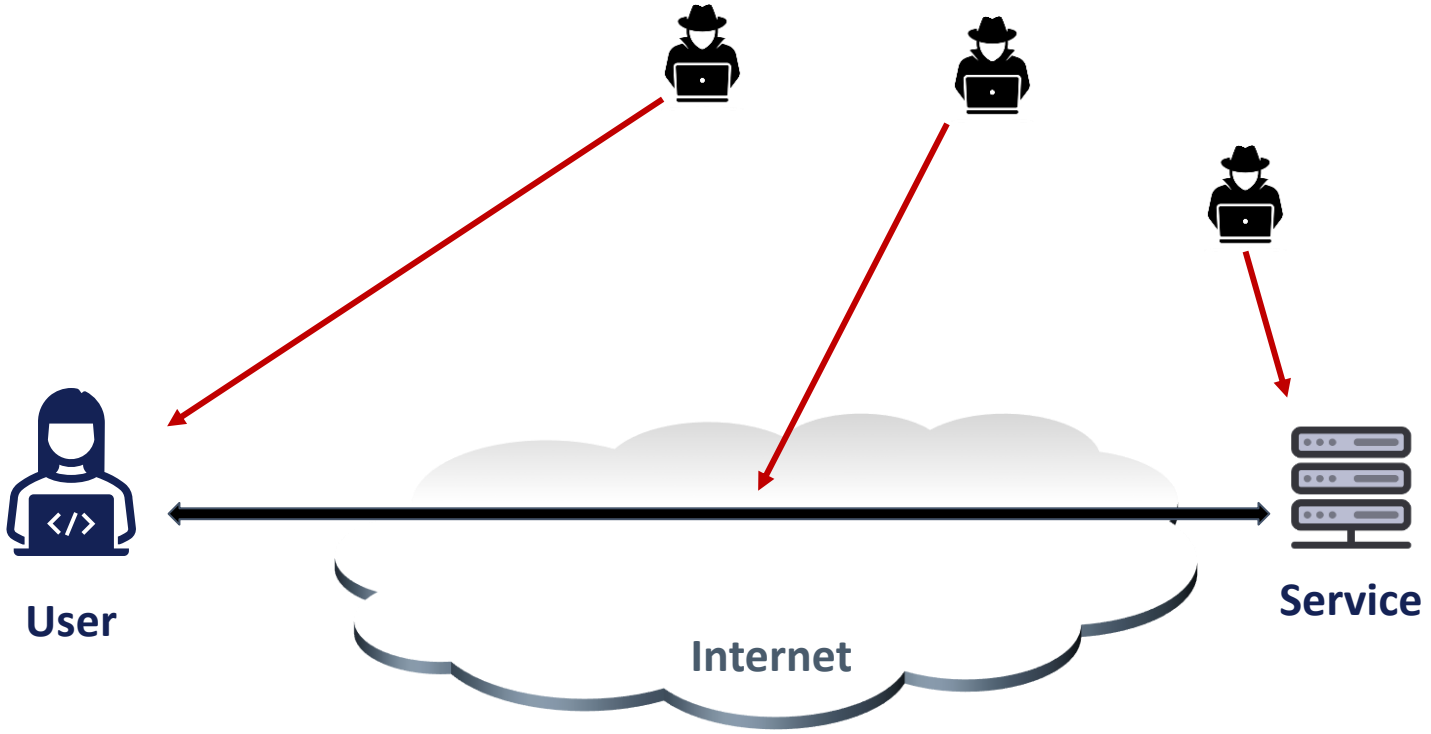
From classical networking to Anonymity Networks Problem



From classical networking to Anonymity Networks Problem

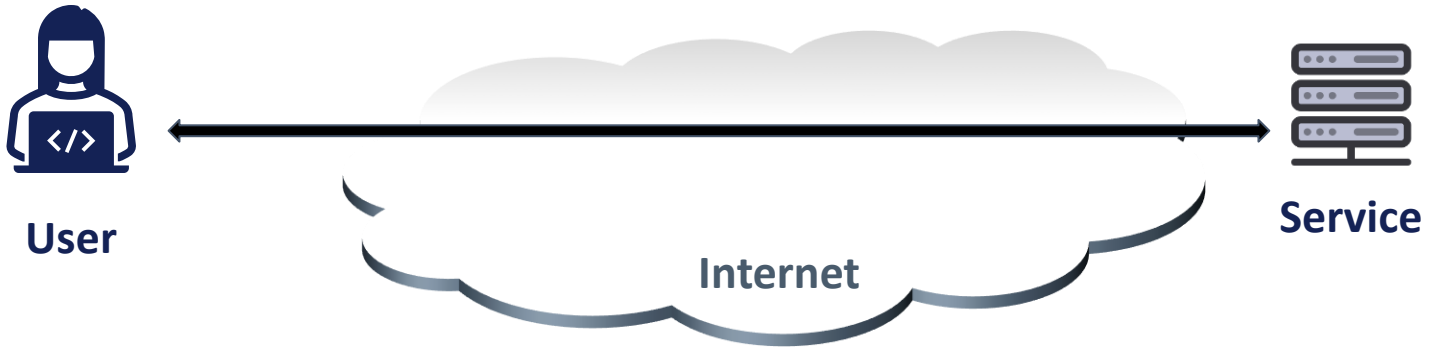


From classical networking to Anonymity Networks Problem

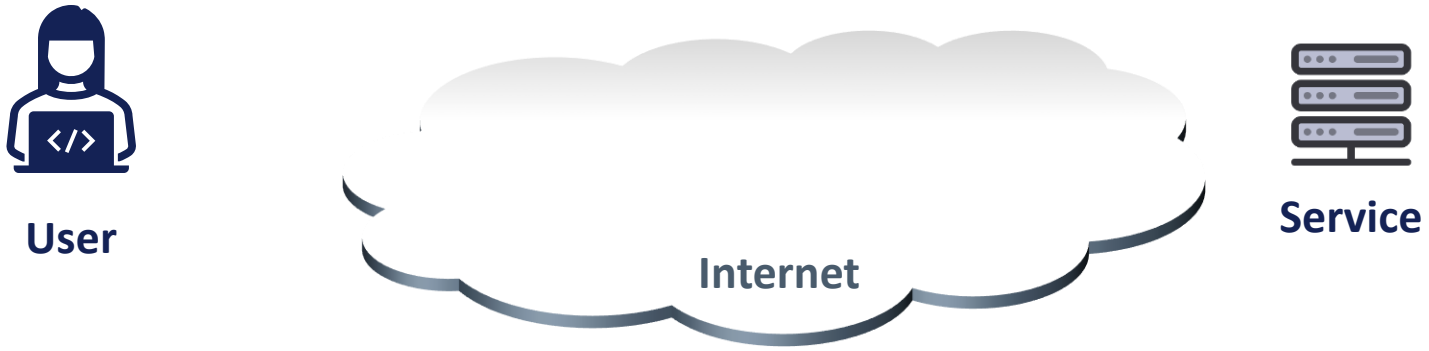


How to make User, Service and their data Unlinkable and Invisible ?

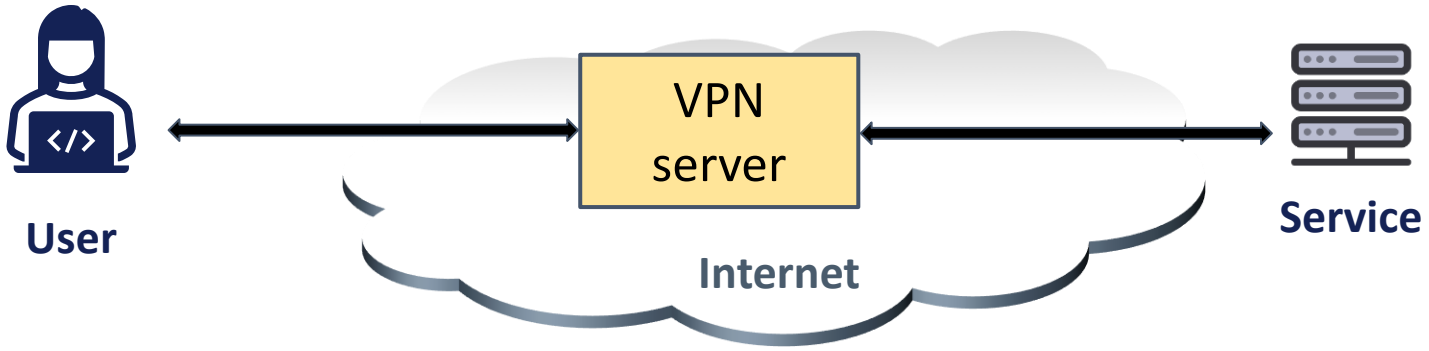
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



From classical networking to Anonymity Networks
VPN solution & vulnerabilities

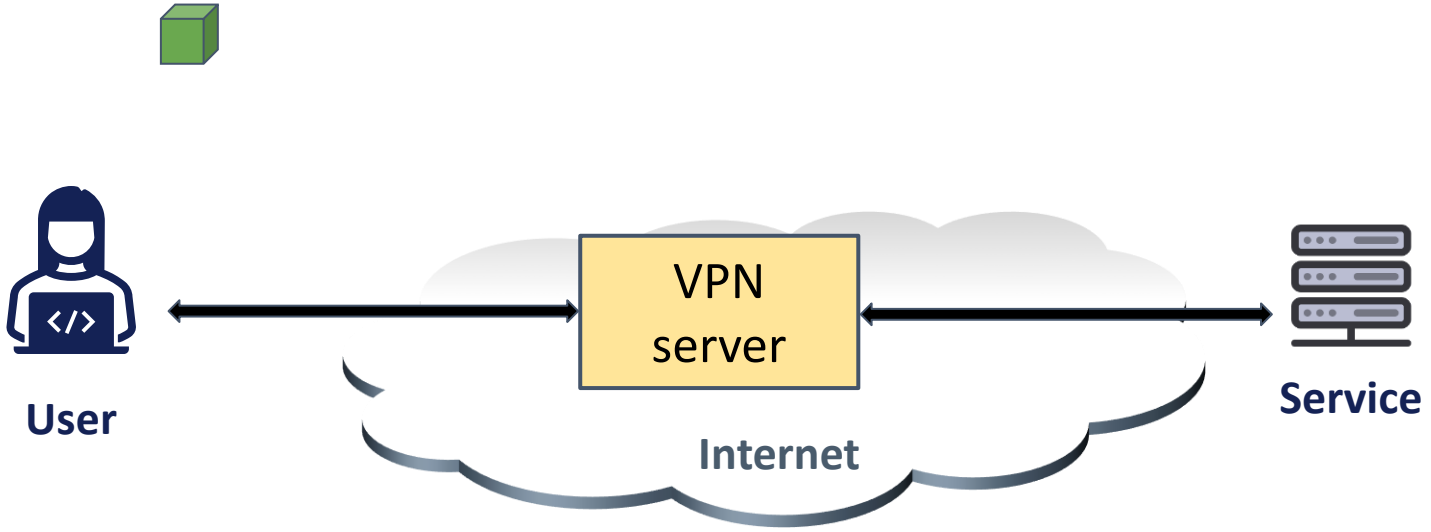


From classical networking to Anonymity Networks
VPN solution & vulnerabilities

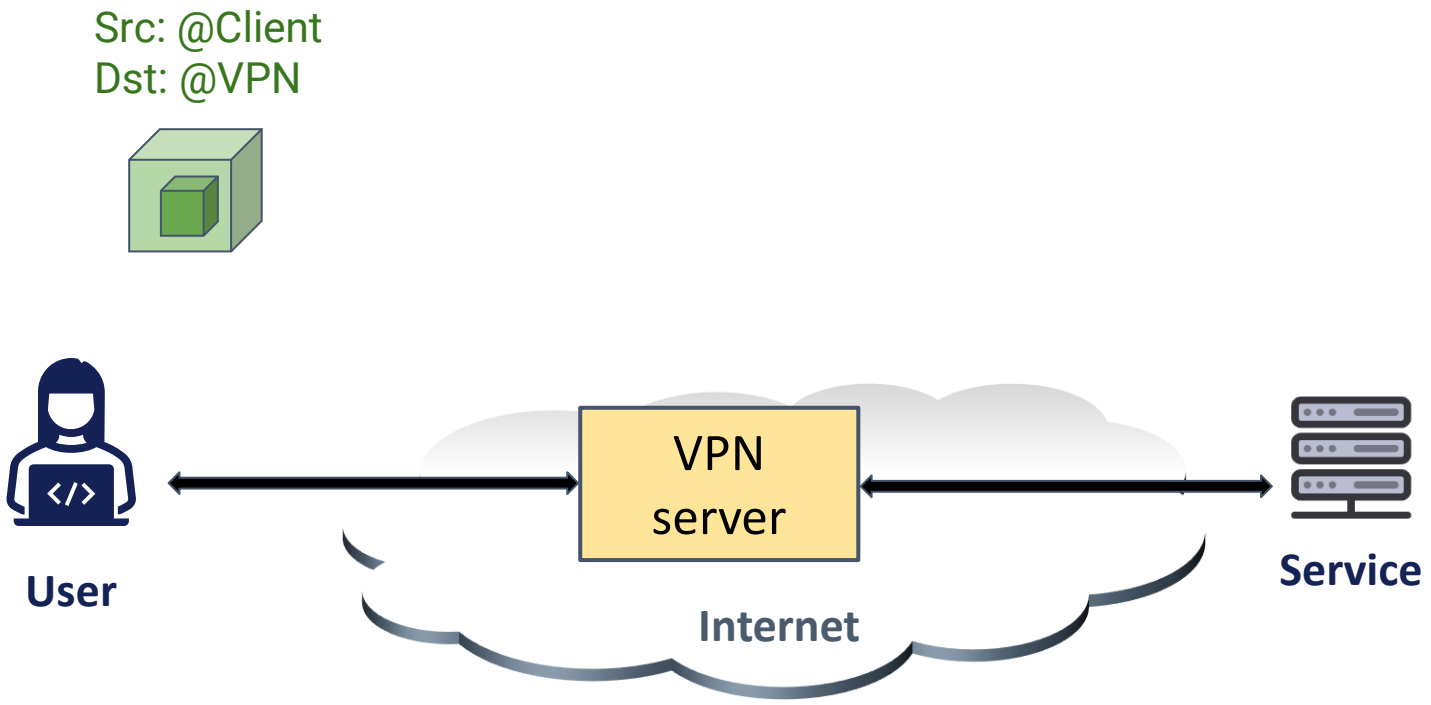


From classical networking to Anonymity Networks
VPN solution & vulnerabilities

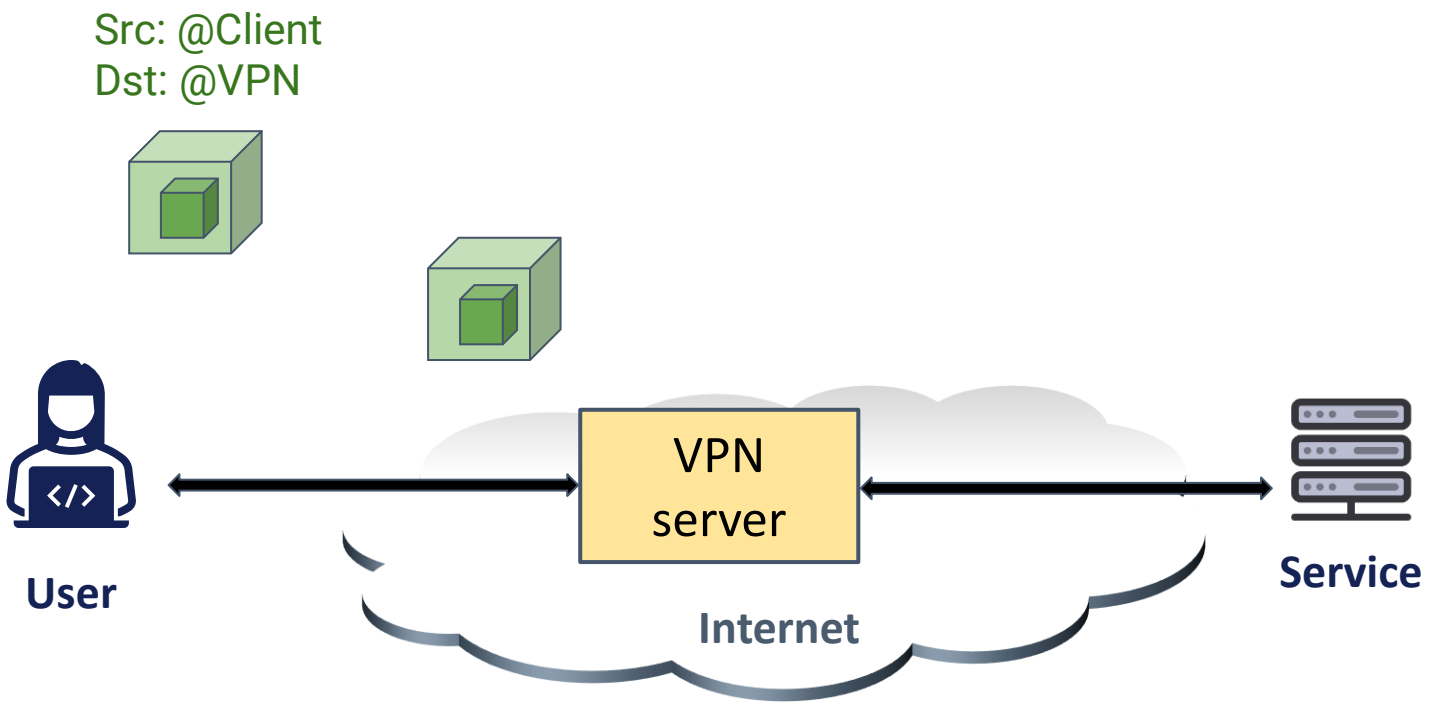
Src: @Client
Dst: @Service



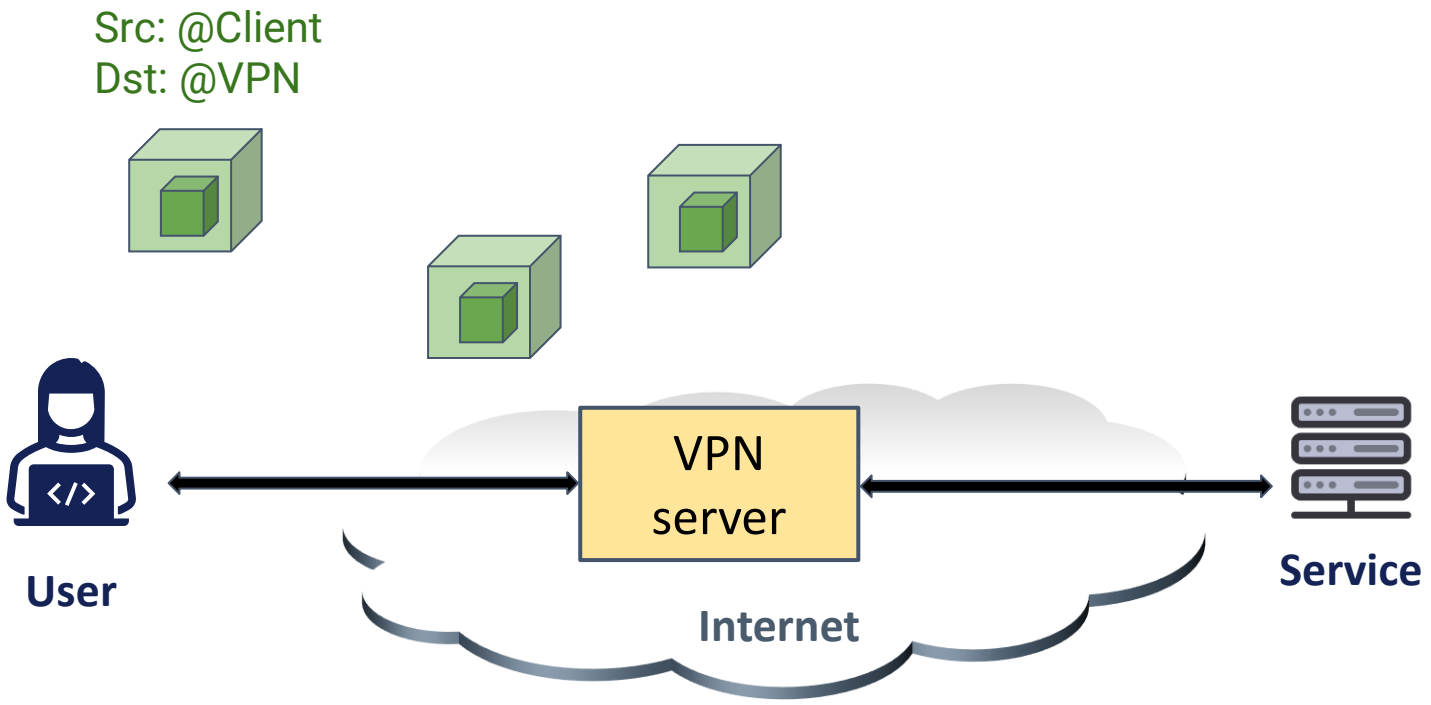
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



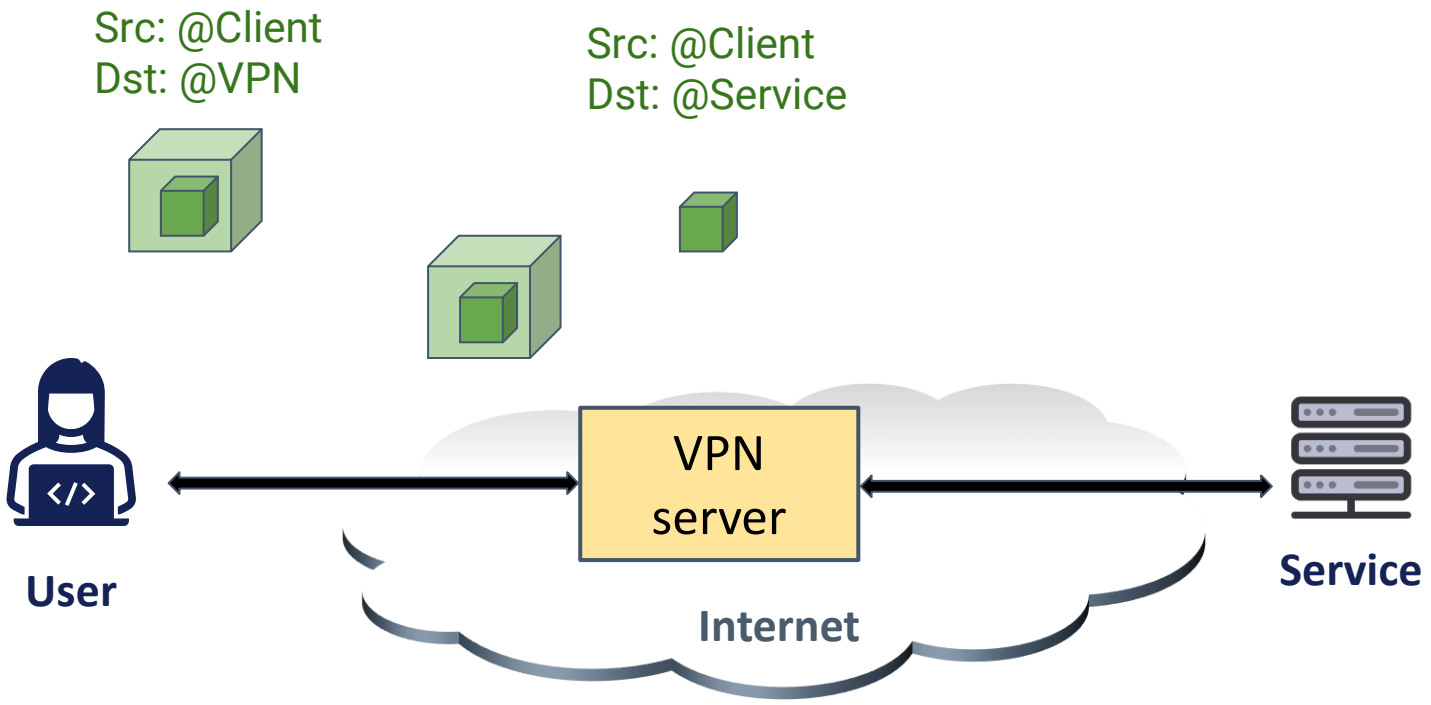
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



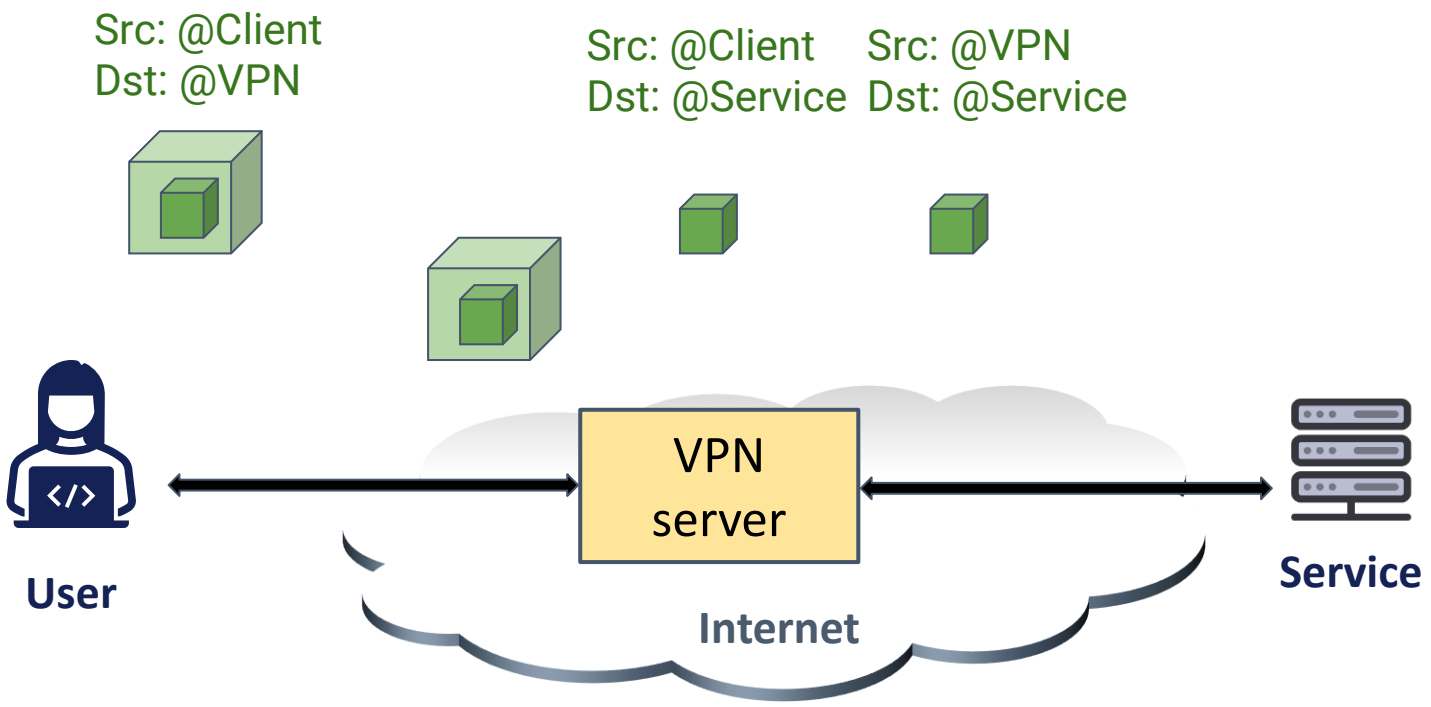
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



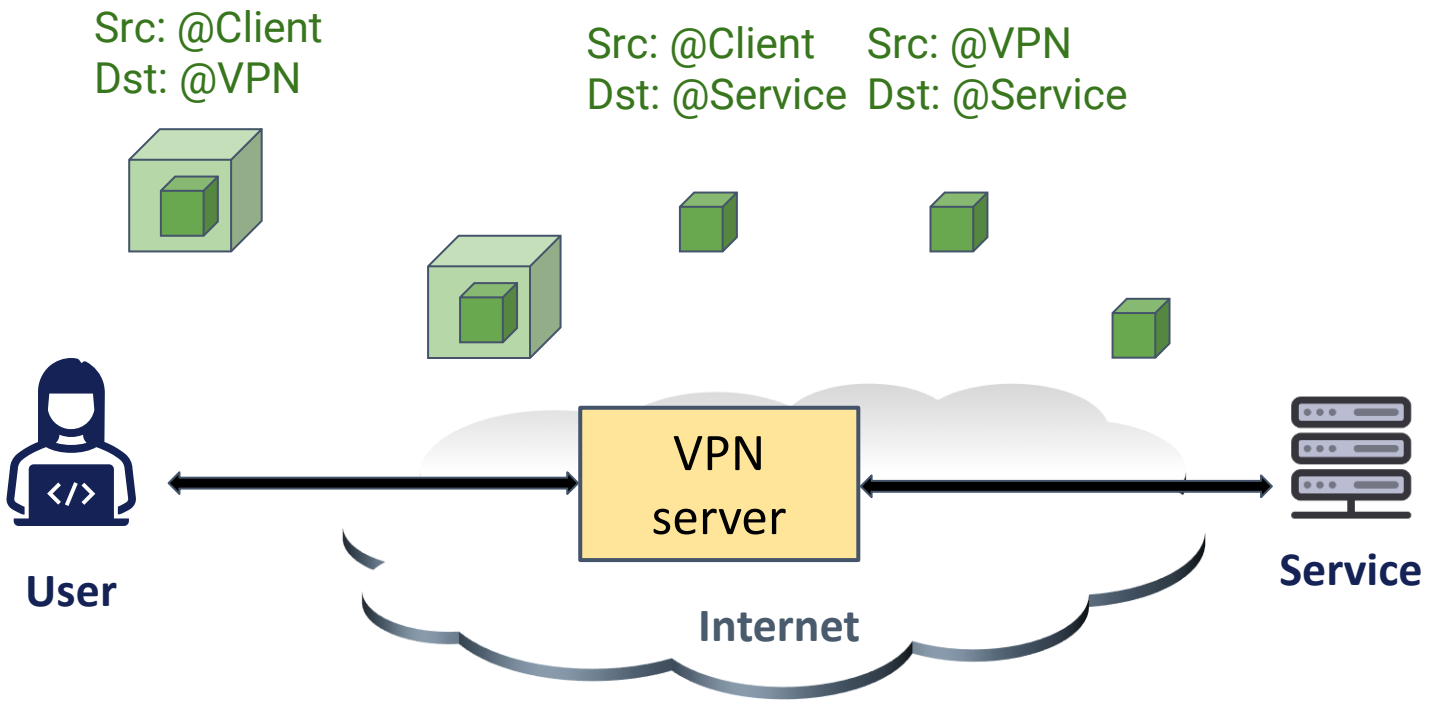
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



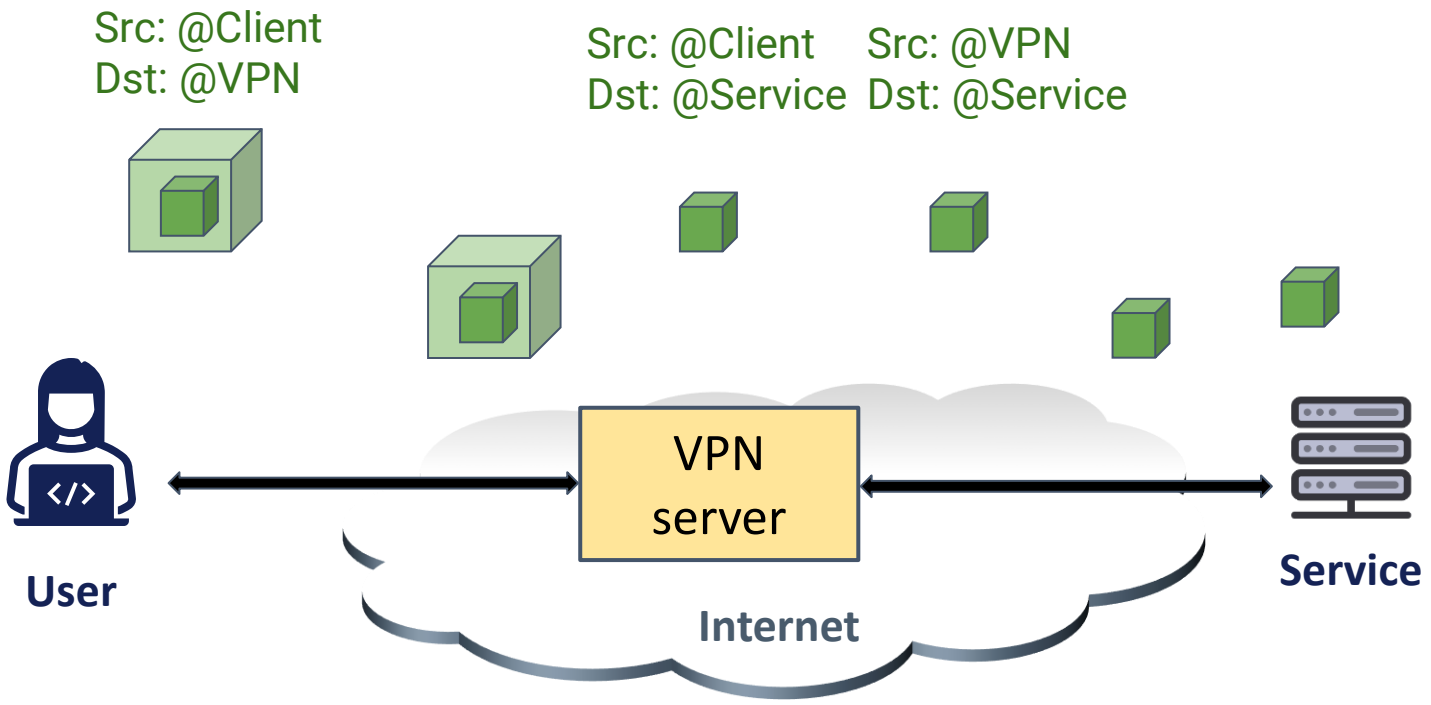
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



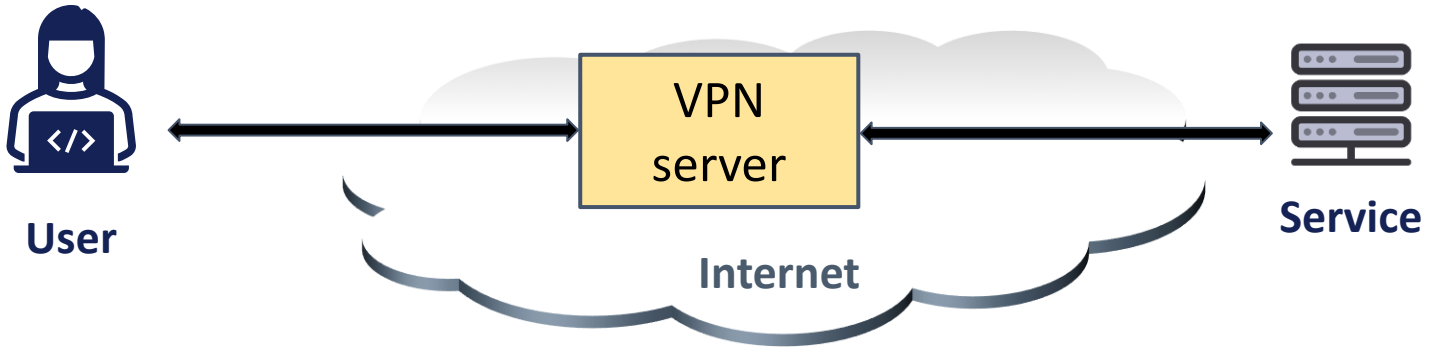
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



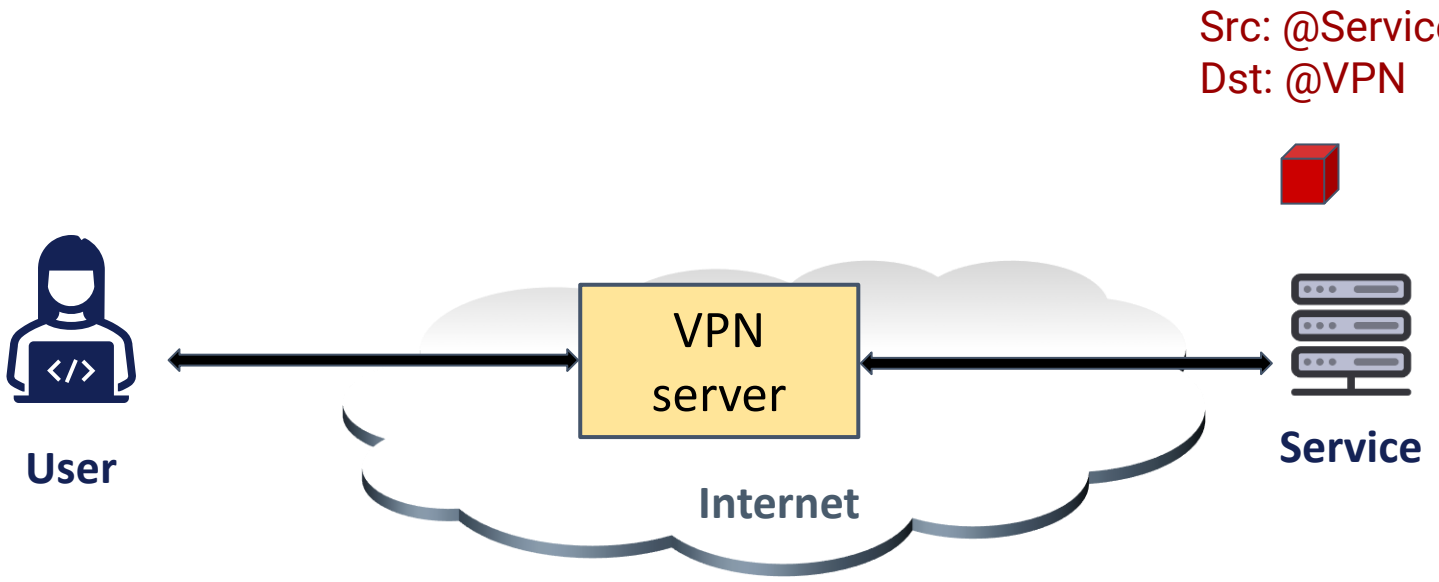
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



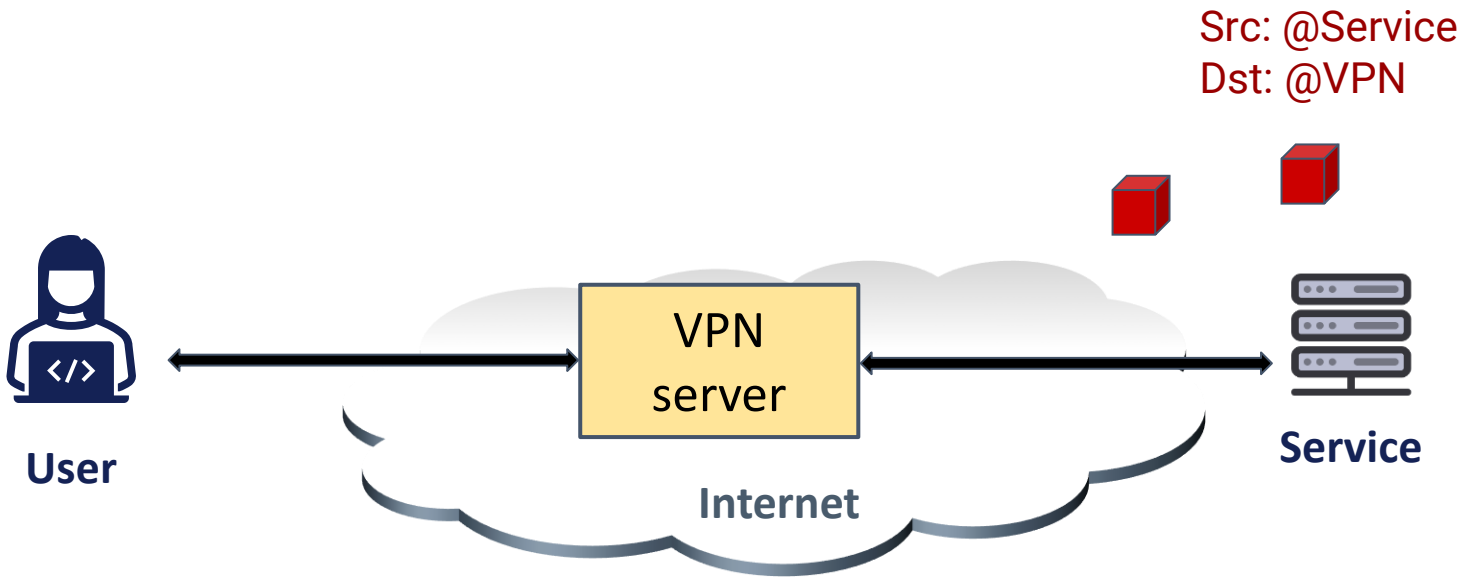
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



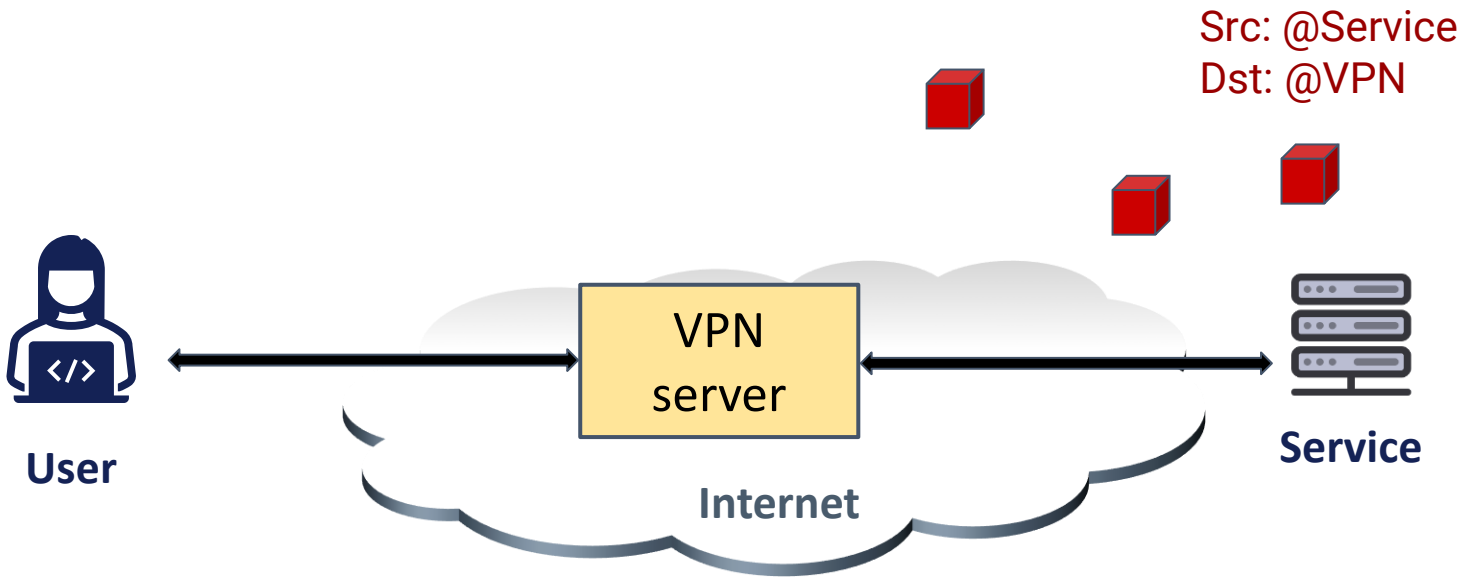
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



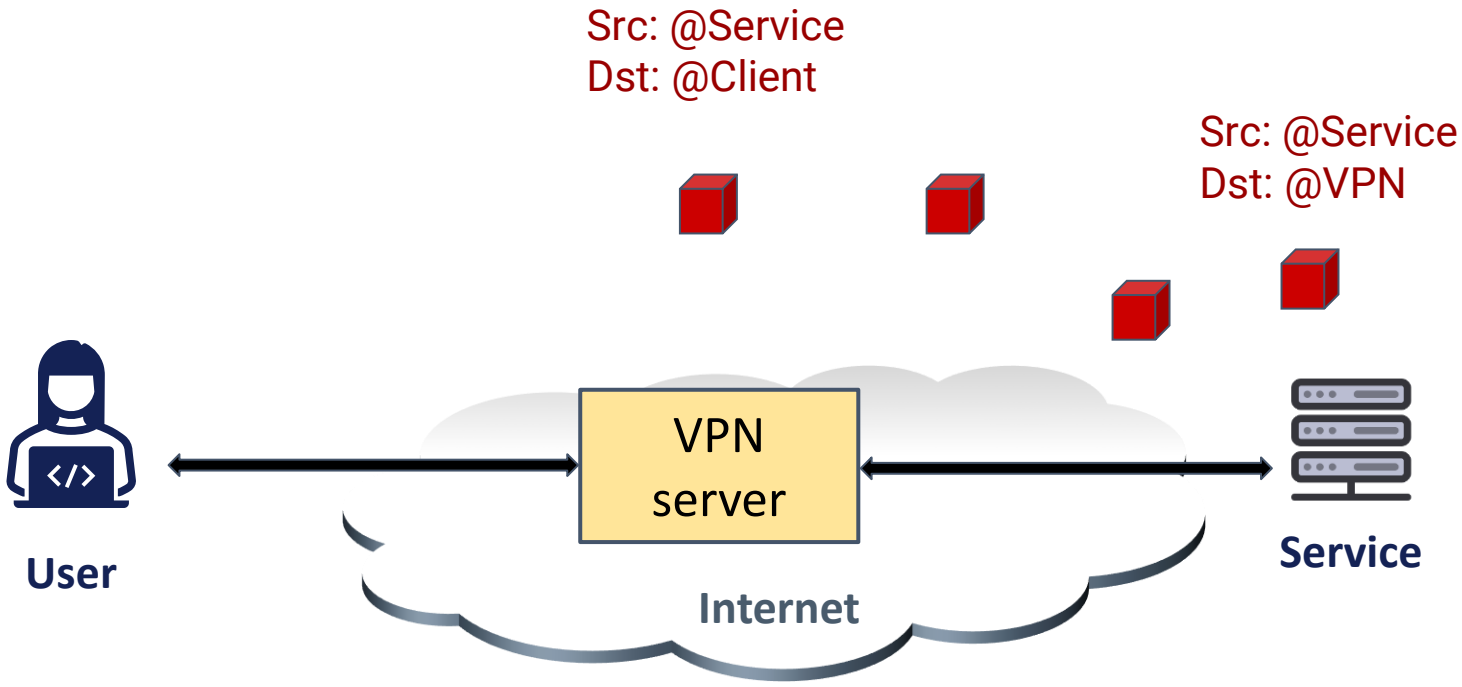
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



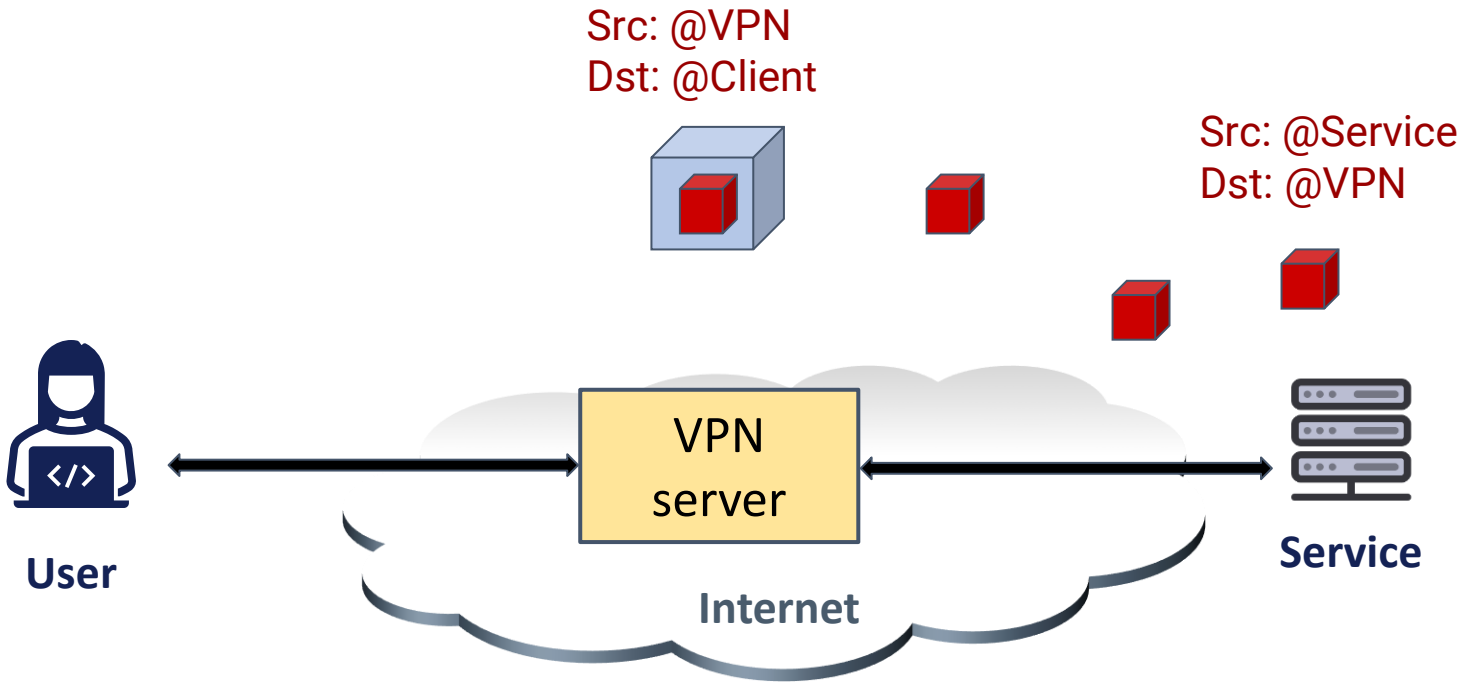
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



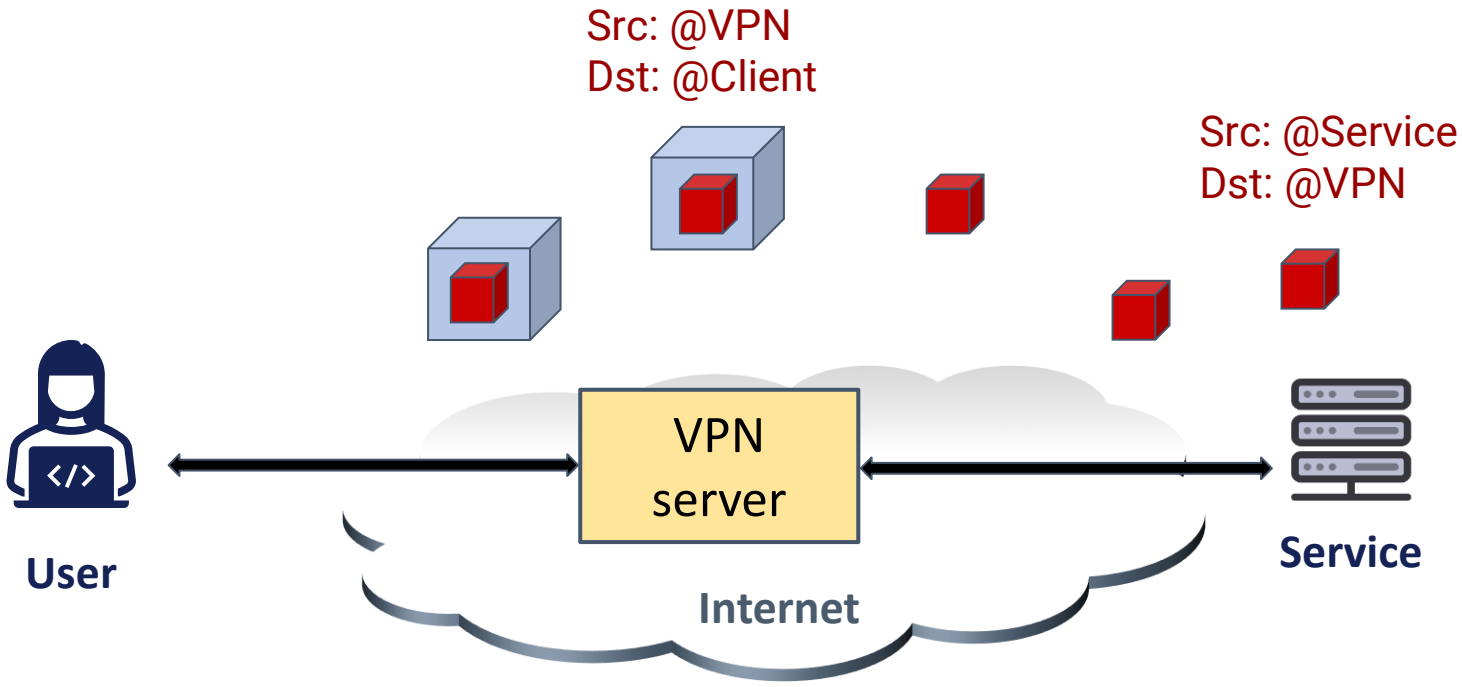
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



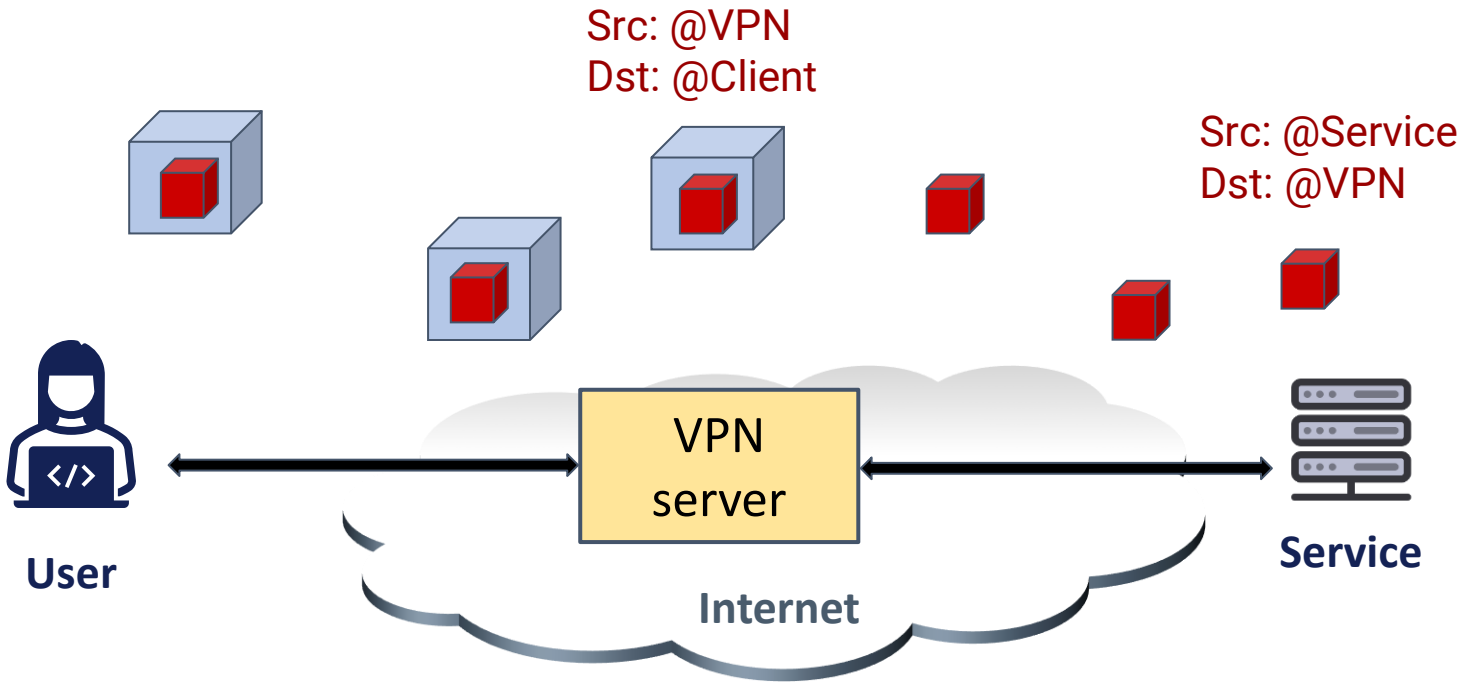
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



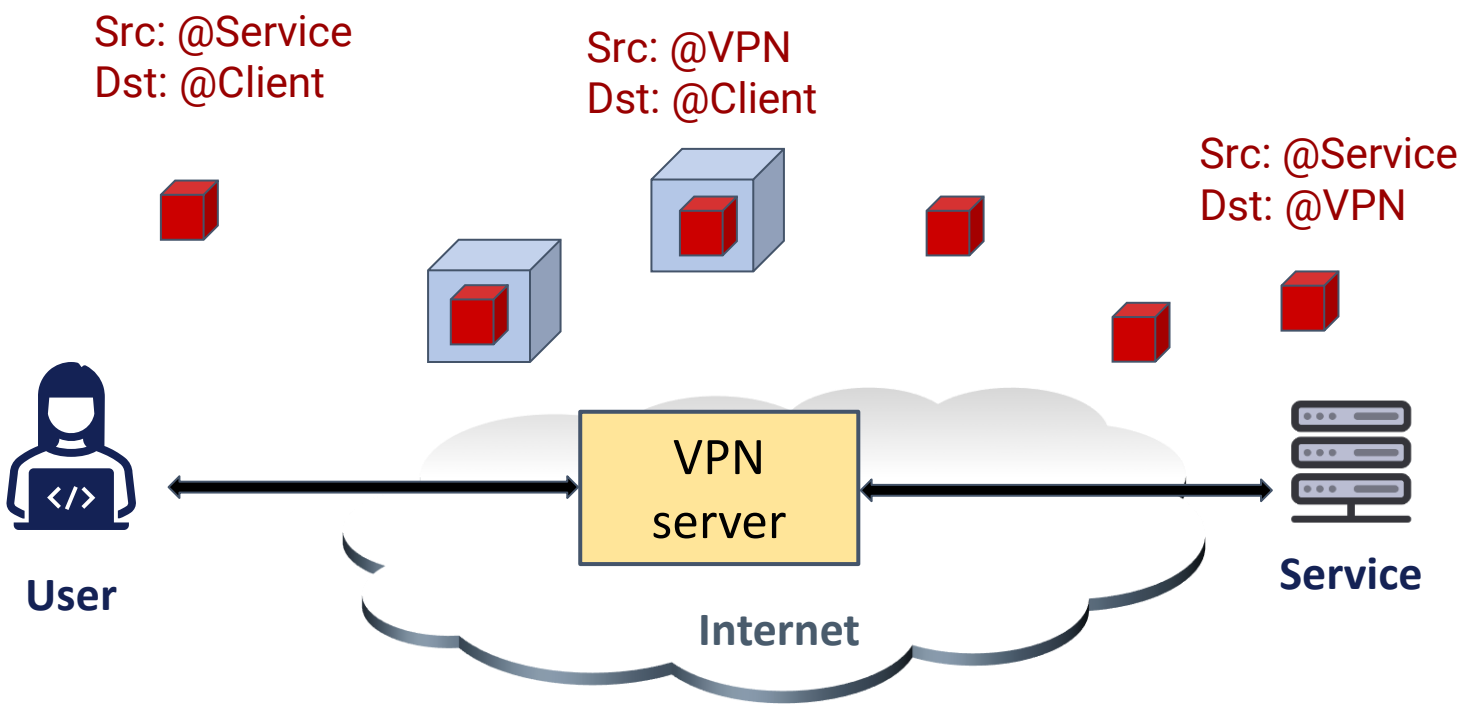
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



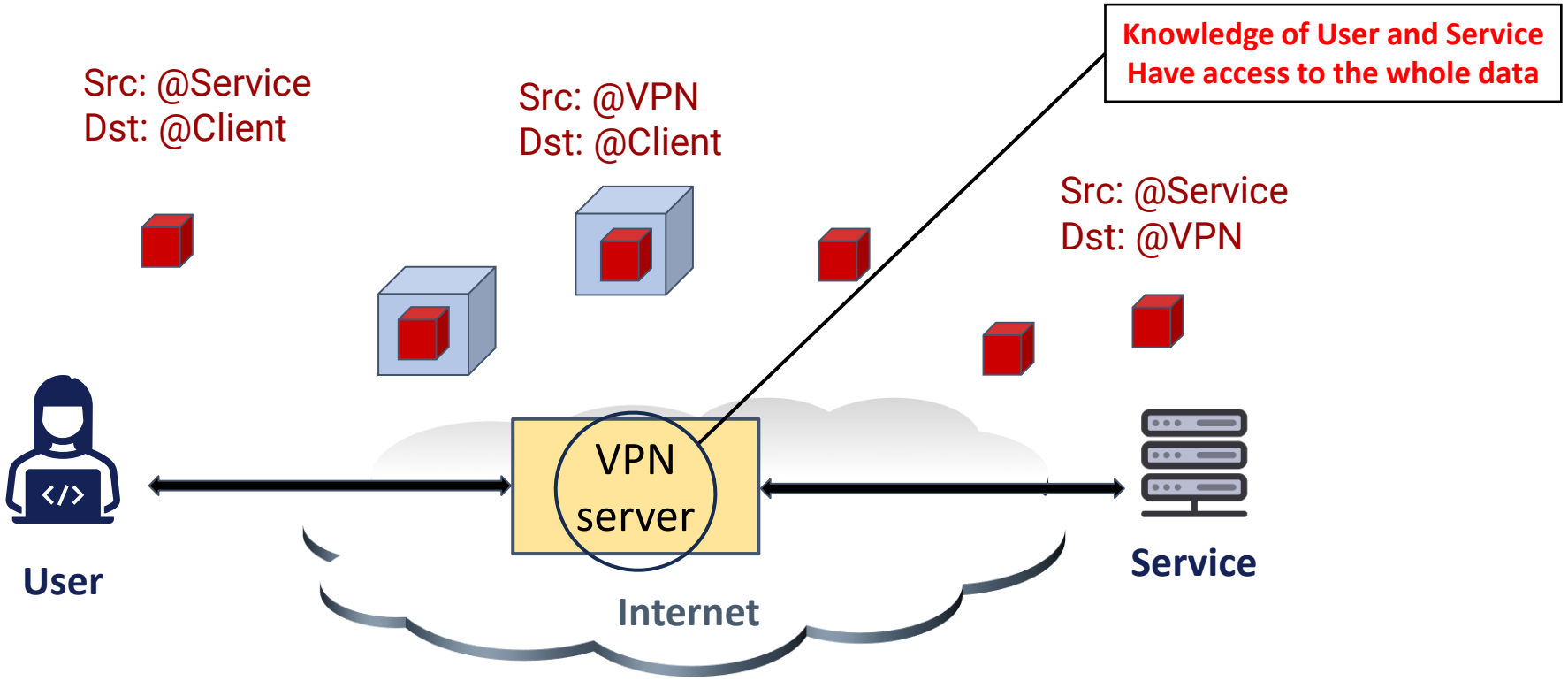
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



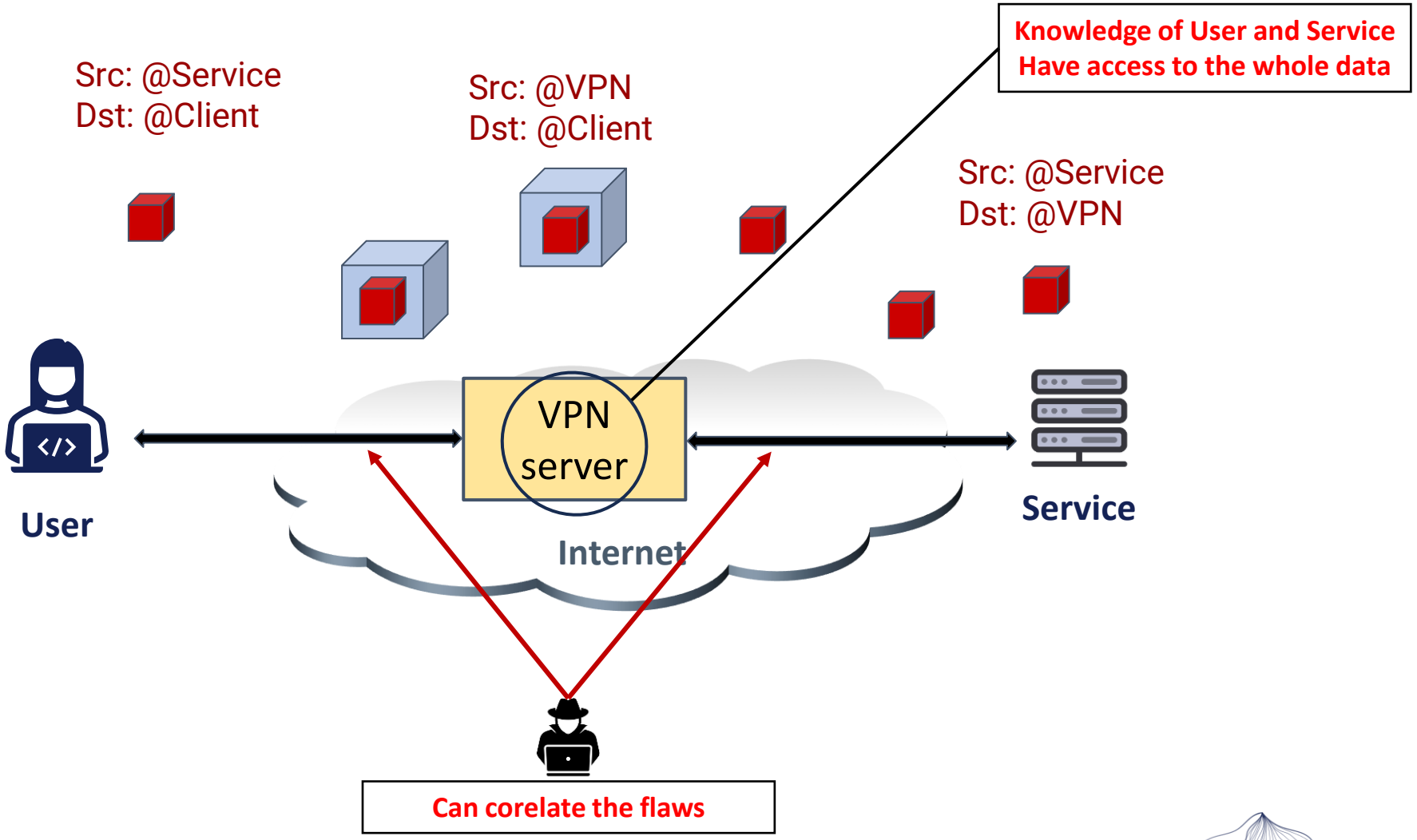
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



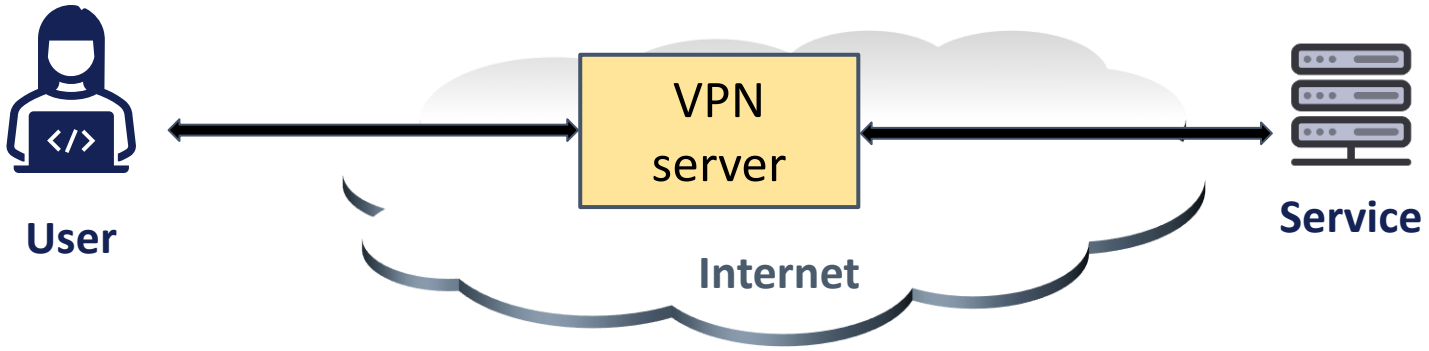
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



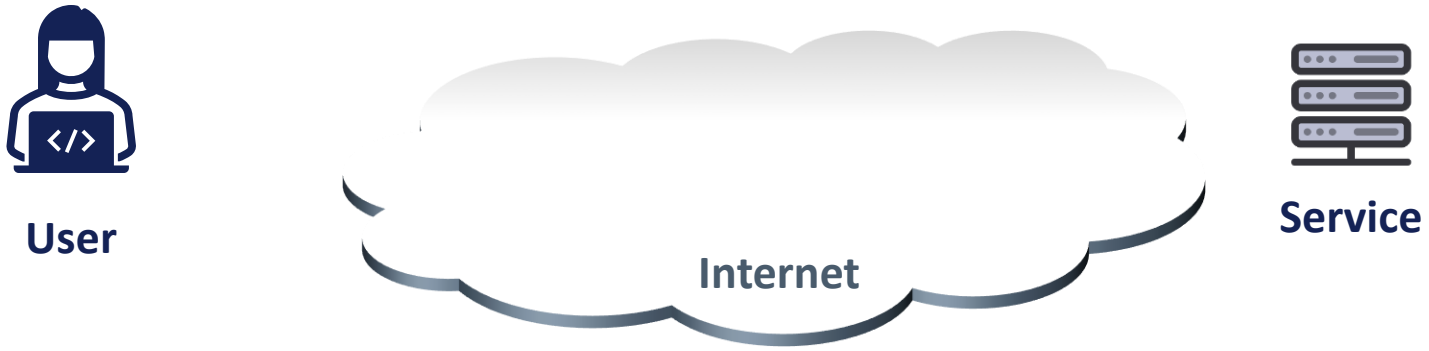
From classical networking to Anonymity Networks
VPN solution & vulnerabilities



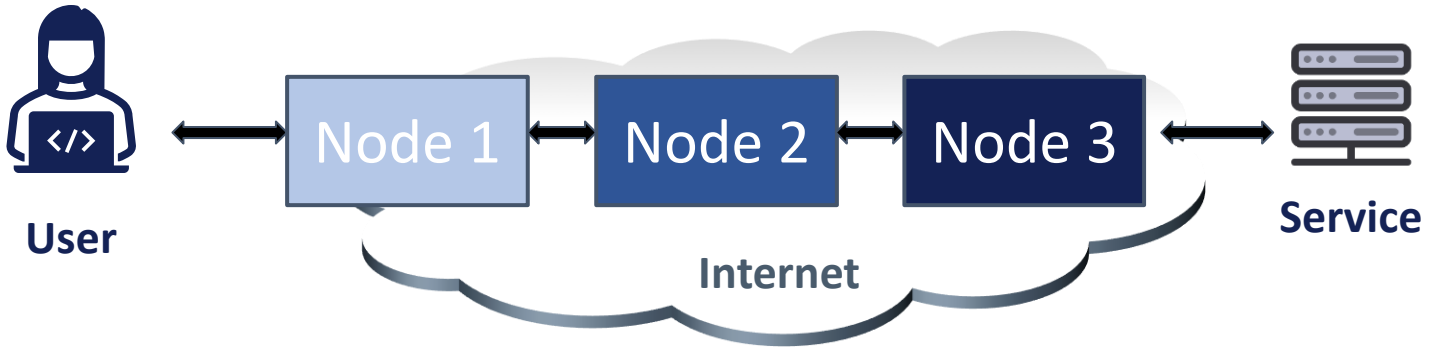
From classical networking to Anonymity Networks
Onion routing vulnerabilities



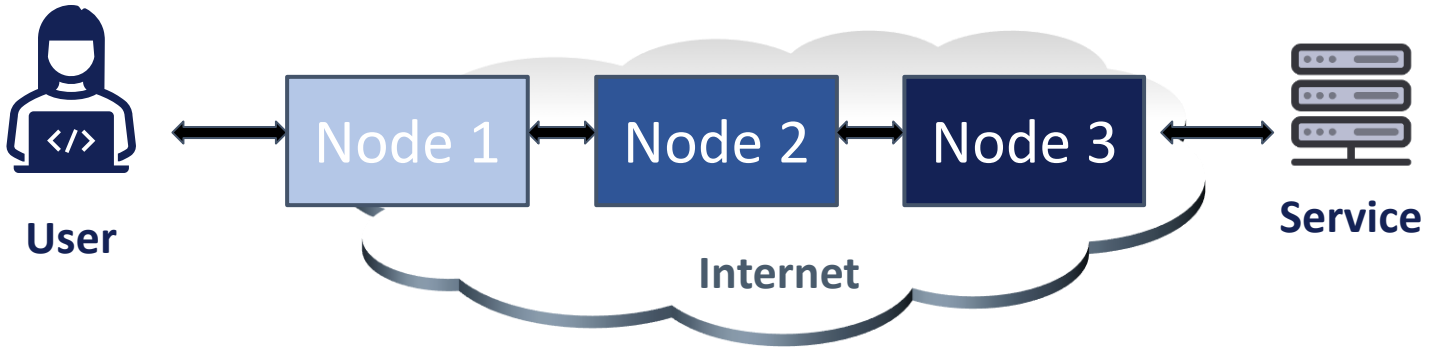
From classical networking to Anonymity Networks
Onion routing vulnerabilities



From classical networking to Anonymity Networks
Onion routing vulnerabilities



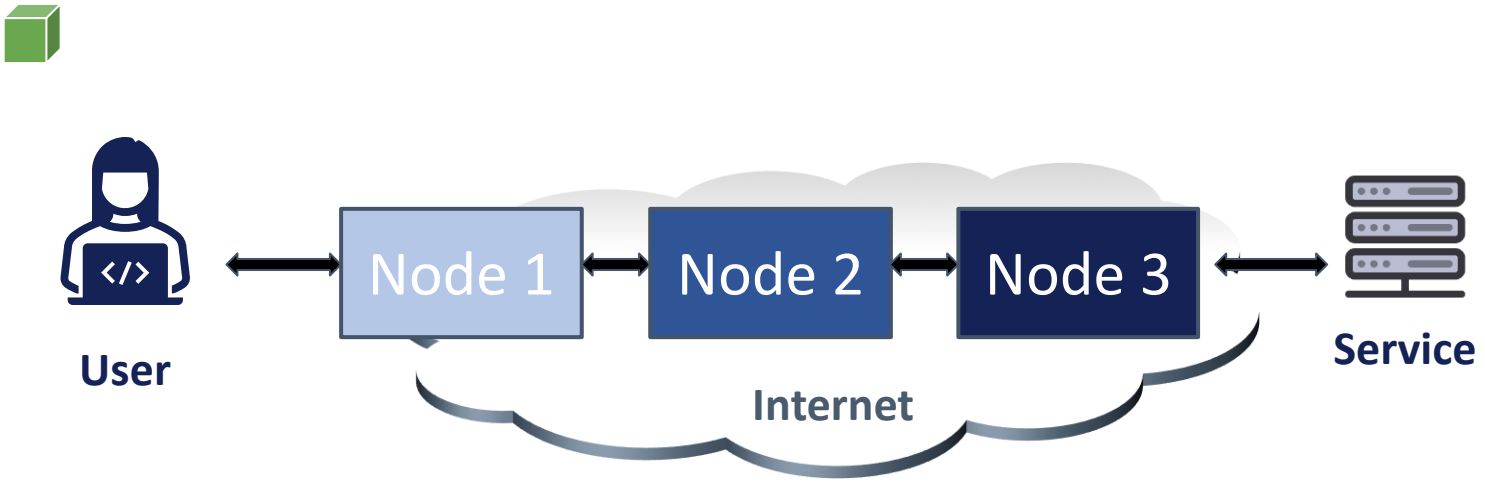
From classical networking to Anonymity Networks
Onion routing vulnerabilities



: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities

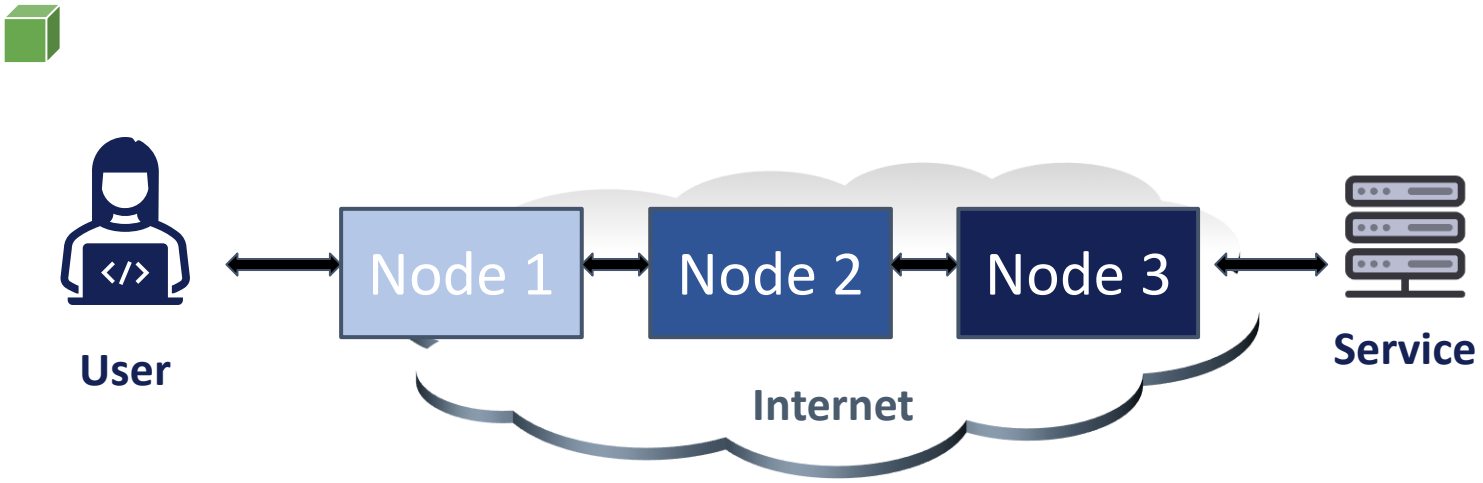
Src: @Client
Dst: @Service



: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities

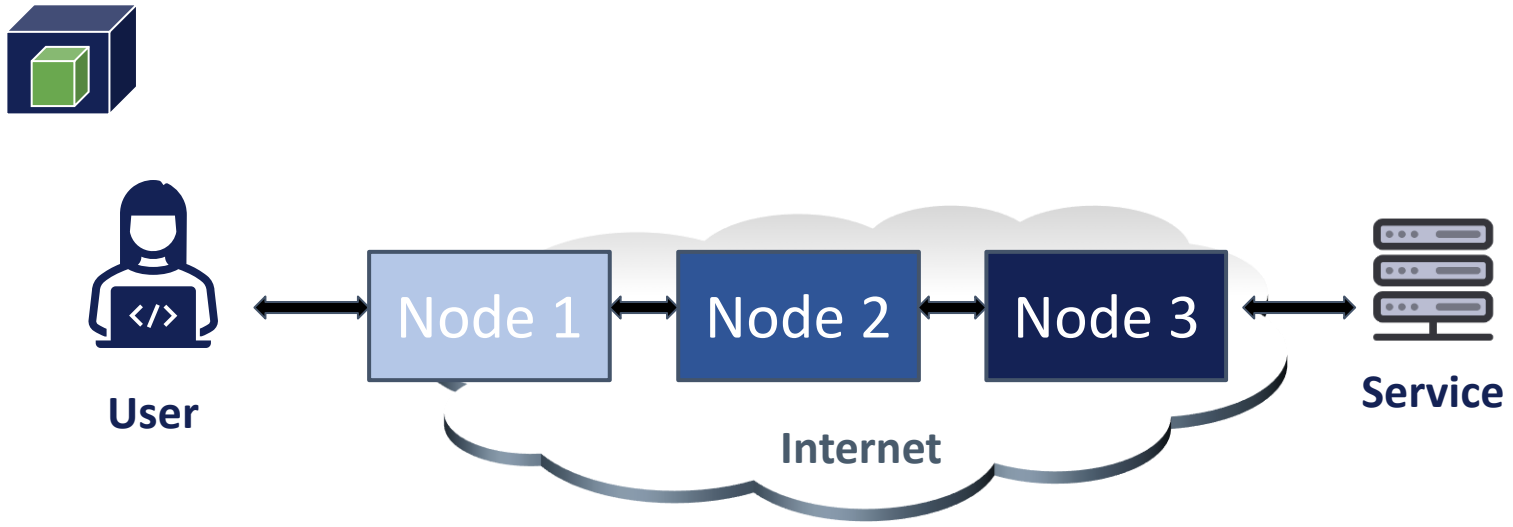
Src:
Dst: @Service



: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities

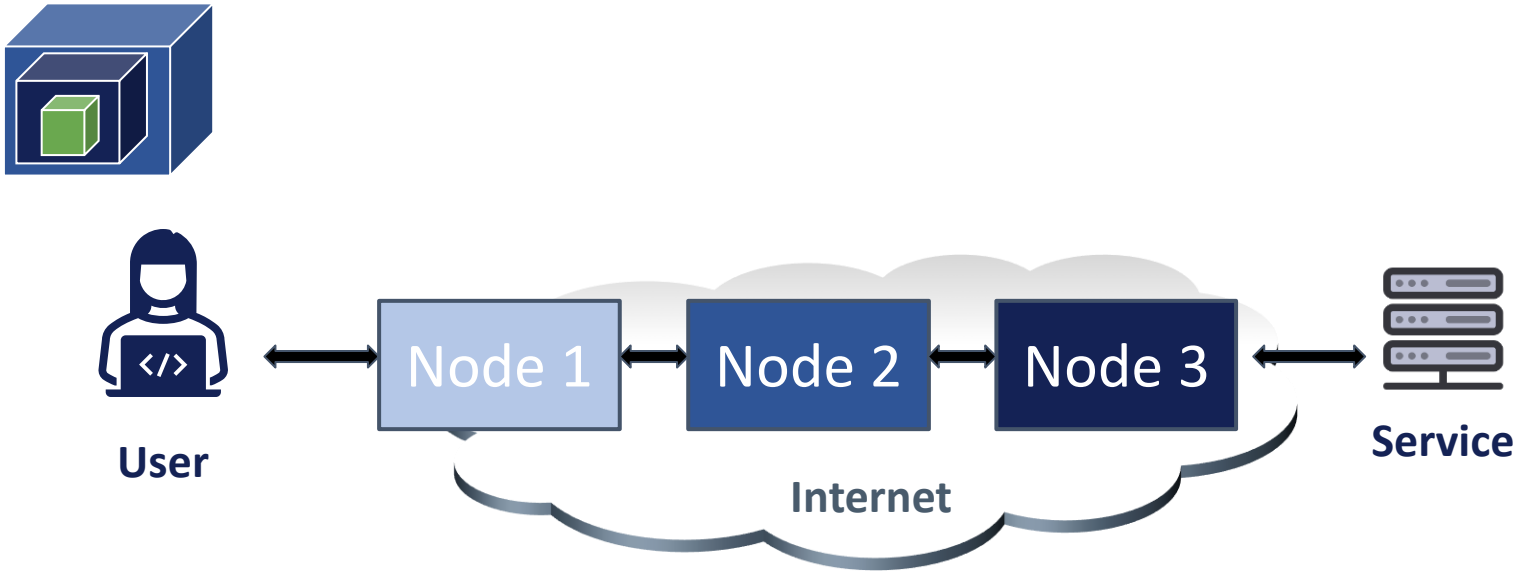
Src:
Dst: @Service



: Packet emitted

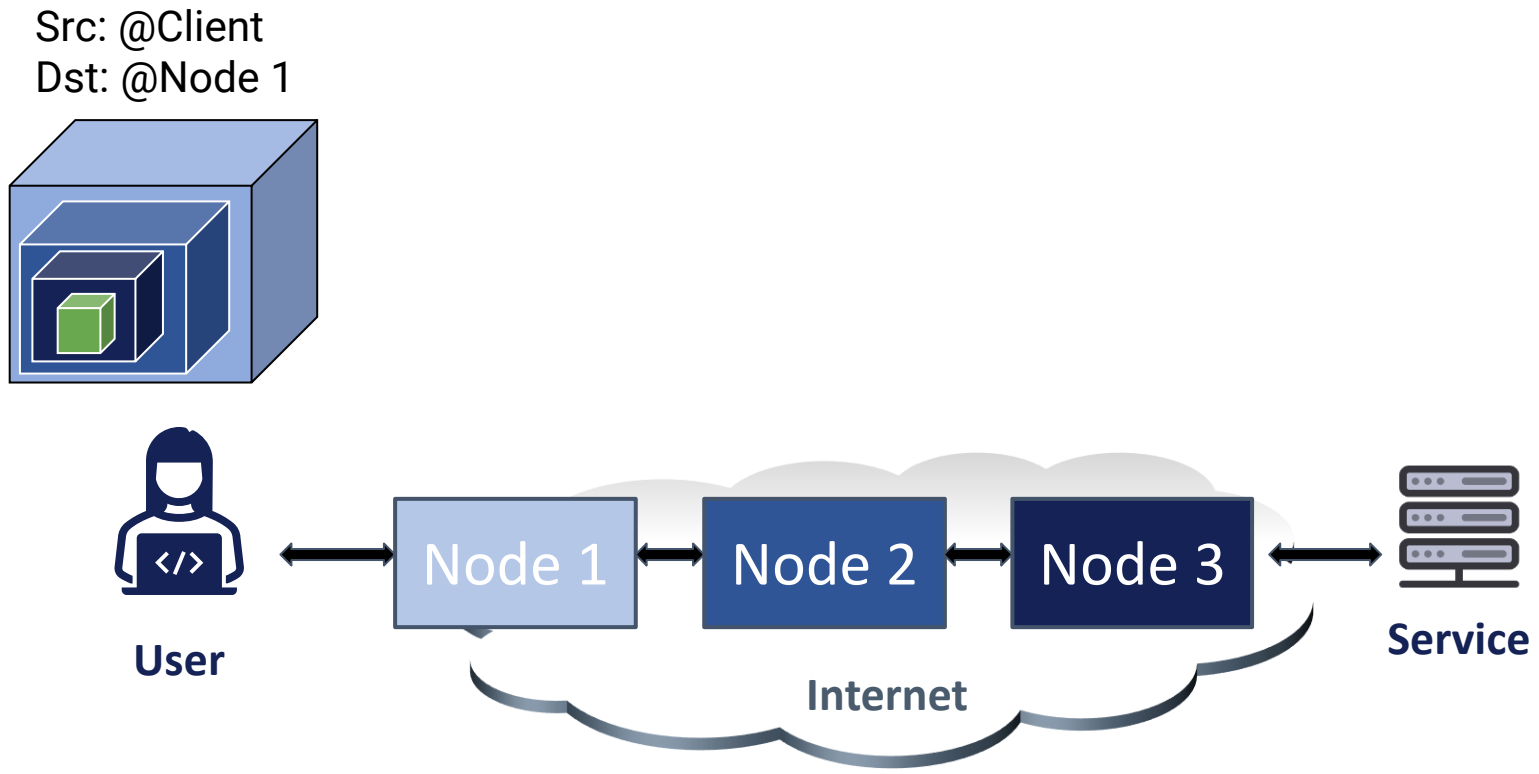
From classical networking to Anonymity Networks
Onion routing vulnerabilities

Src:
Dst: @Service



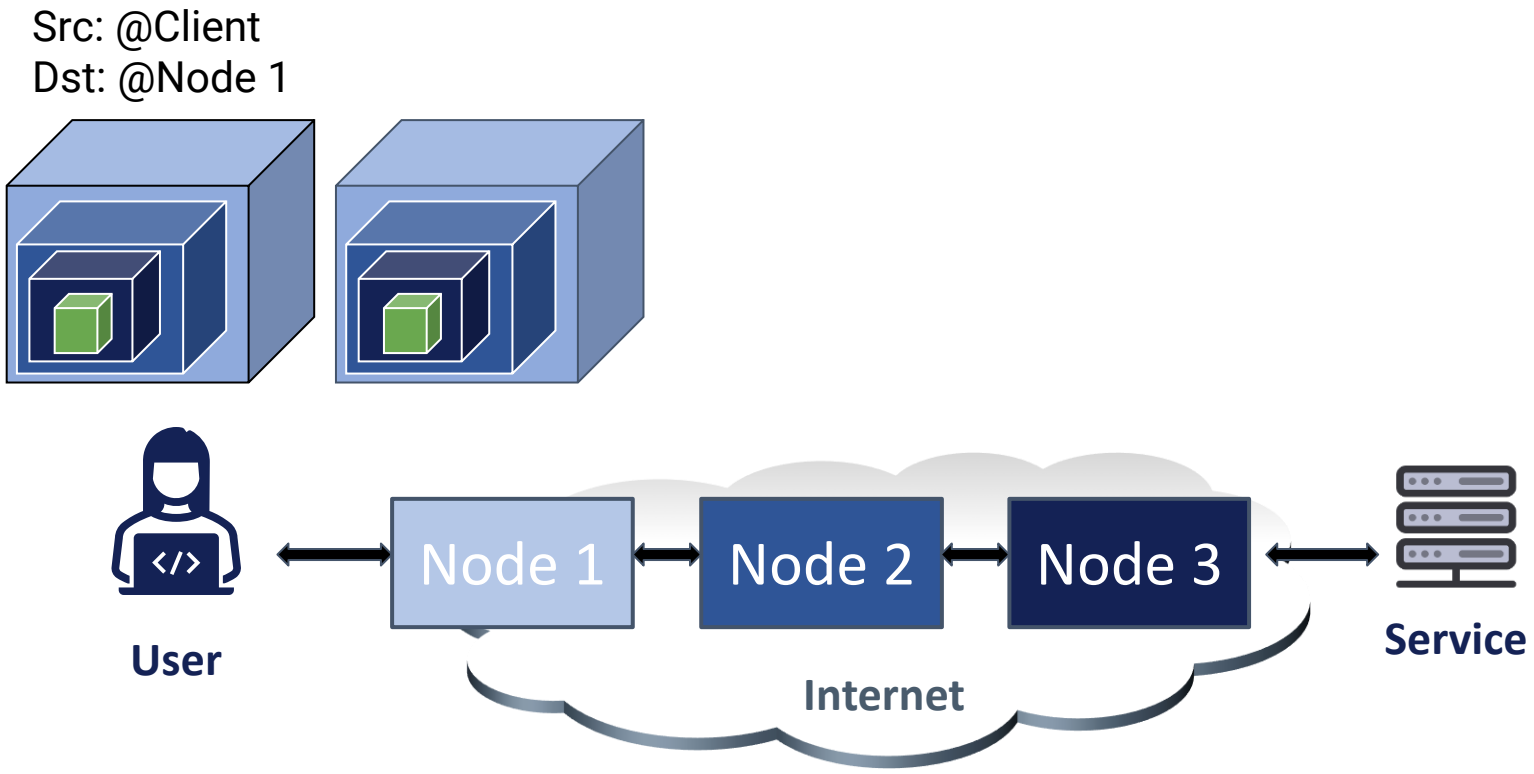
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



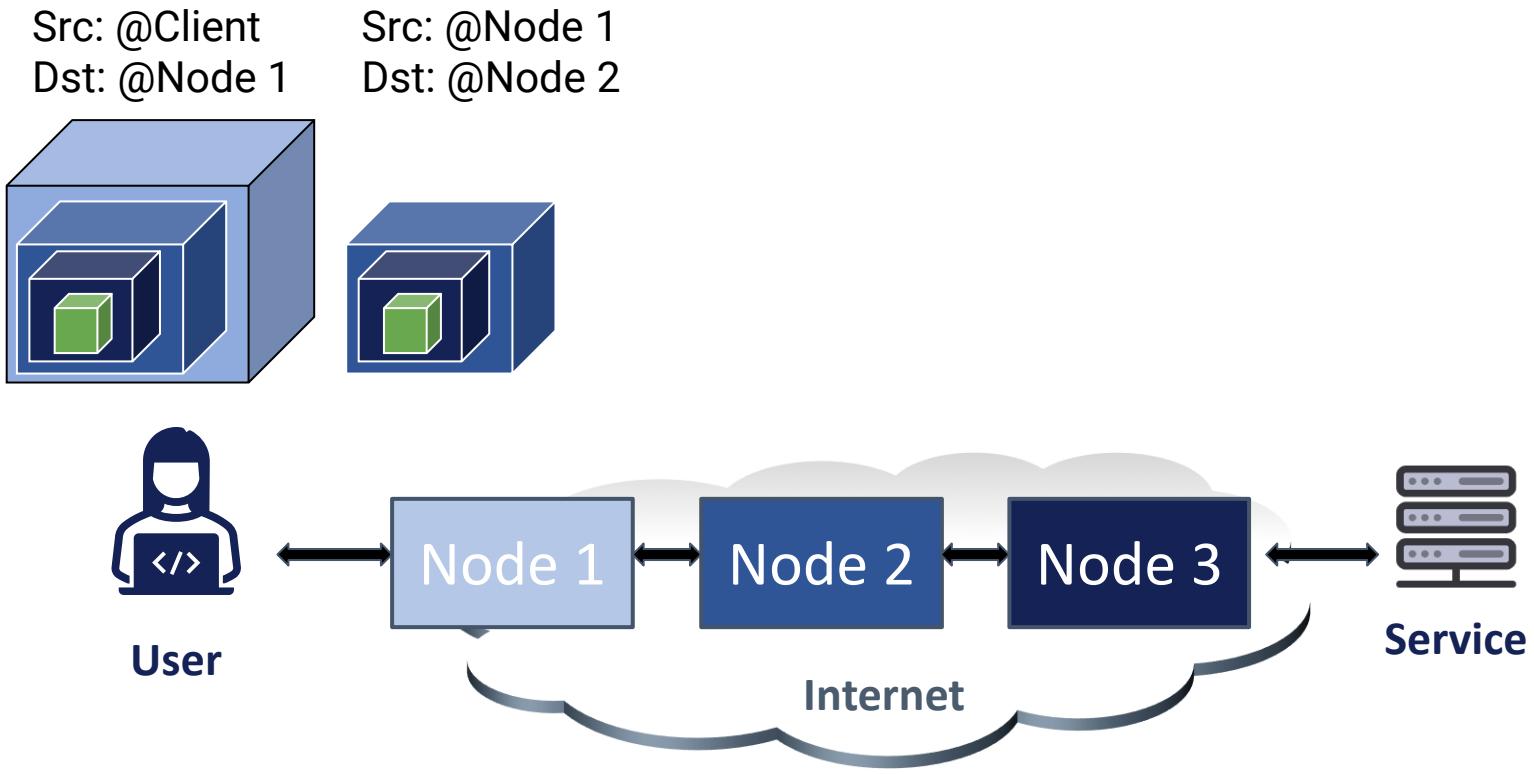
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



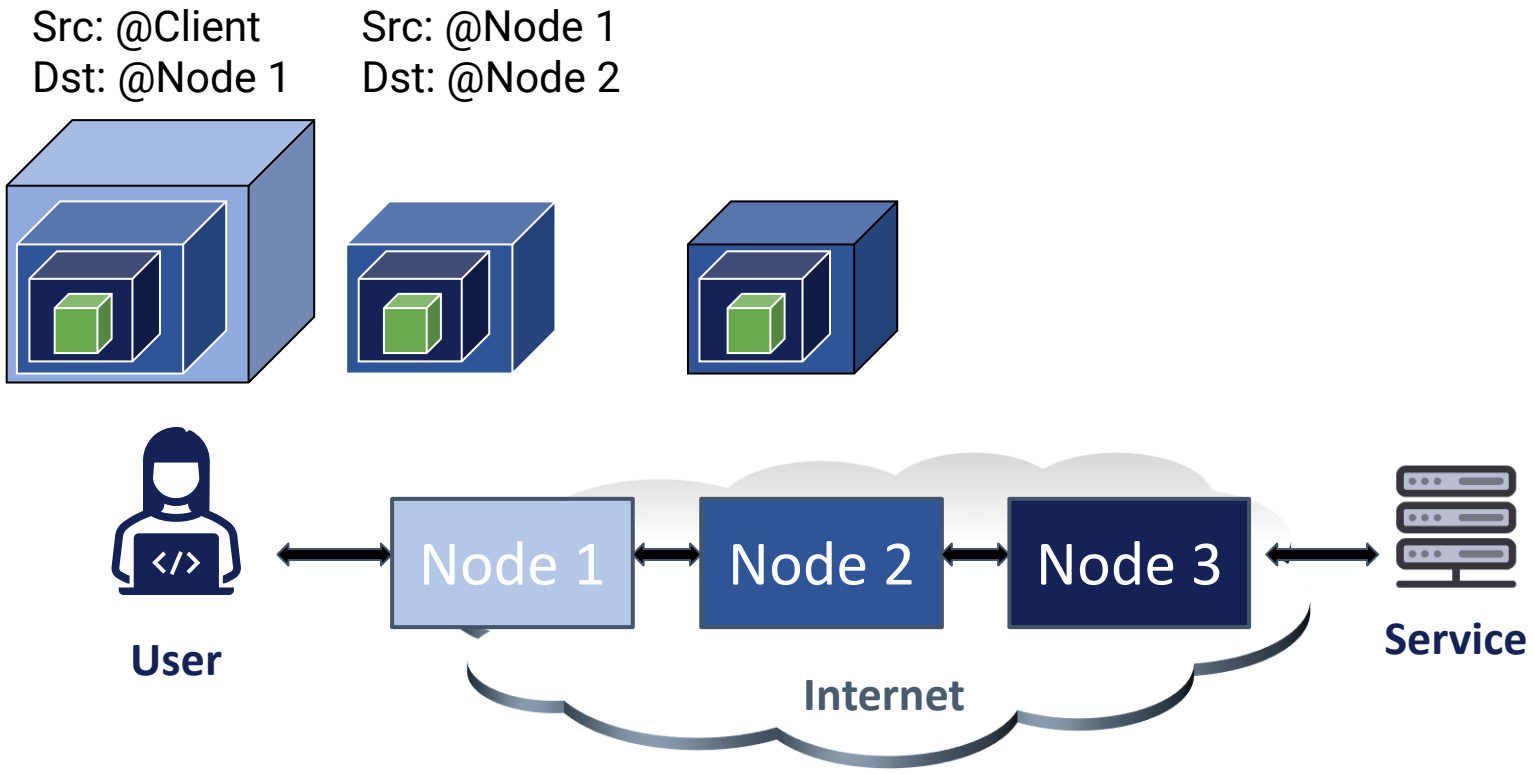
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



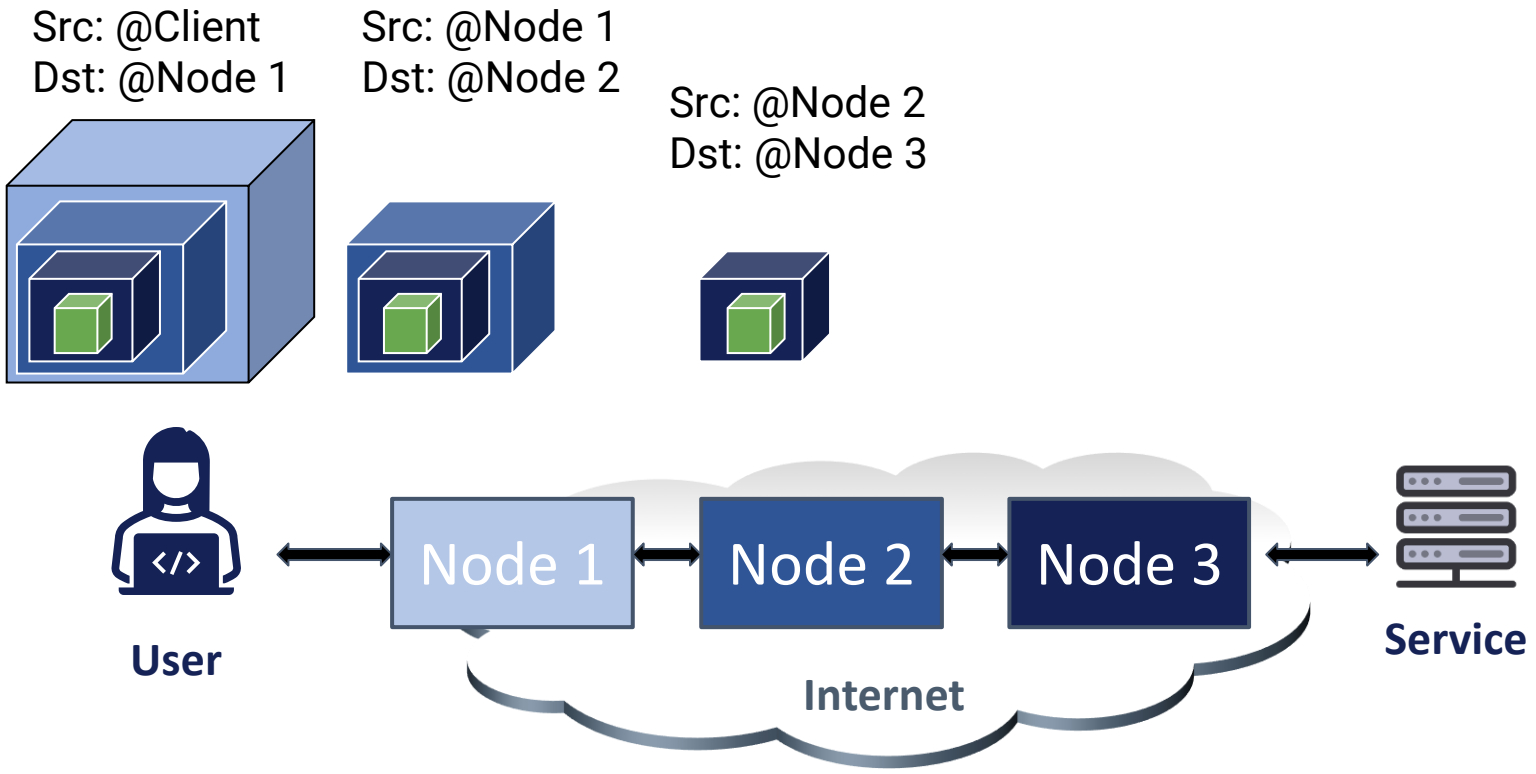
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



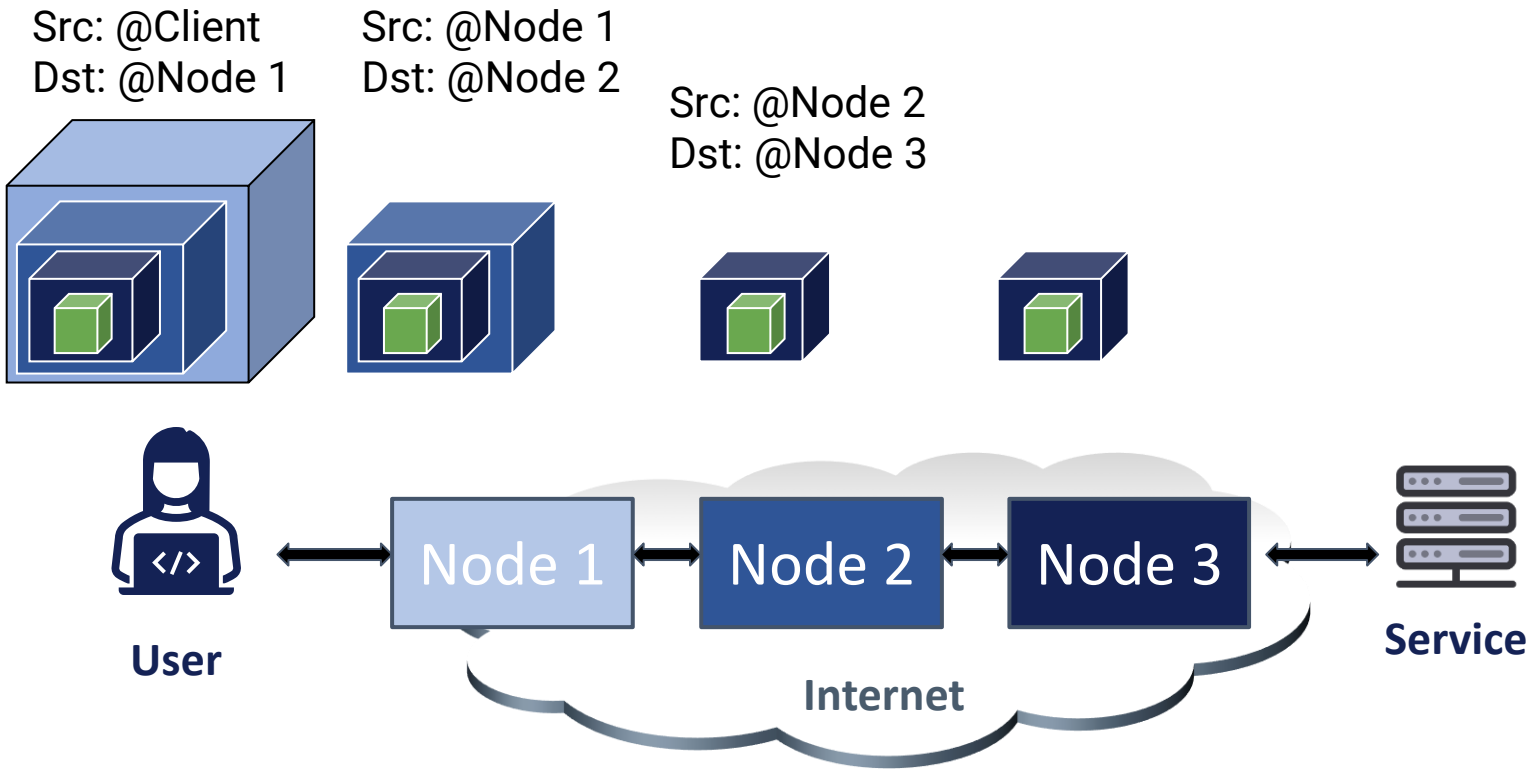
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



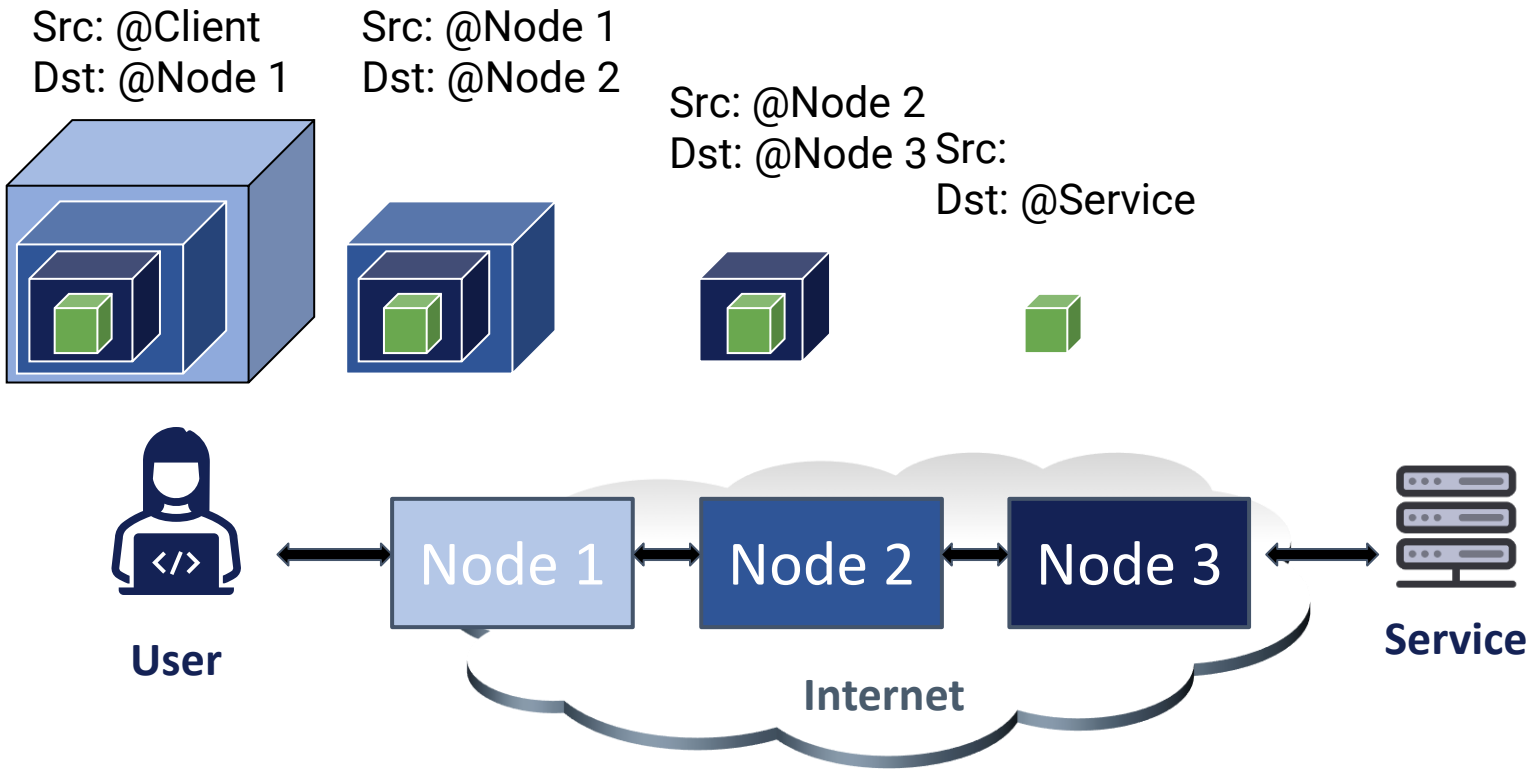
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



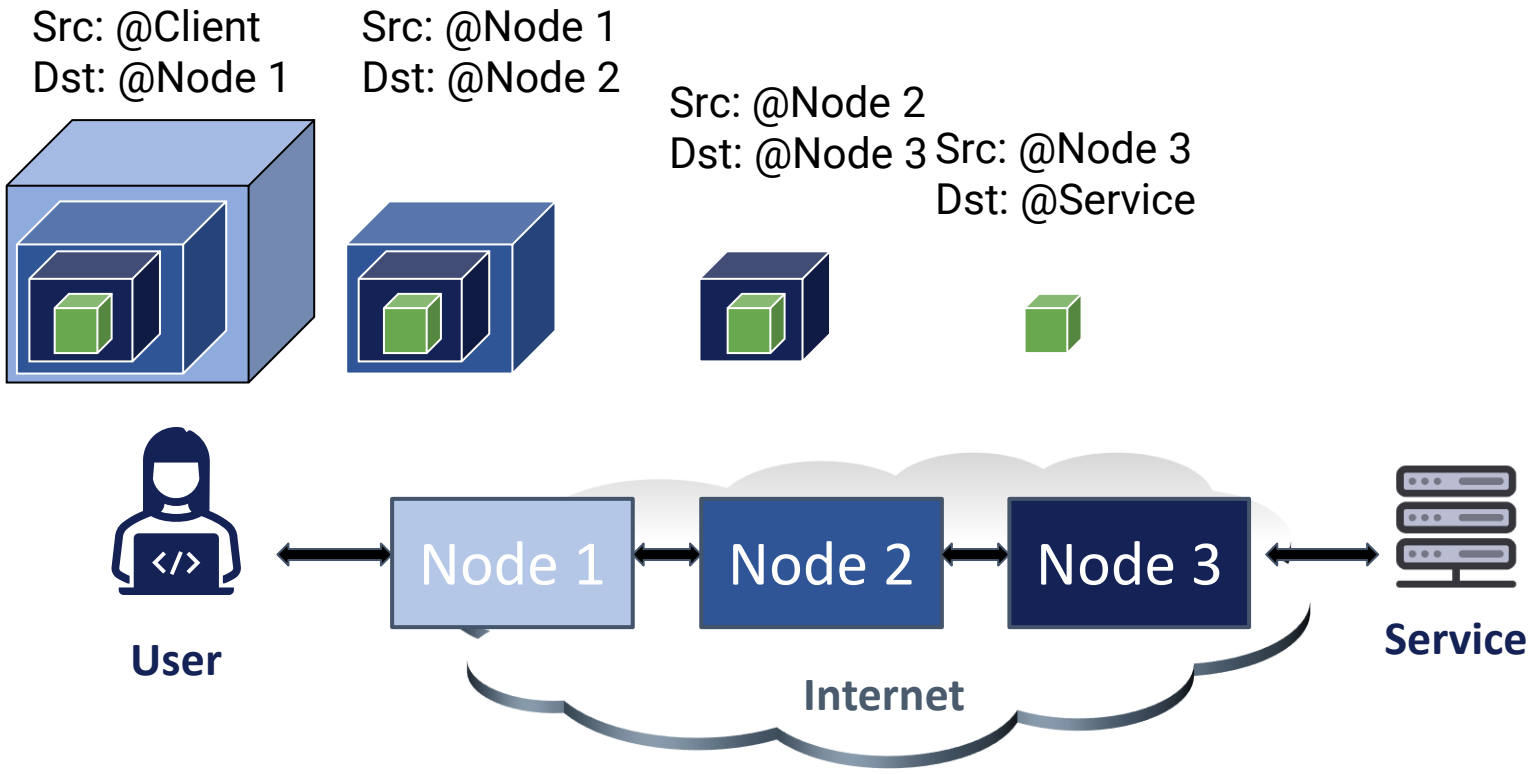
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



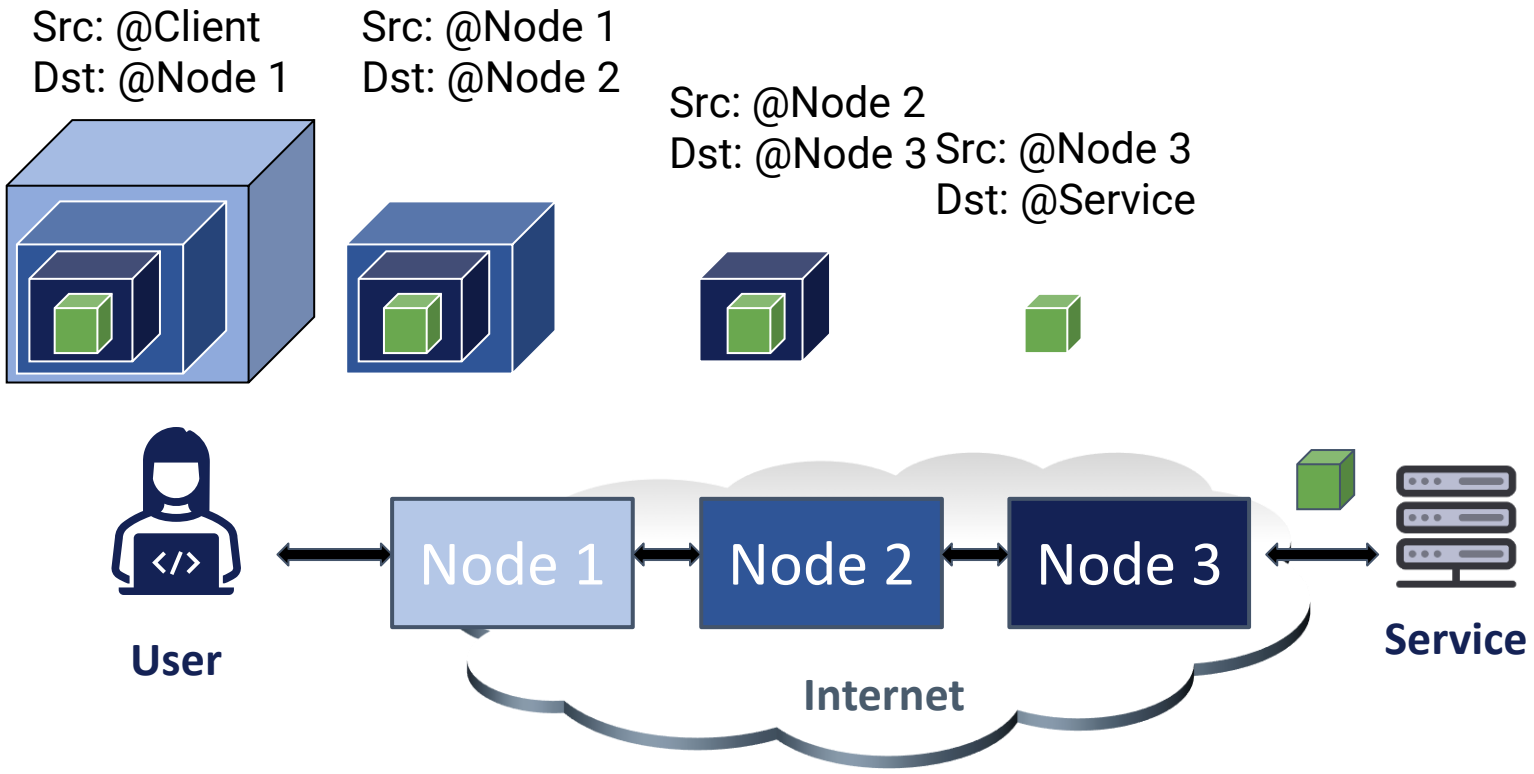
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



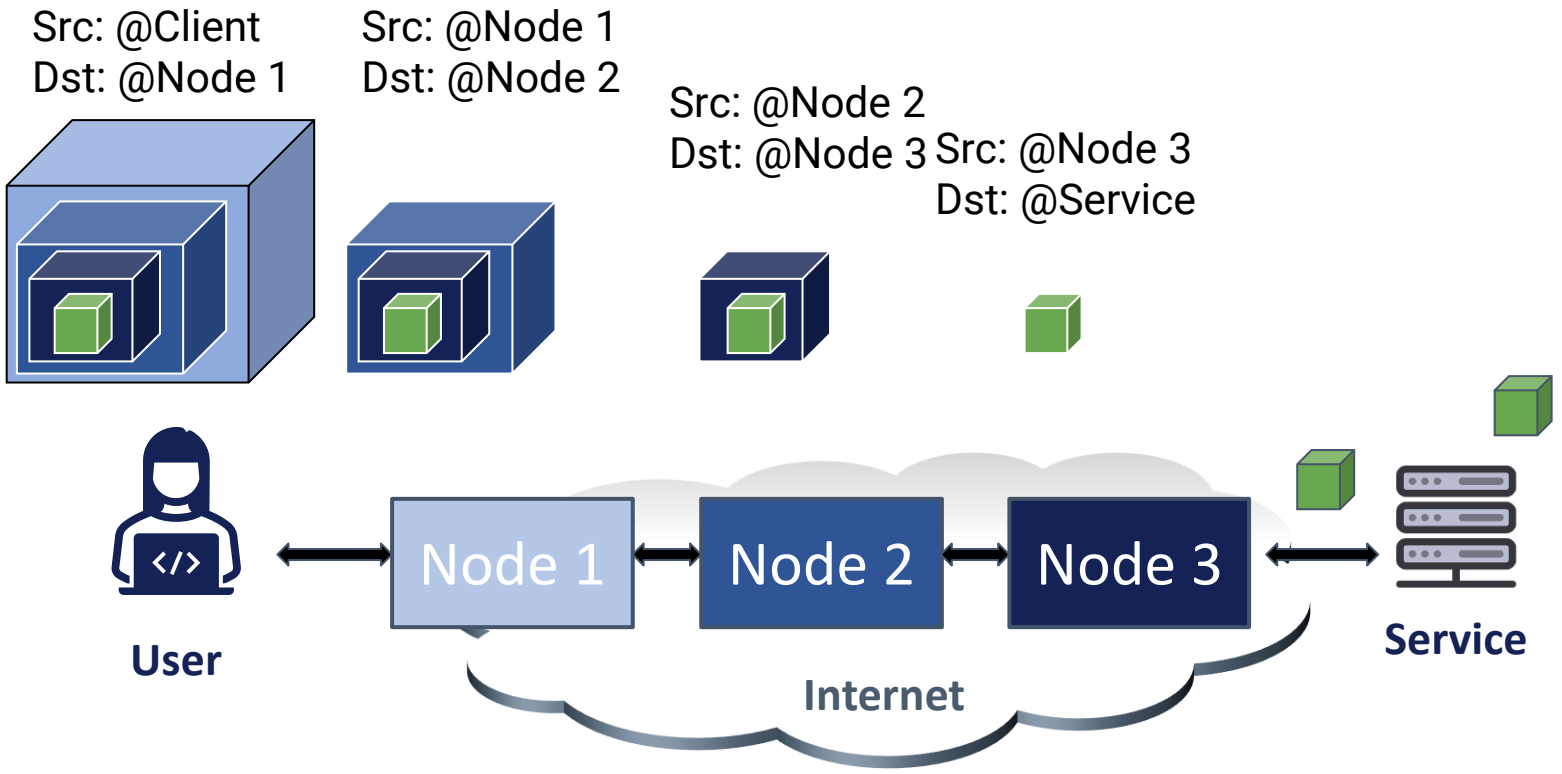
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities



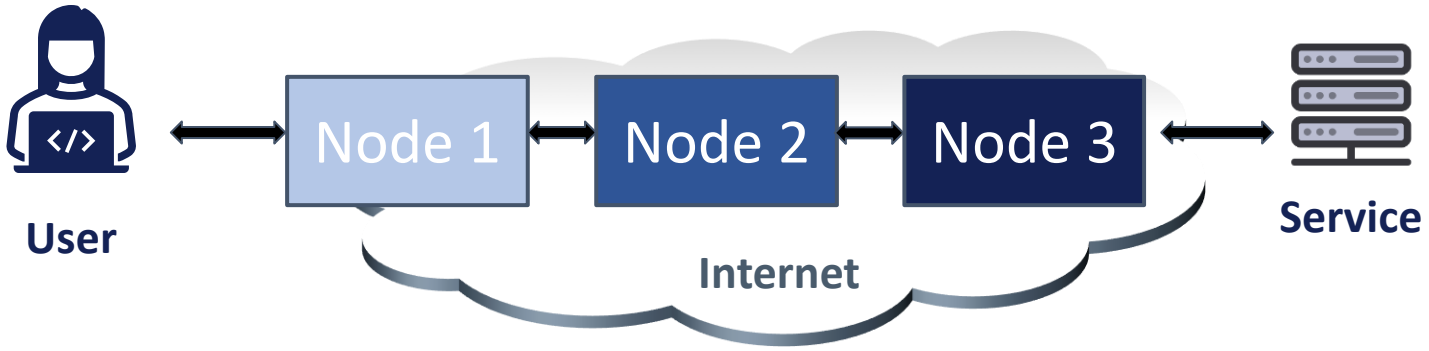
: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities

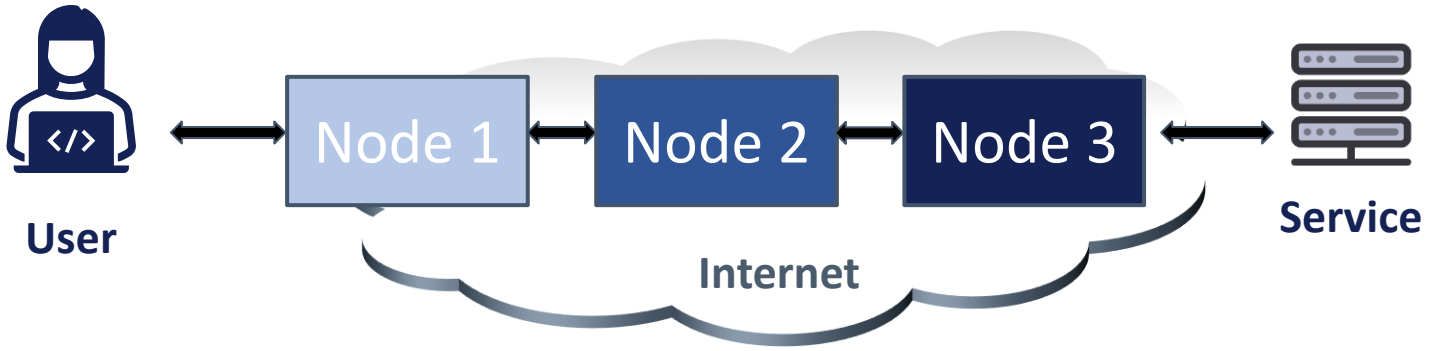


: Packet emitted

From classical networking to Anonymity Networks
Onion routing vulnerabilities

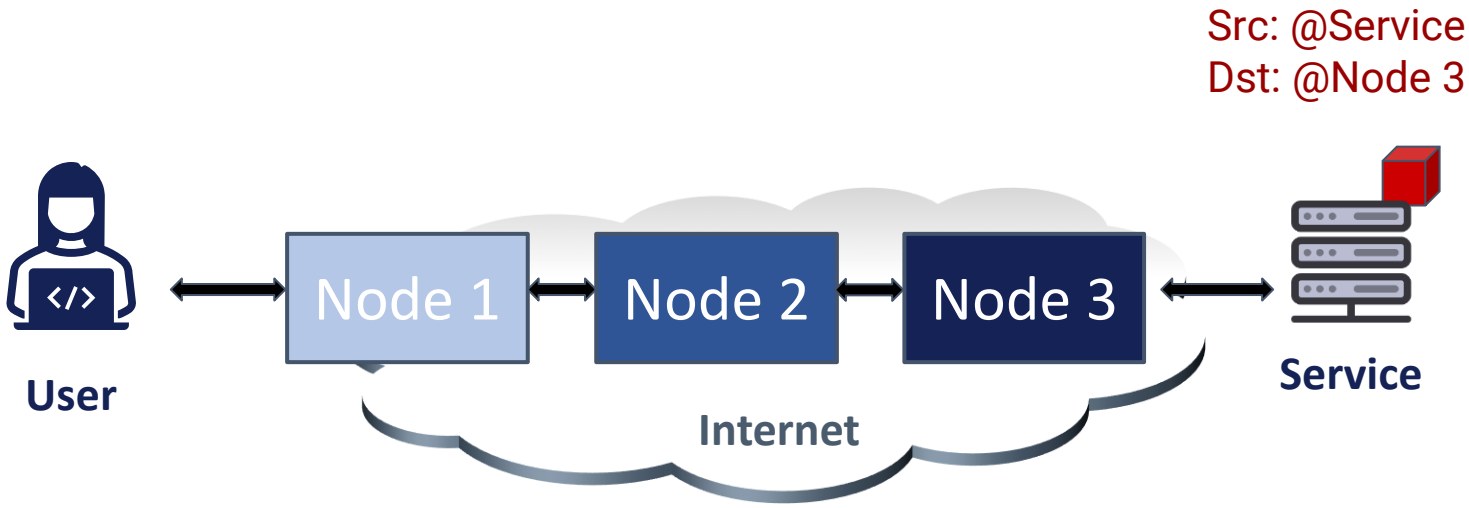


From classical networking to Anonymity Networks
Onion routing vulnerabilities



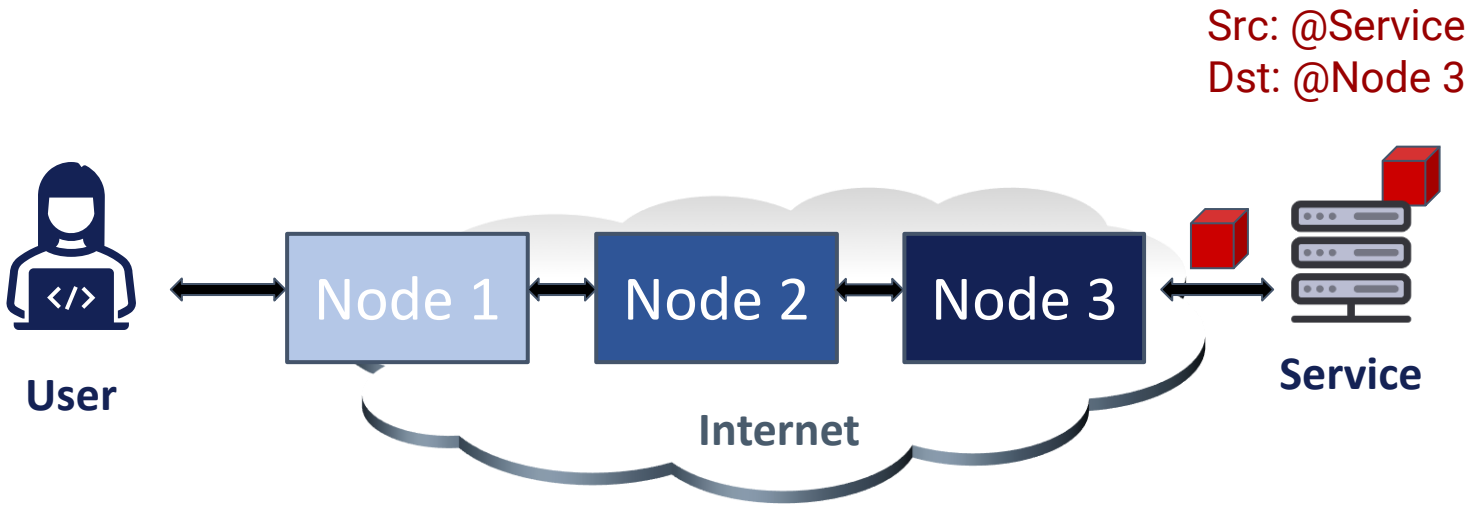
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



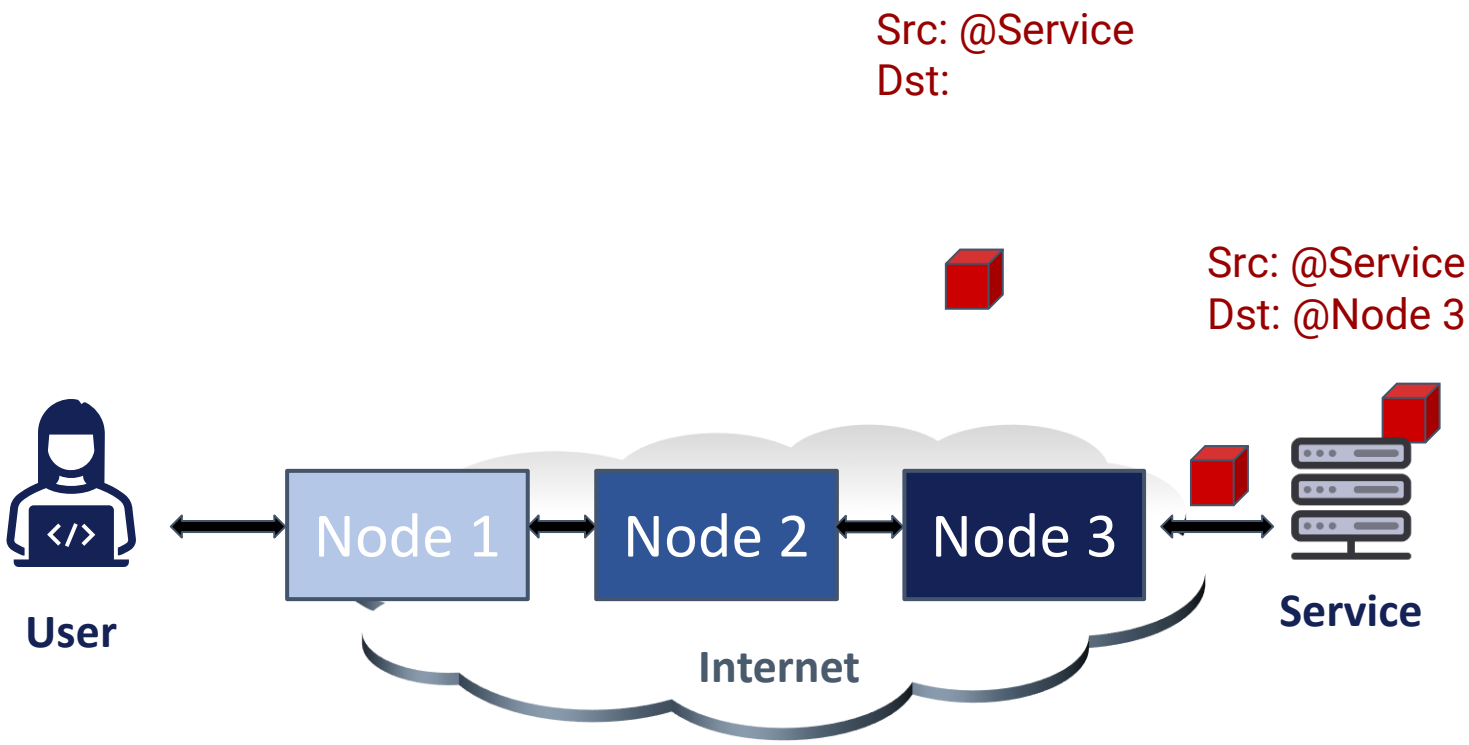
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



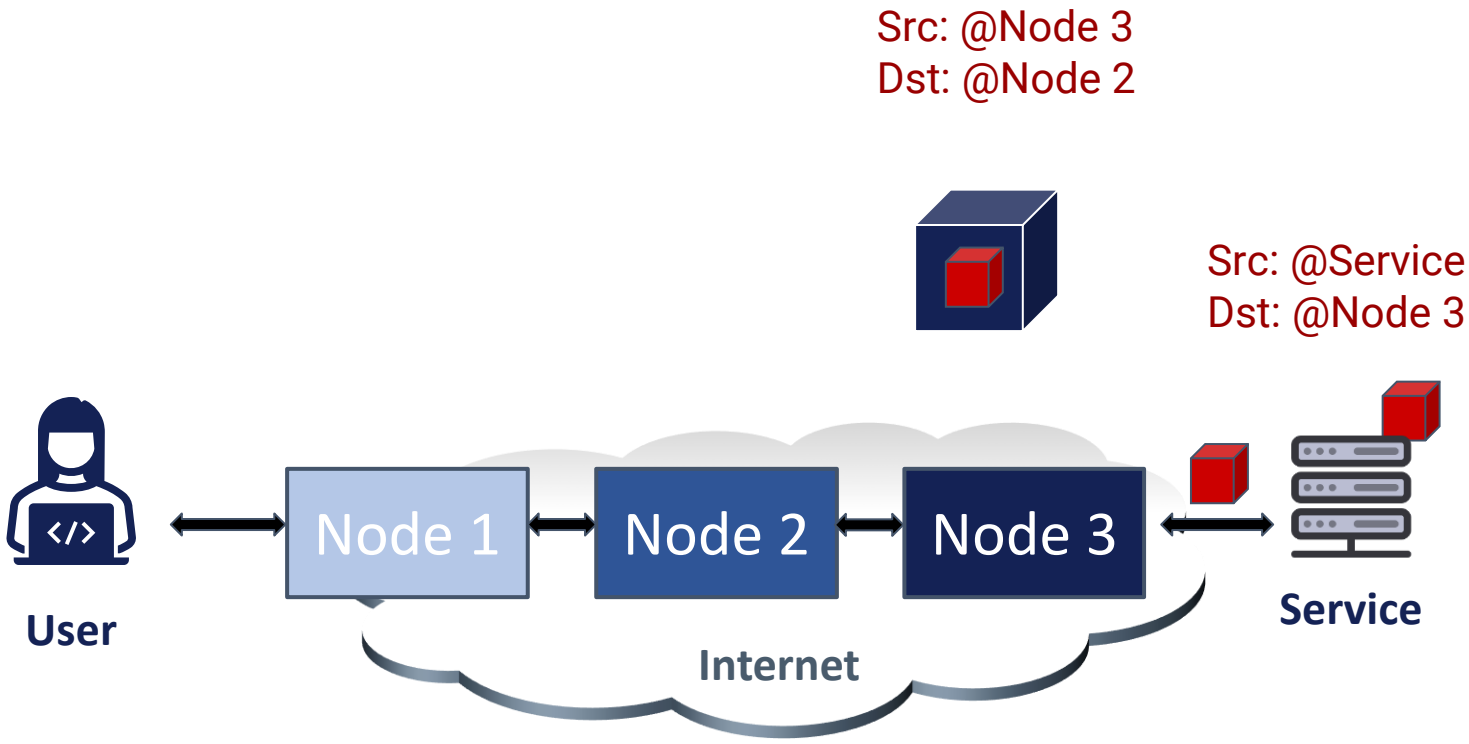
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



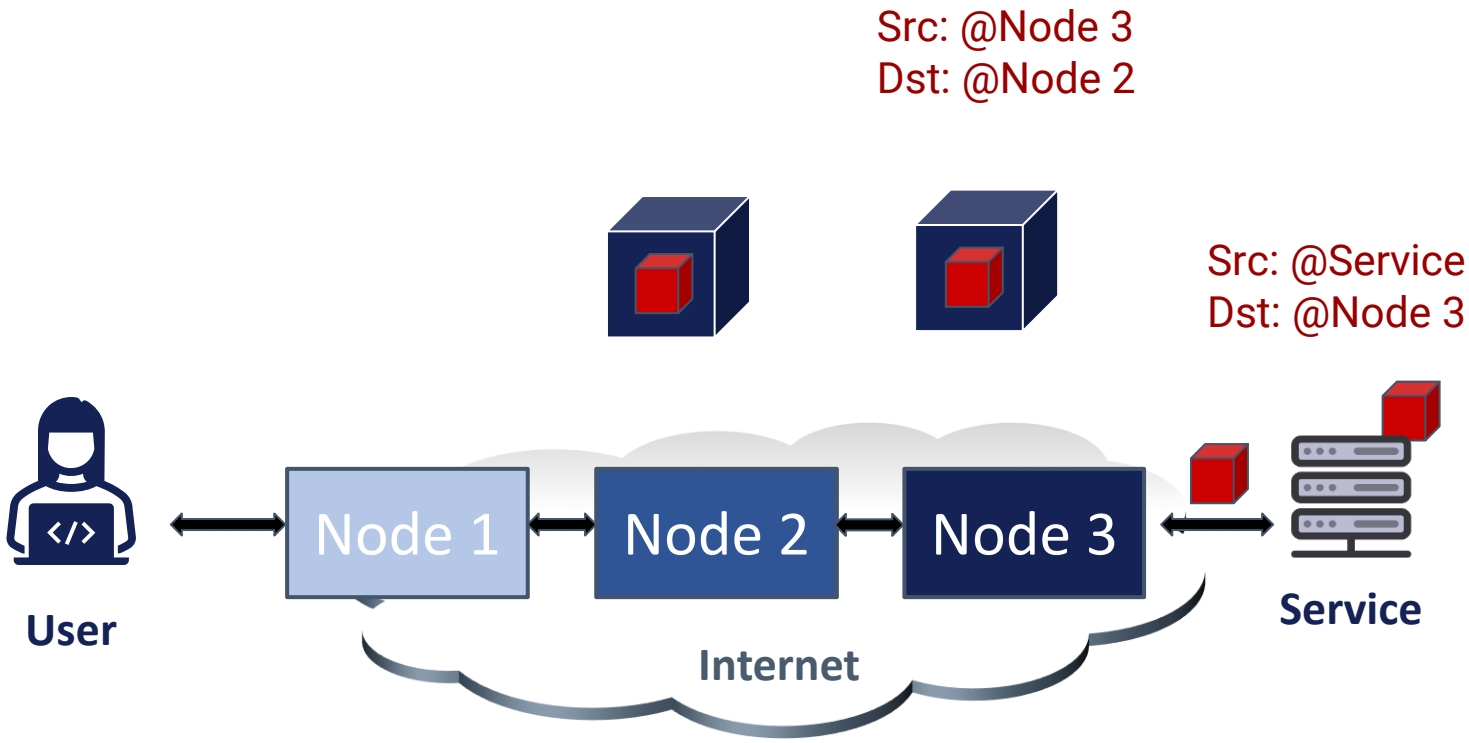
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



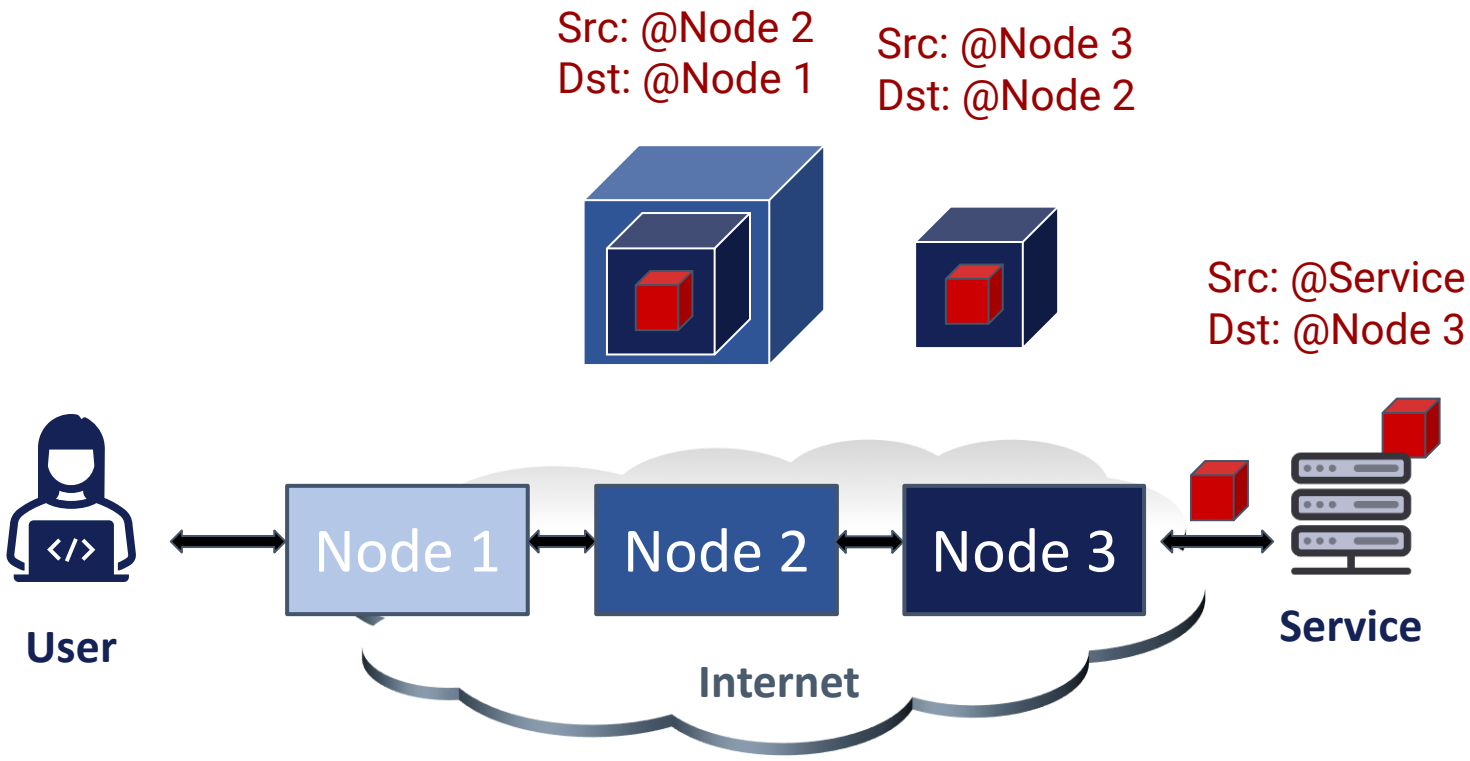
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



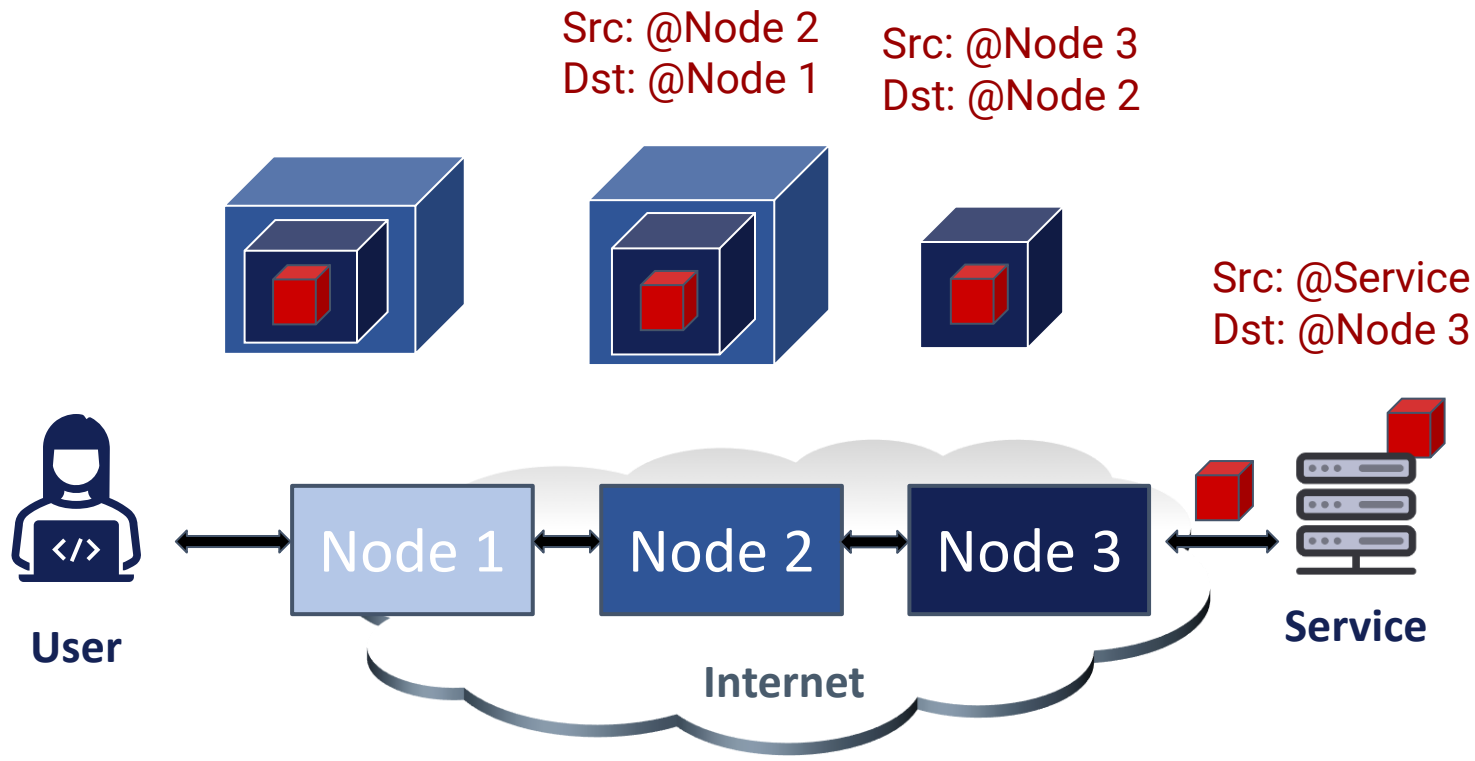
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



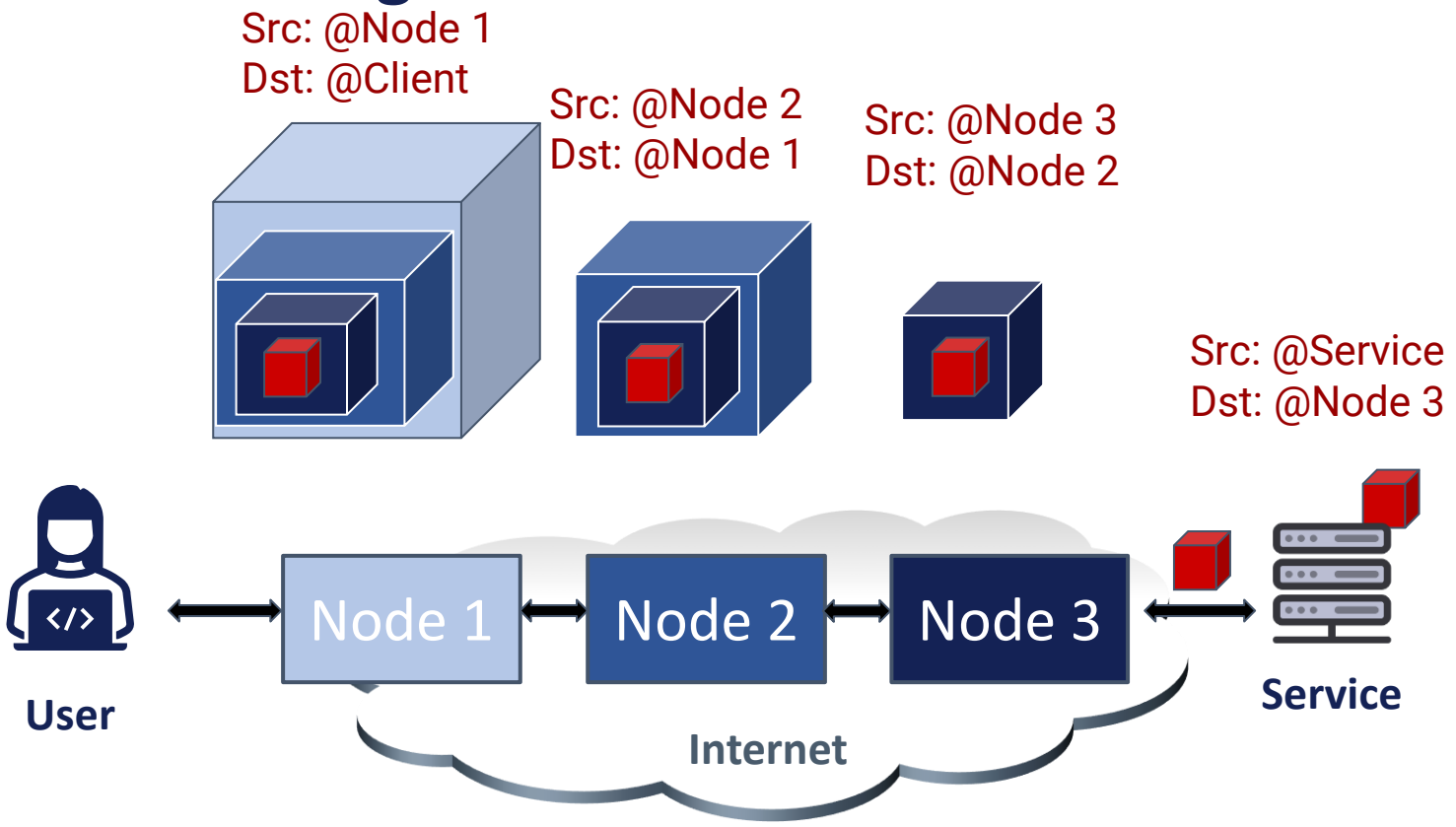
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



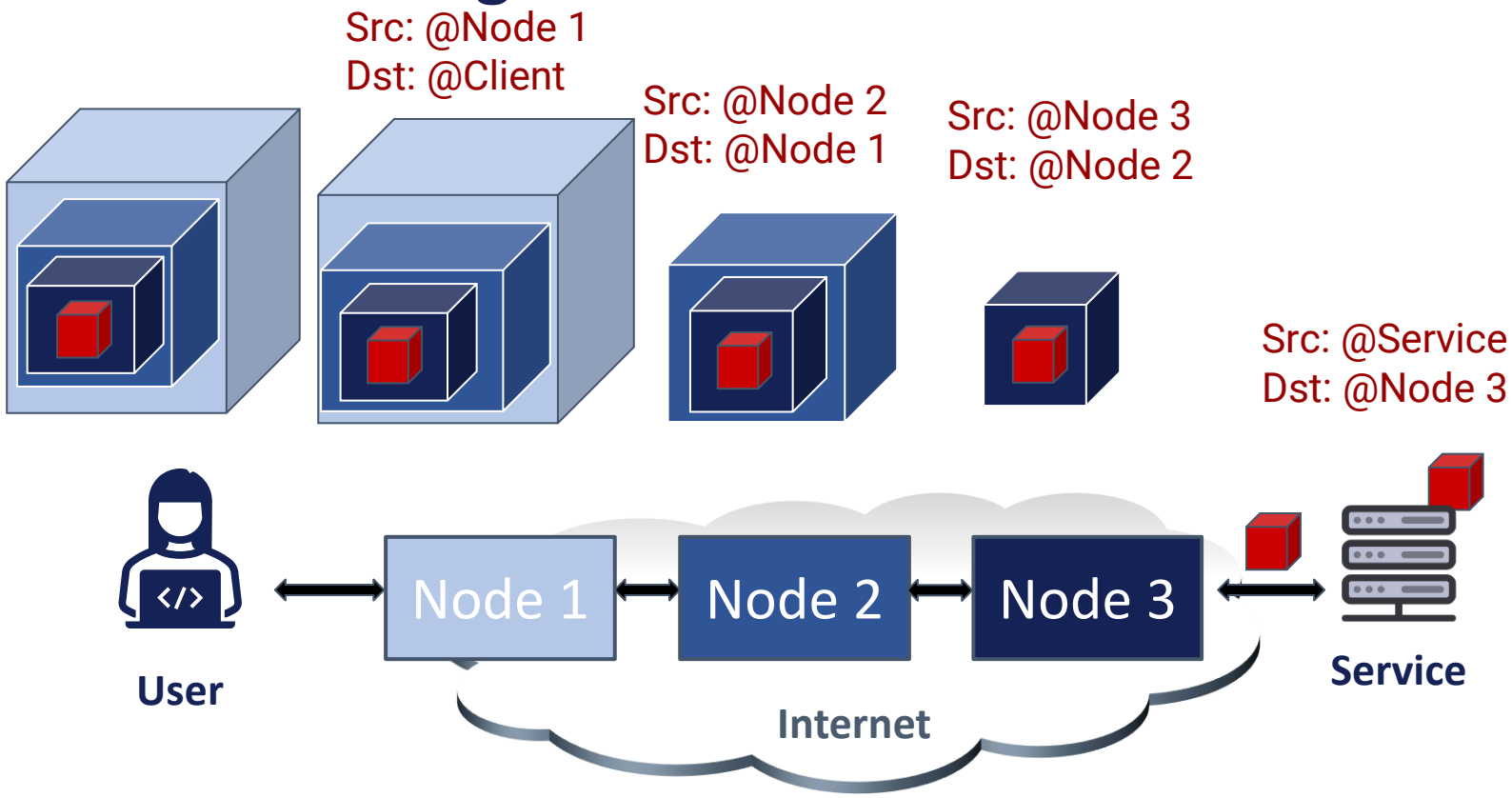
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



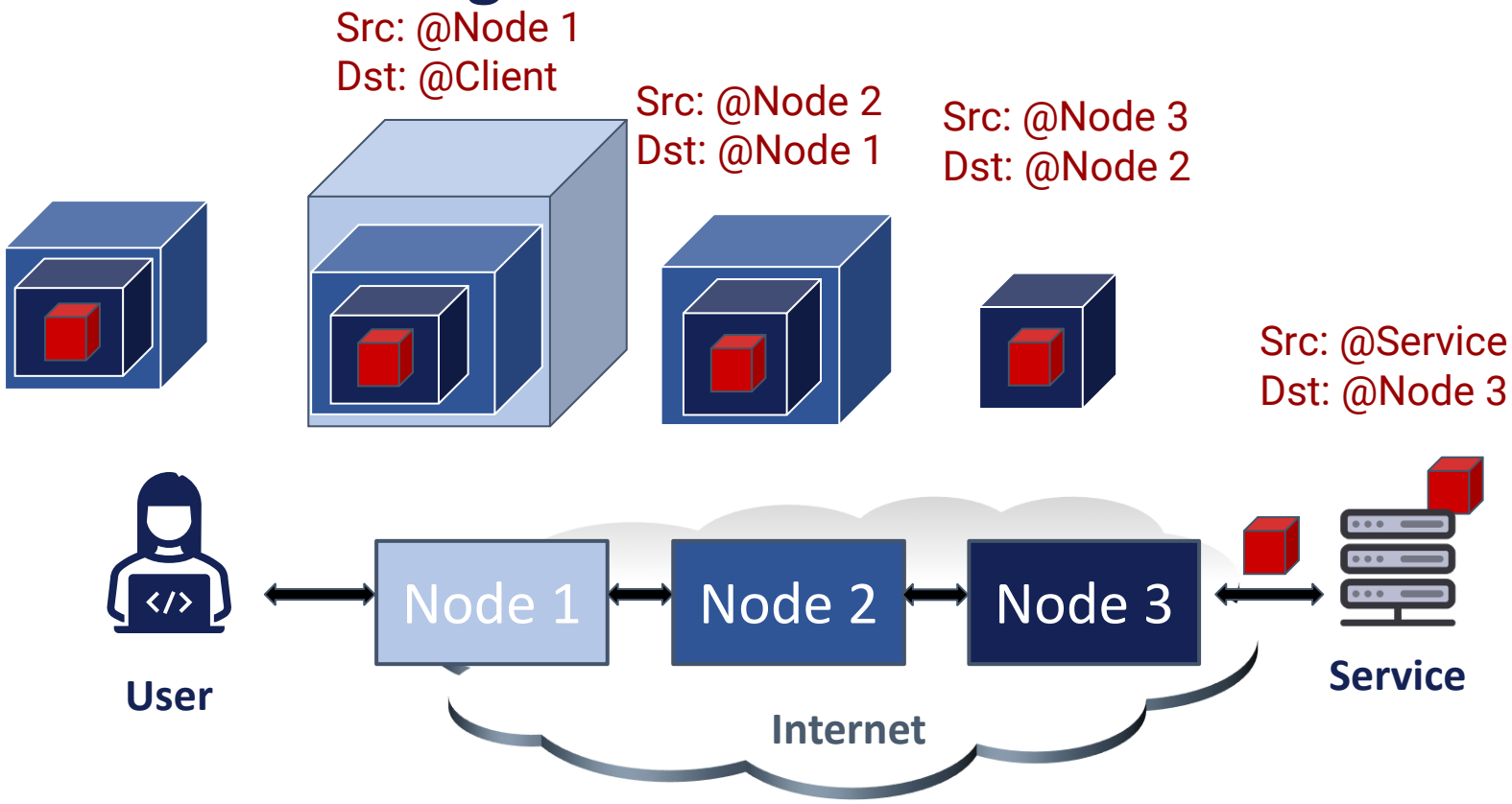
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



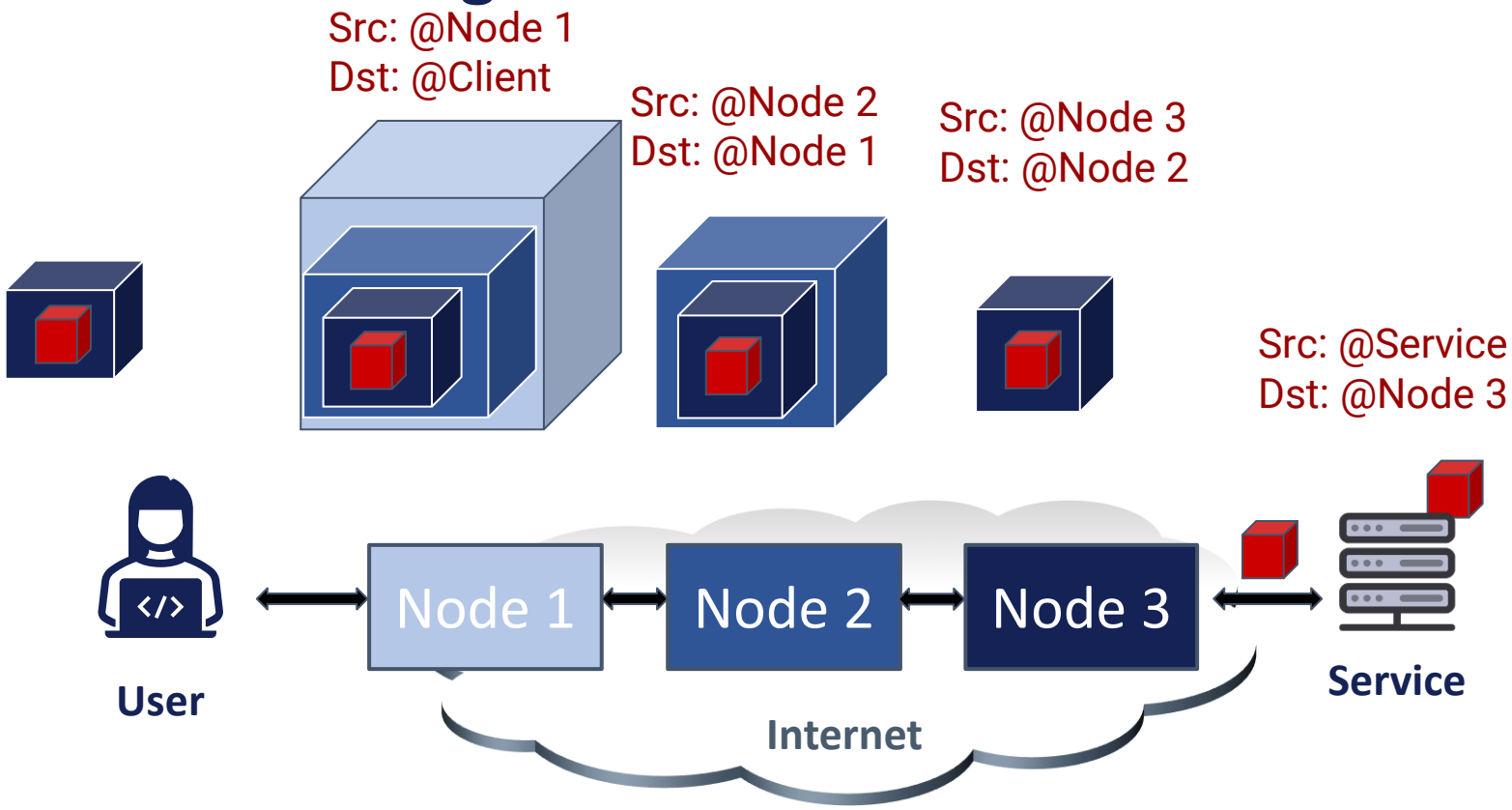
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



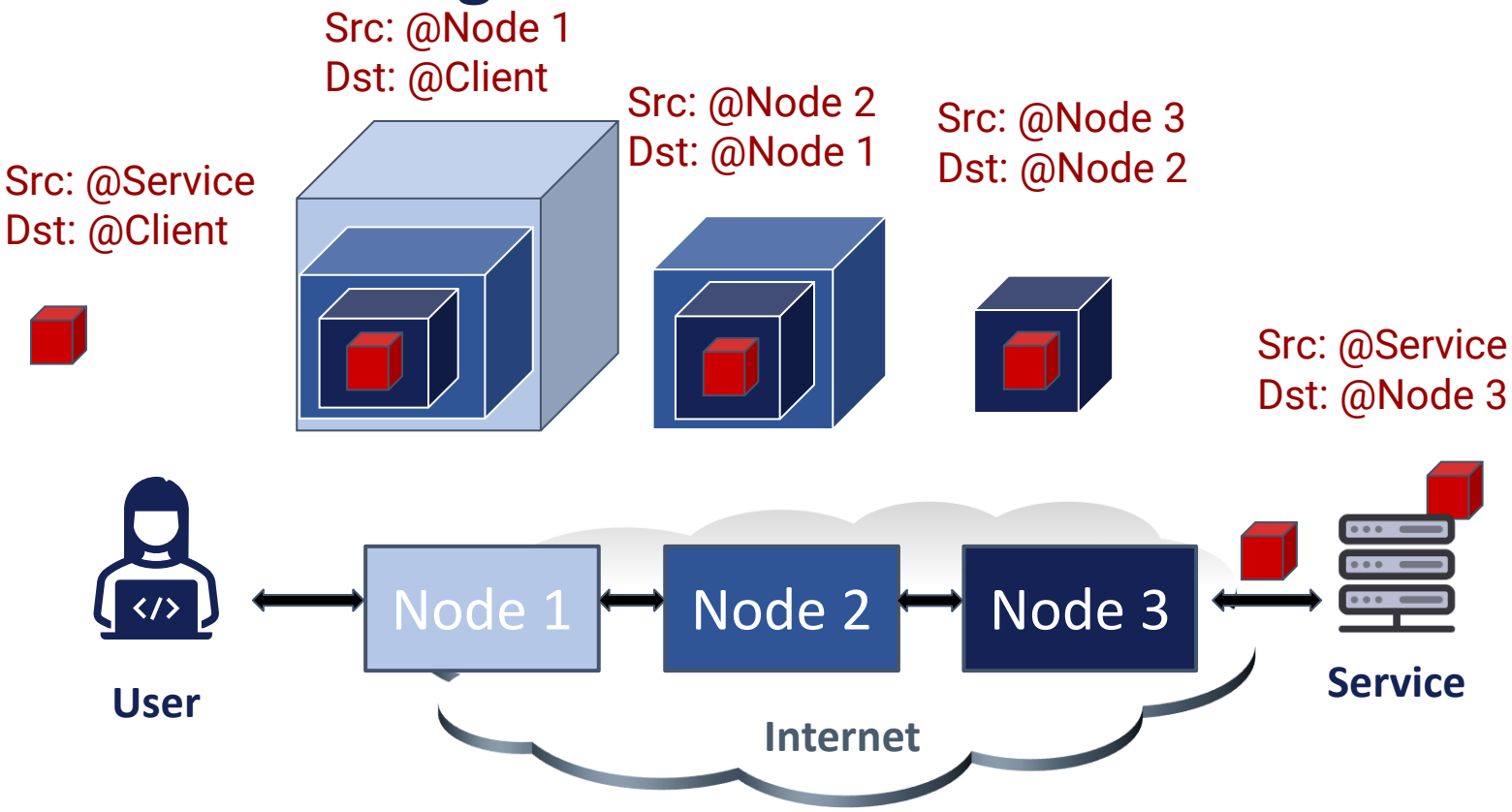
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



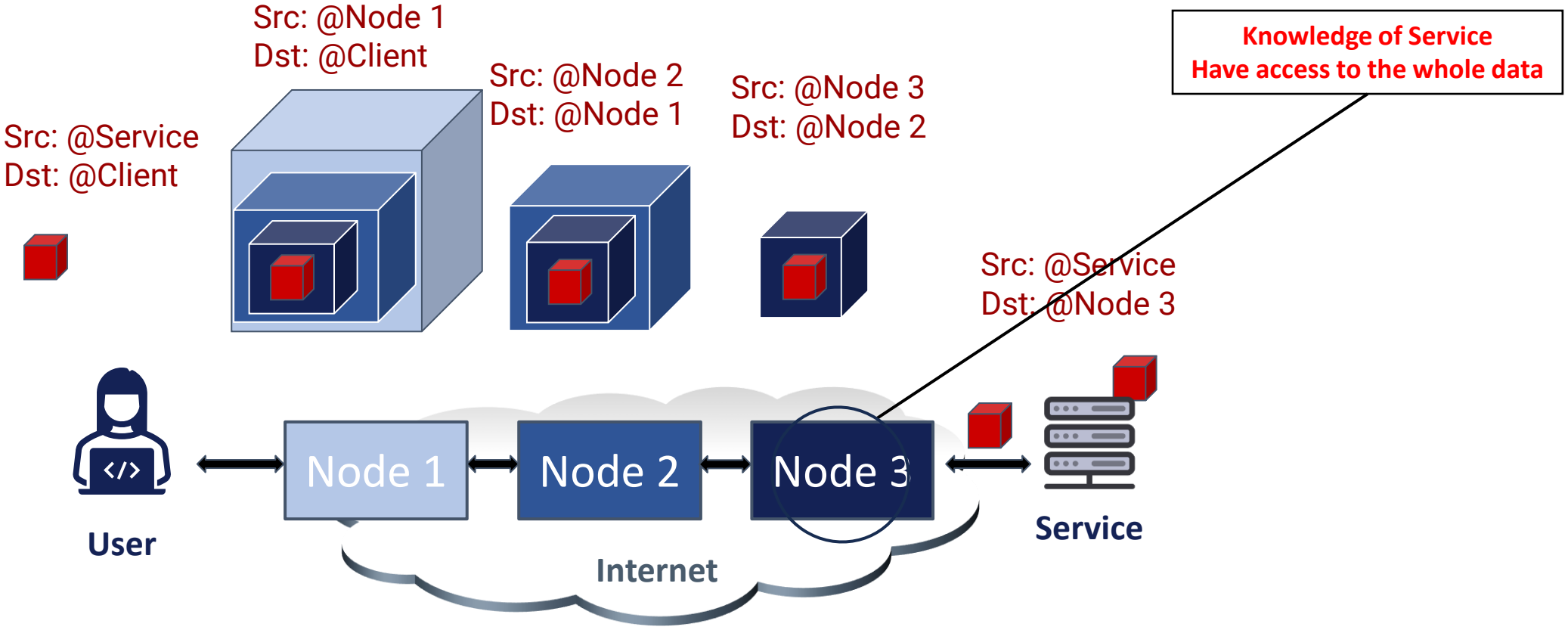
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities



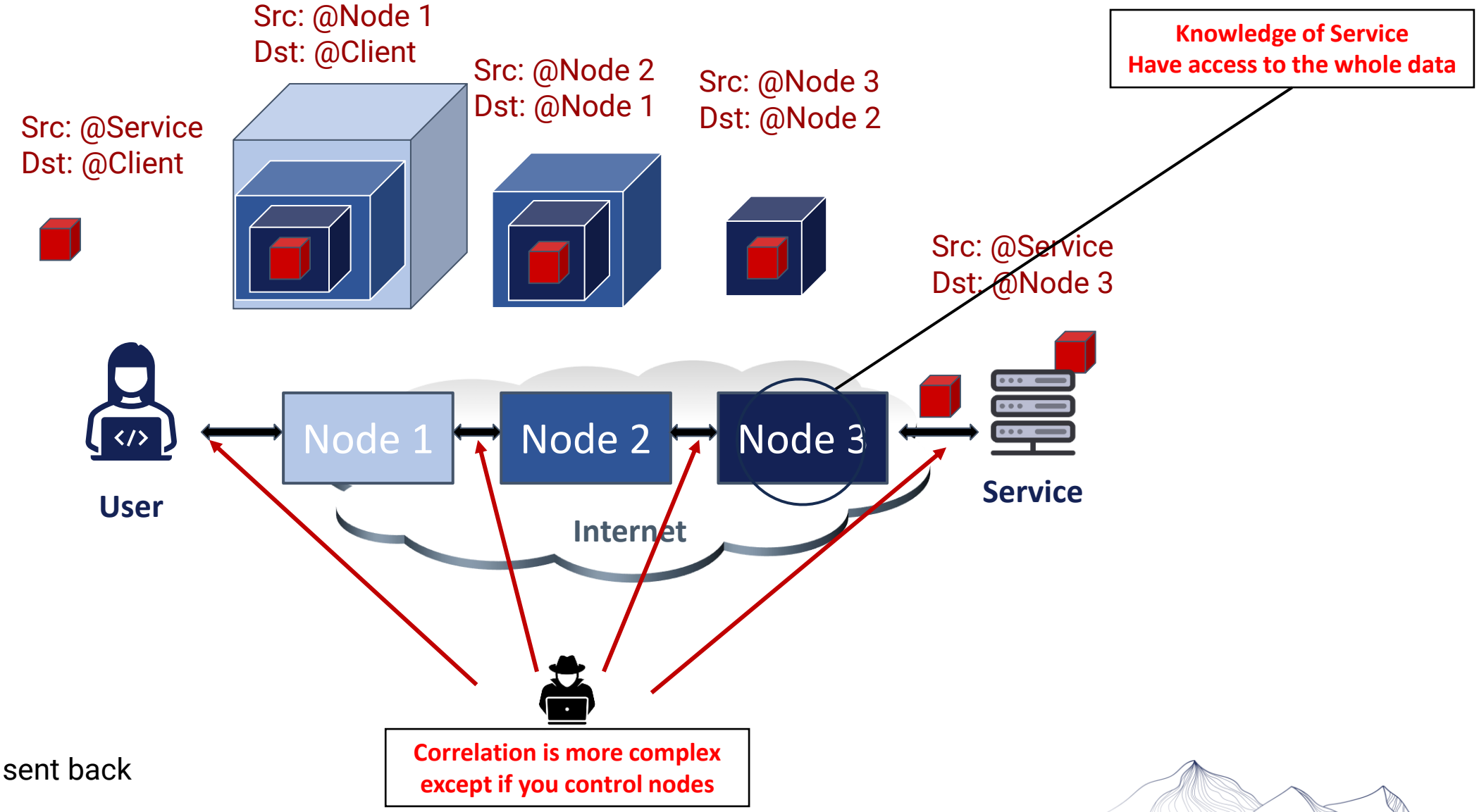
: Packet sent back

From classical networking to Anonymity Networks
Onion routing vulnerabilities

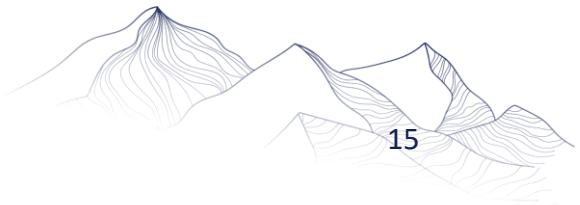


: Packet sent back

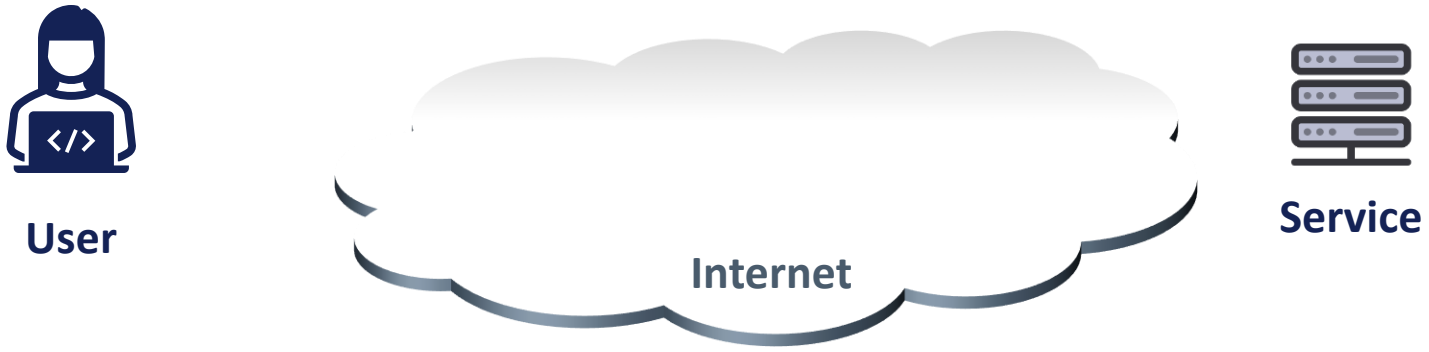
From classical networking to Anonymity Networks
Onion routing vulnerabilities



snowpack | How our VIPN works without trusted-third-party ?

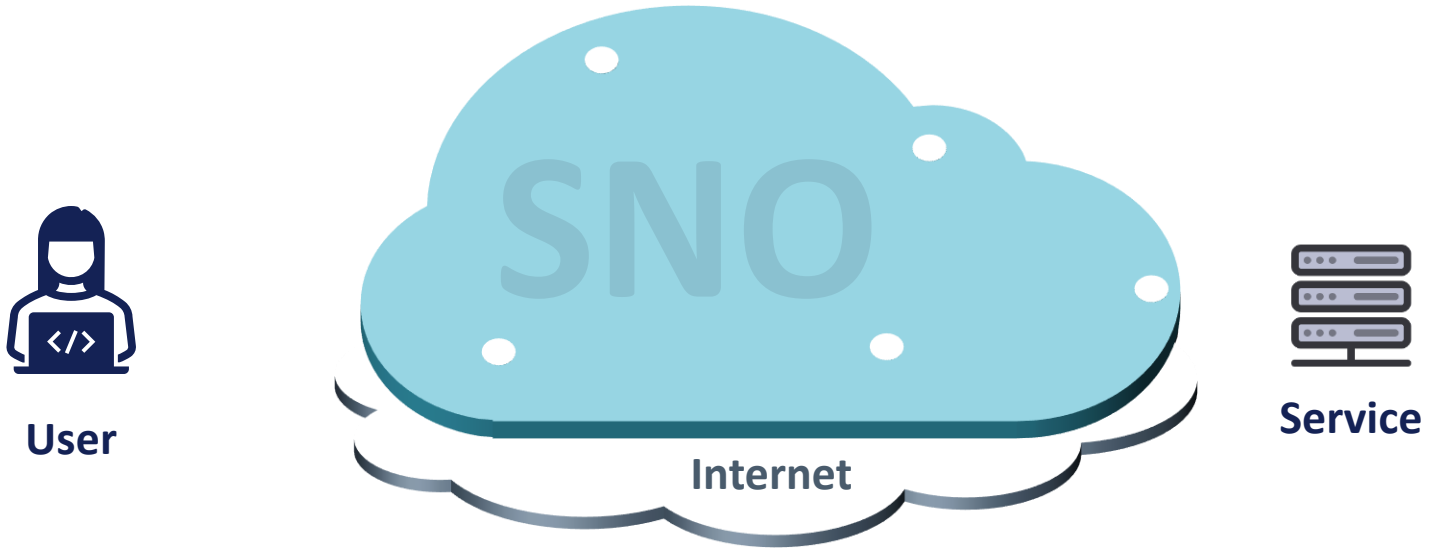


snowpack | How our VIPN works without trusted-third-party ?



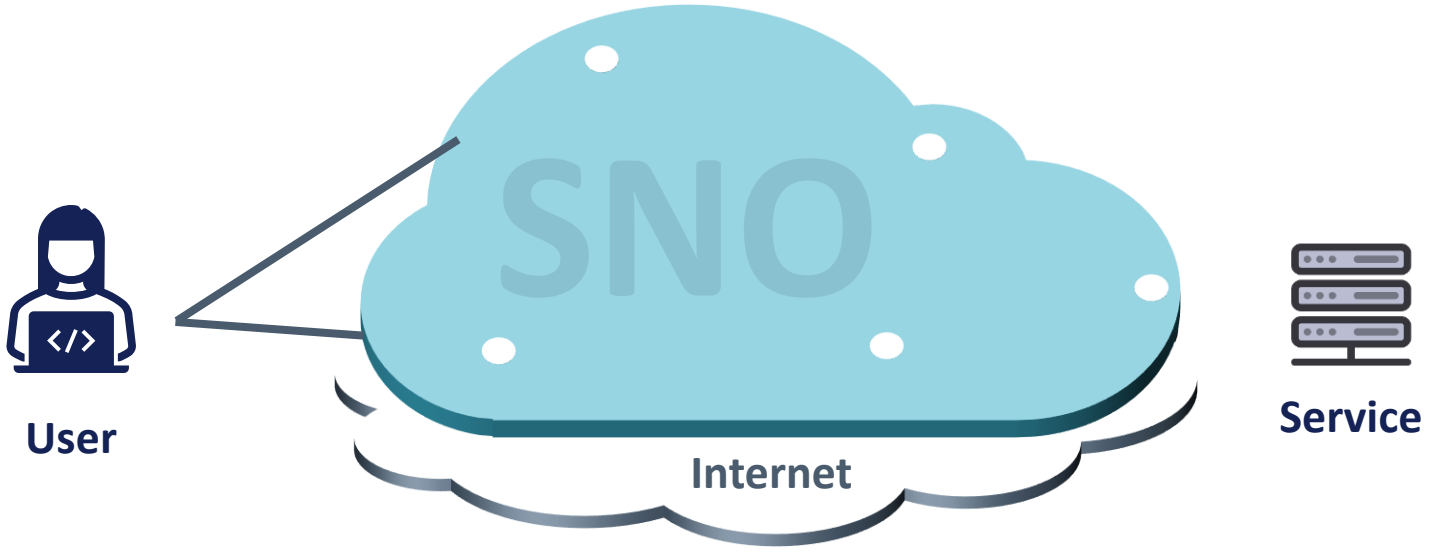
snowpack | How our VIPN works without trusted-third-party ?

Building the route



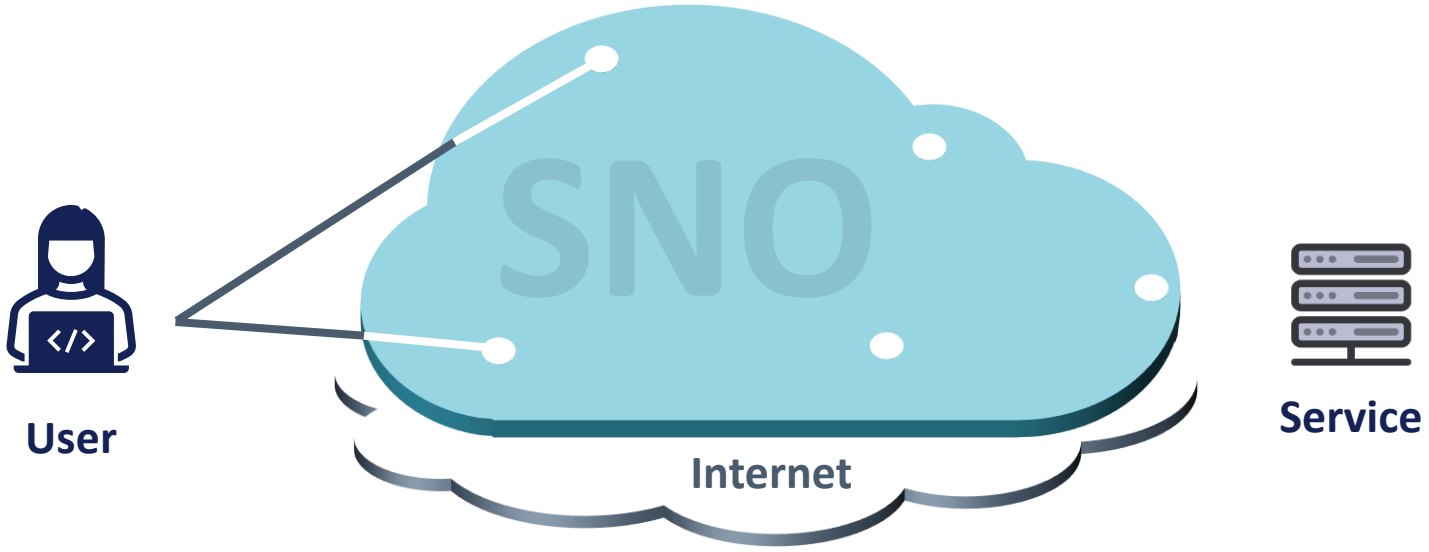
snowpack | How our VIPN works without trusted-third-party ?

Building the route



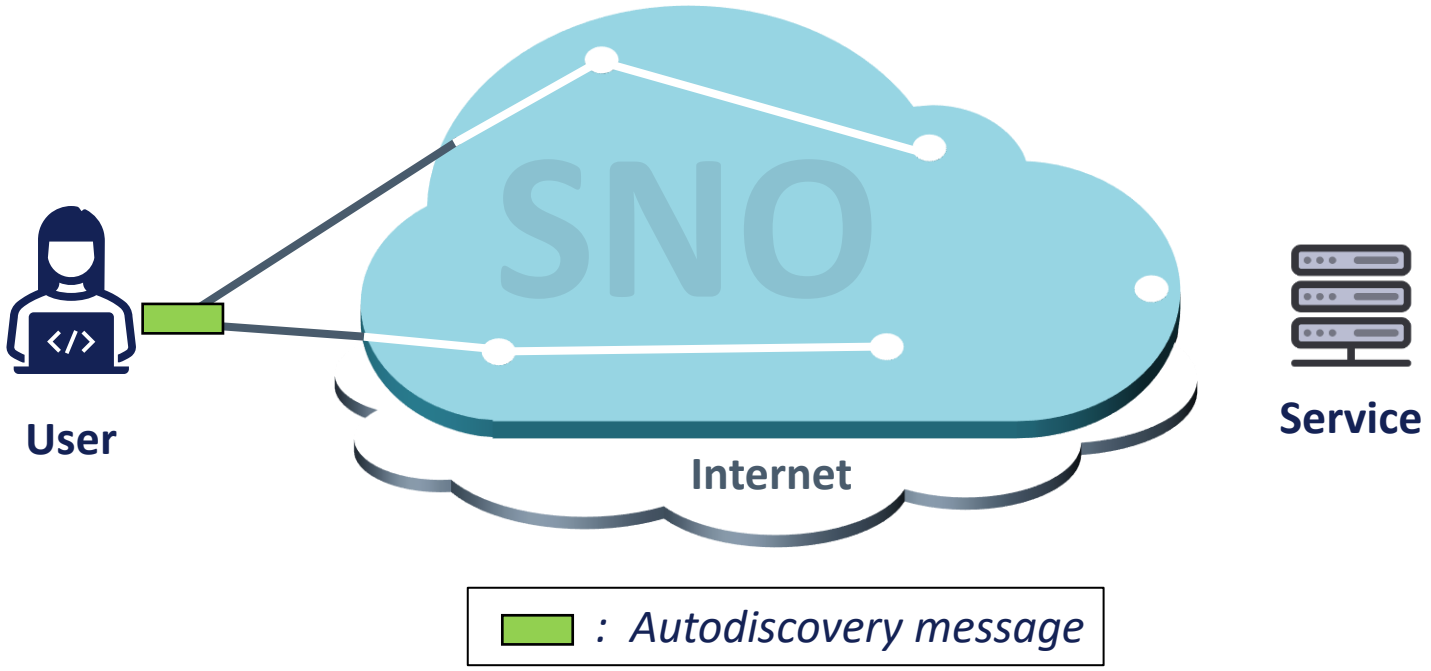
snowpack | How our VIPN works without trusted-third-party ?

Building the route



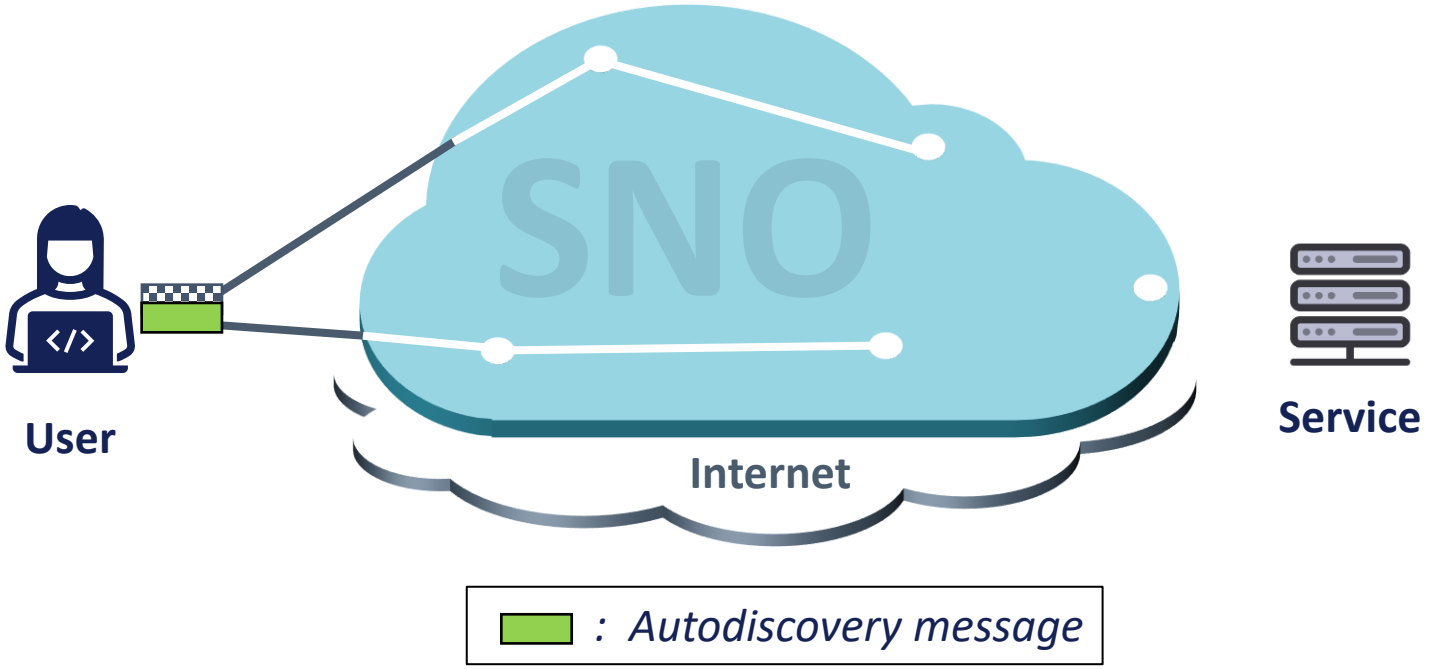
snowpack | How our VIPN works without trusted-third-party ?

Building the route



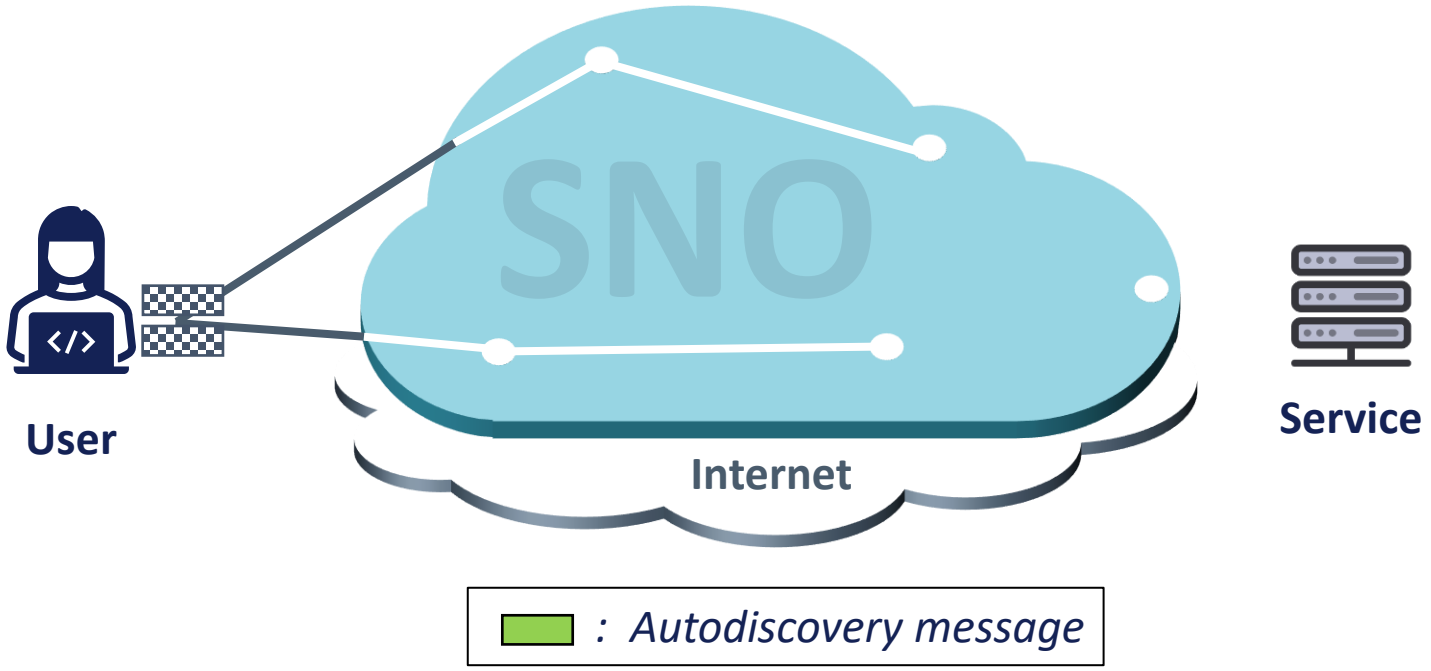
snowpack | How our VIPN works without trusted-third-party ?

Building the route



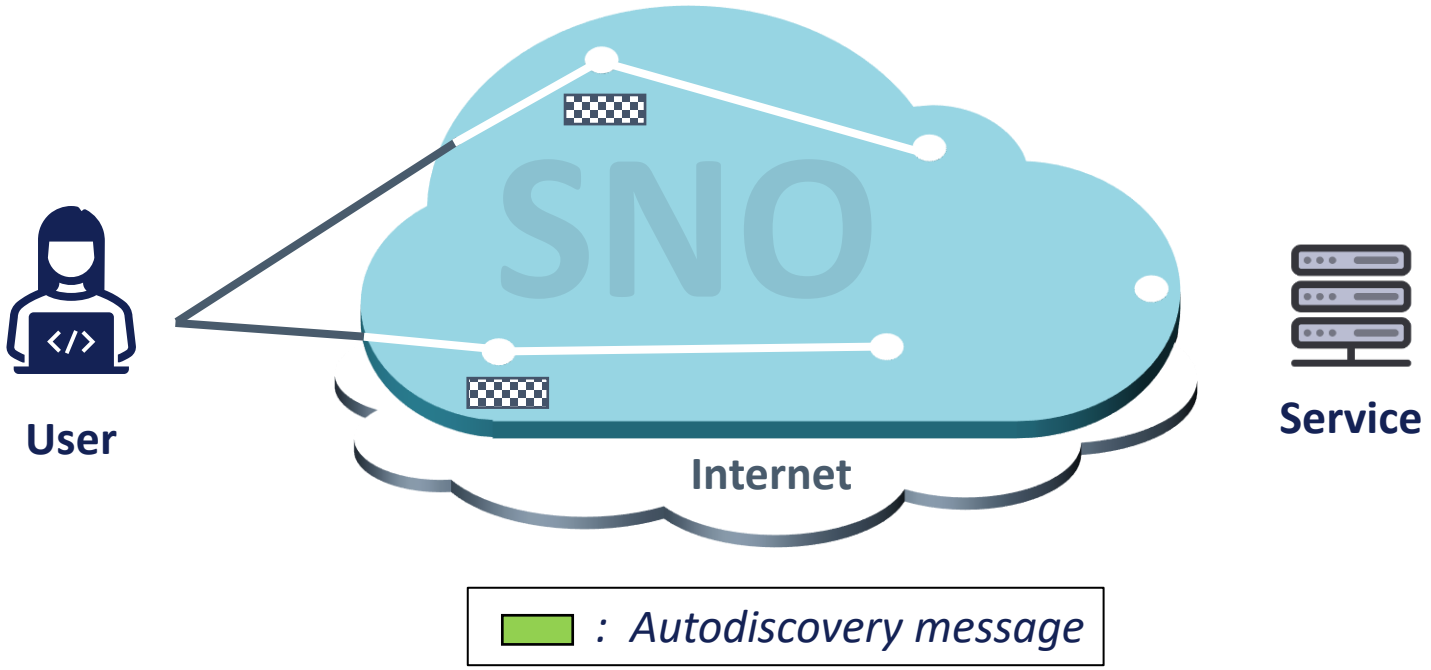
snowpack | How our VIPN works without trusted-third-party ?

Building the route



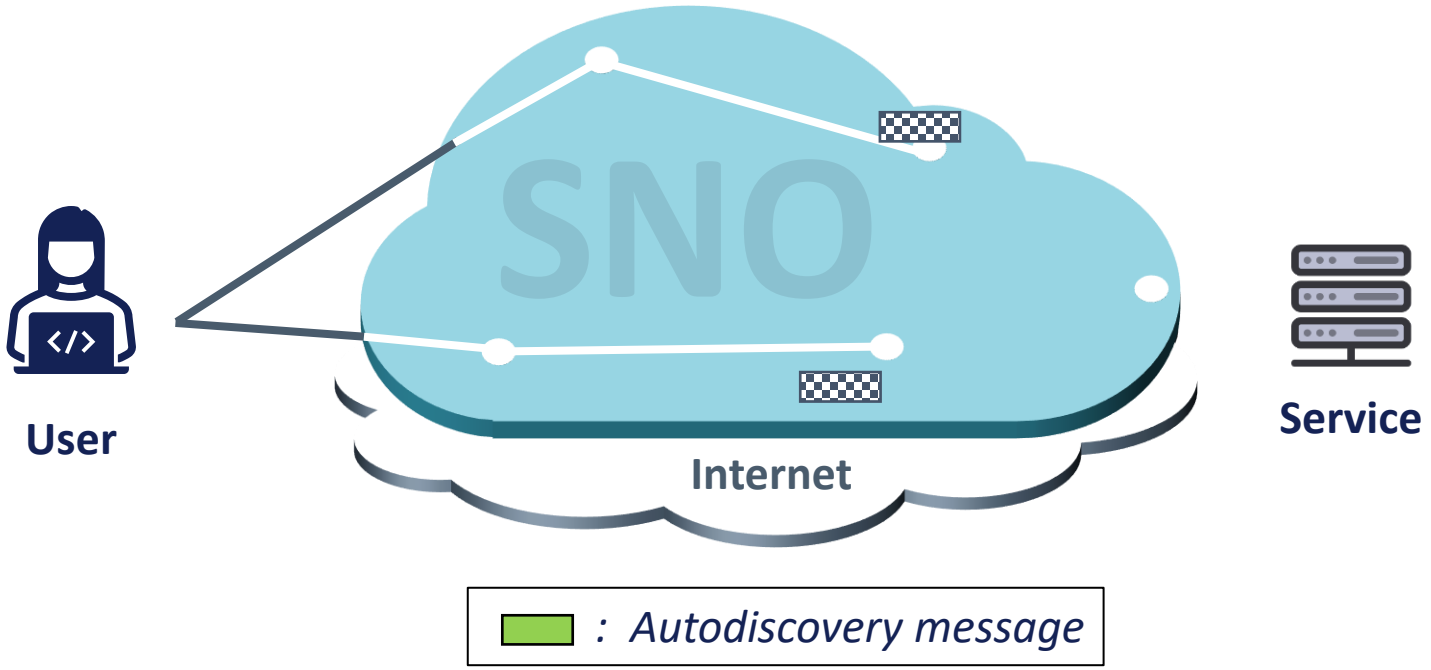
snowpack | How our VIPN works without trusted-third-party ?

Building the route



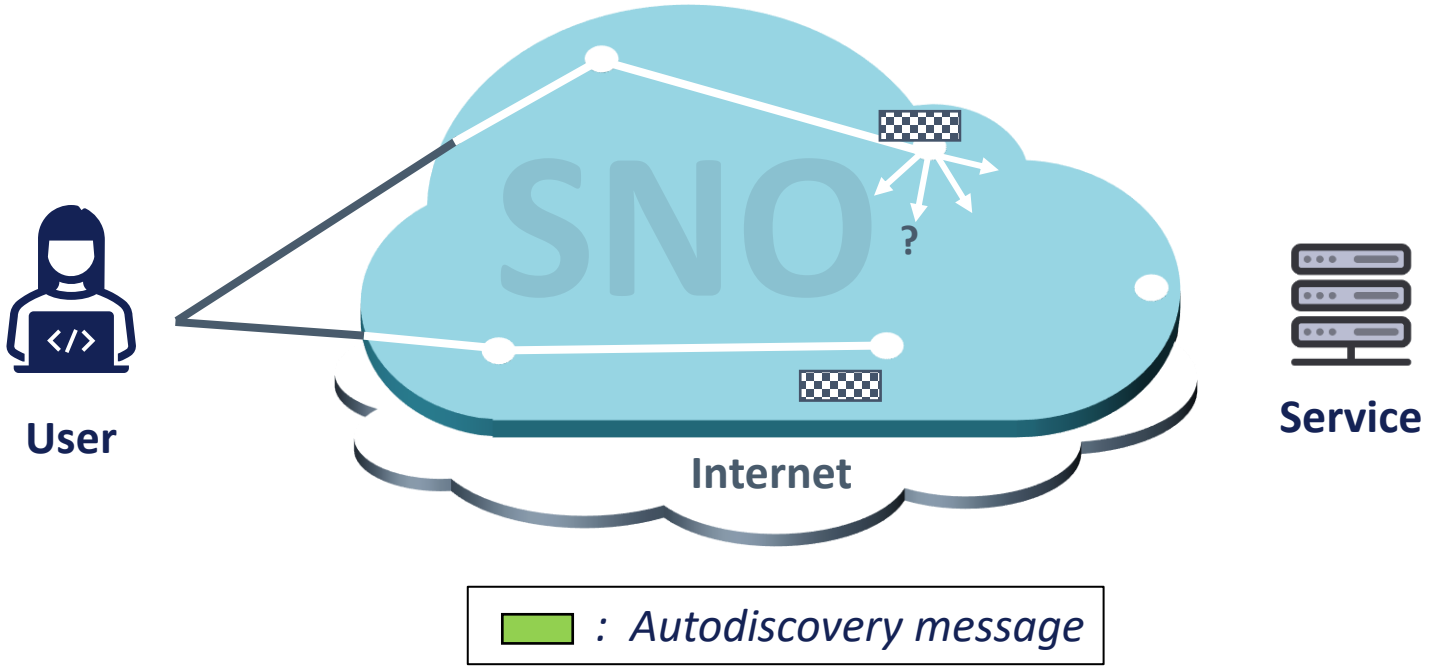
snowpack | How our VIPN works without trusted-third-party ?

Building the route



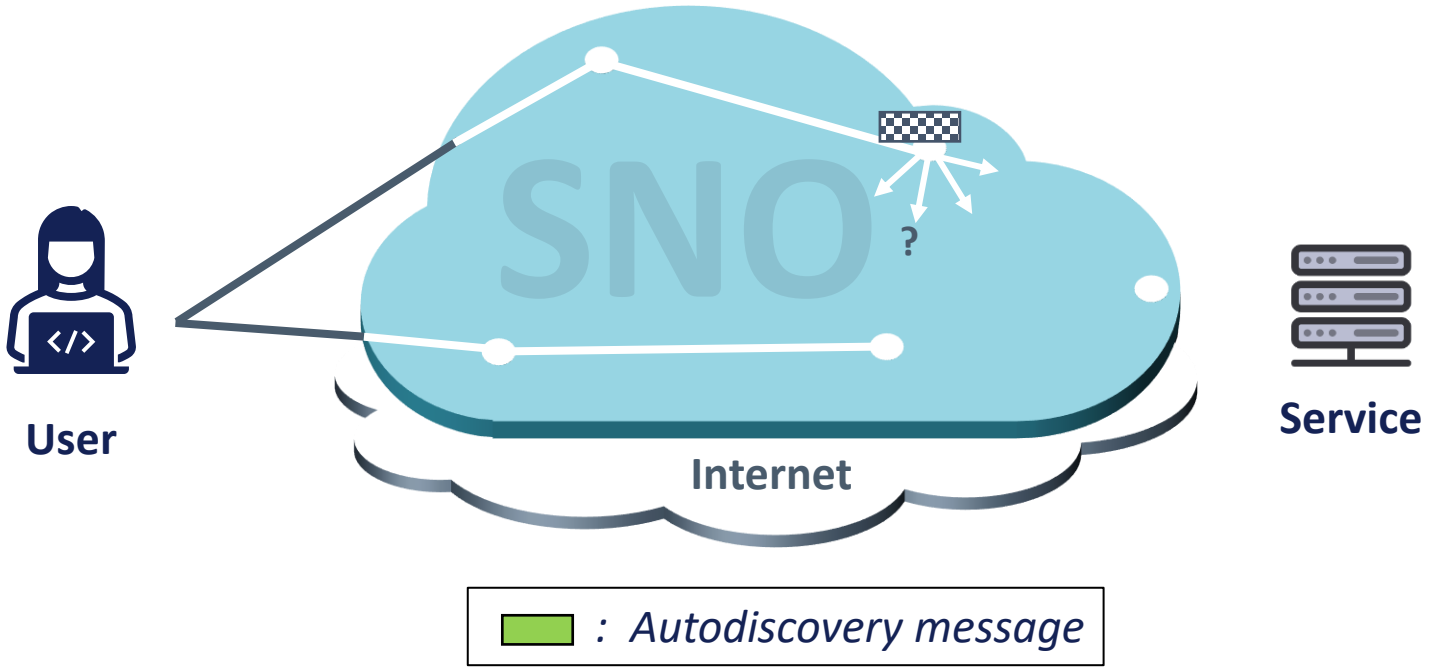
snowpack | How our VIPN works without trusted-third-party ?

Building the route



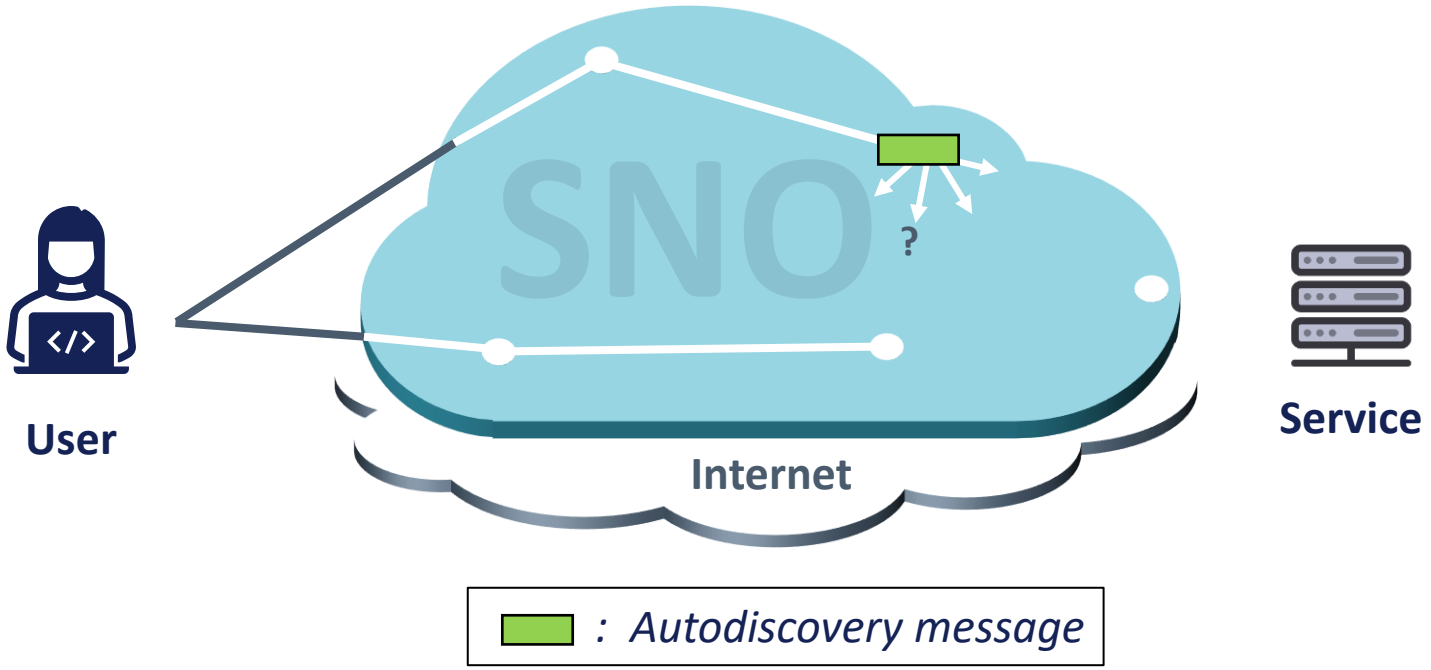
snowpack | How our VIPN works without trusted-third-party ?

Building the route



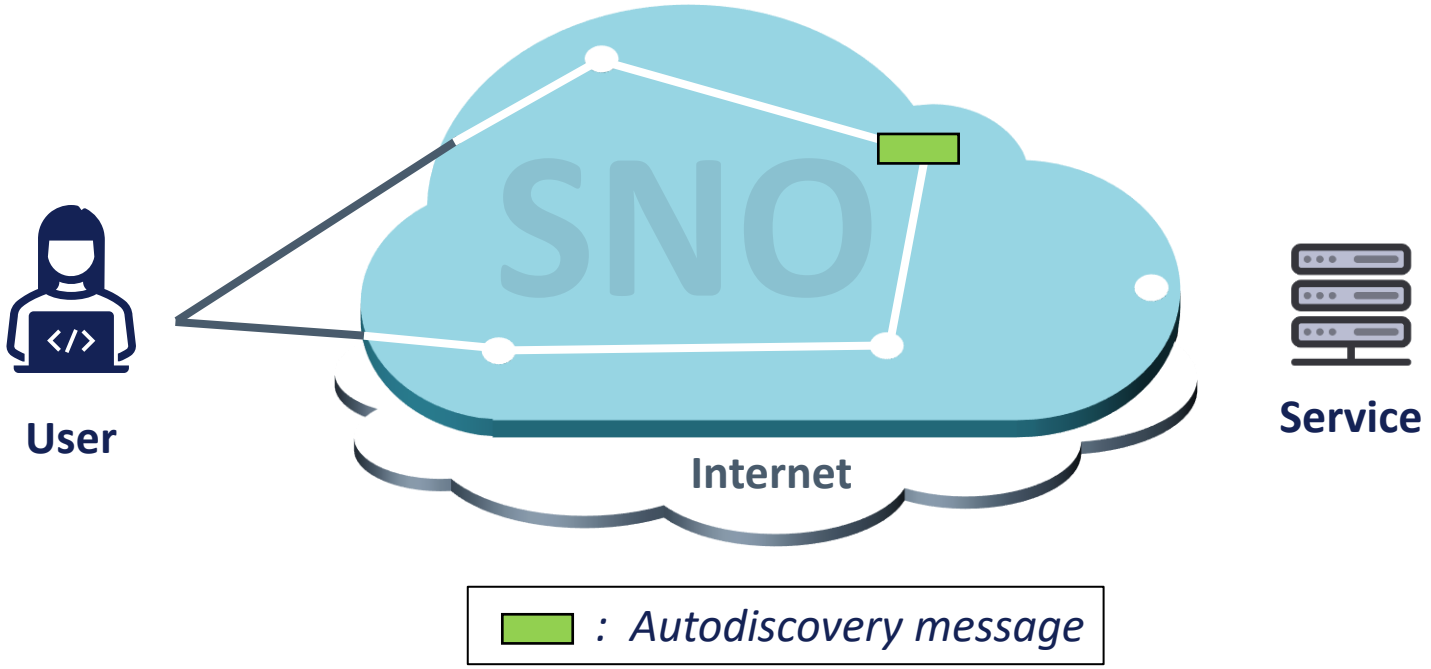
snowpack | How our VIPN works without trusted-third-party ?

Building the route



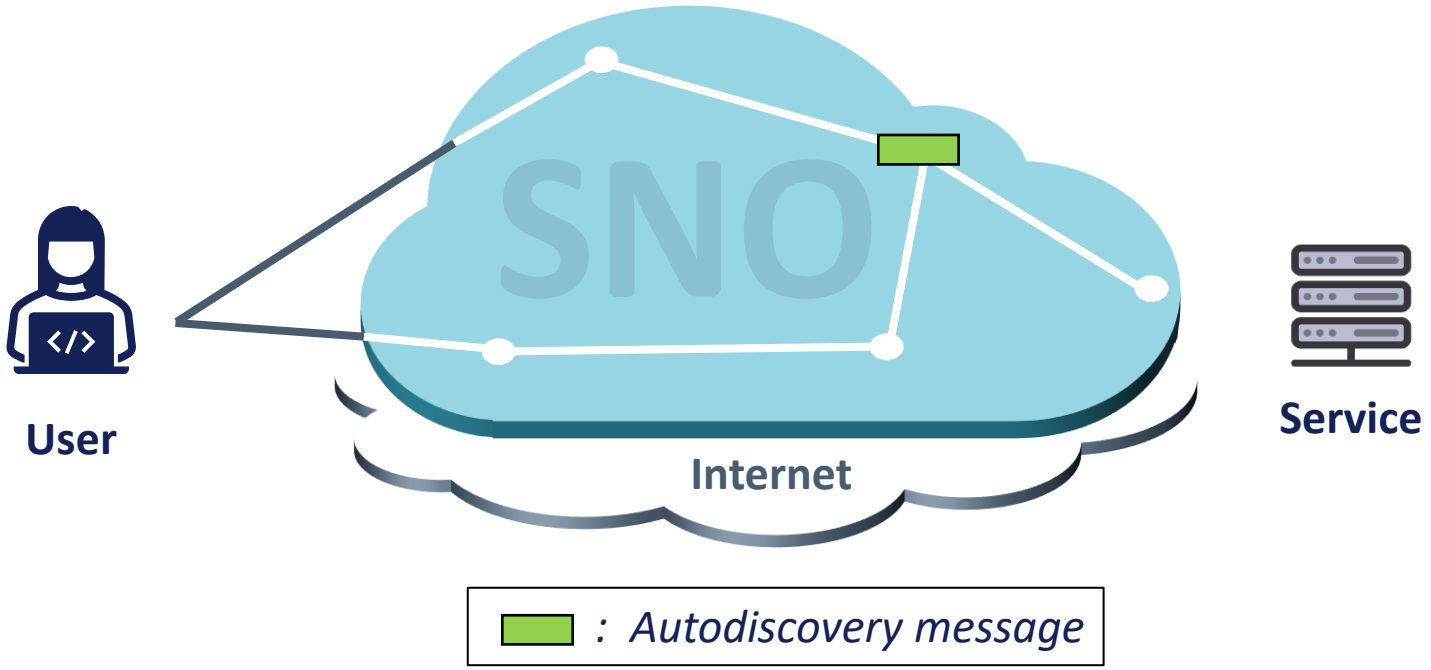
snowpack | How our VIPN works without trusted-third-party ?

Building the route



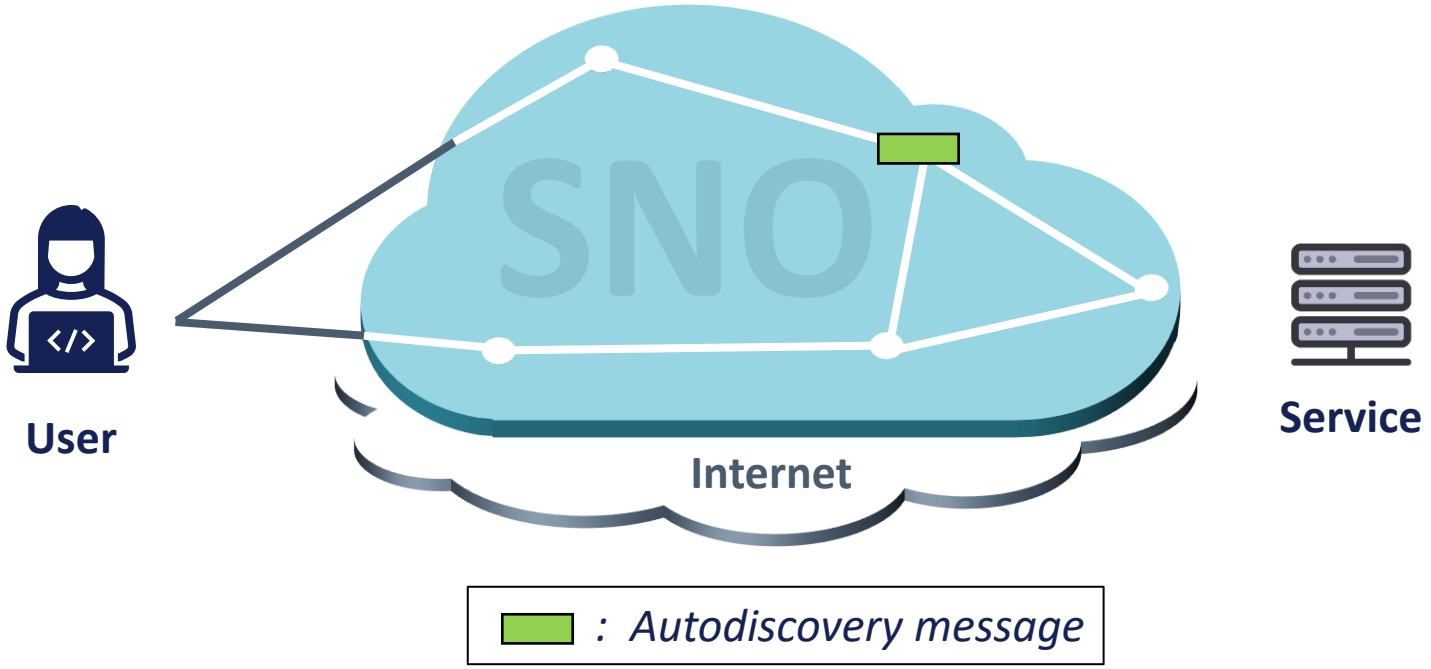
snowpack | How our VIPN works without trusted-third-party ?

Building the route

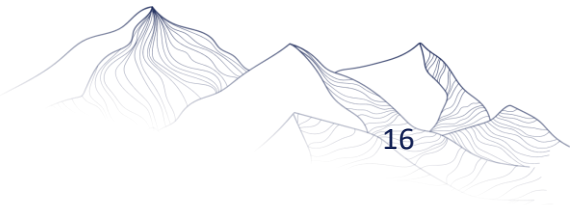


snowpack | How our VIPN works without trusted-third-party ?

Building the route



snowpack | How our VIPN works without trusted-third-party ?



snowpack | How our VIPN works without trusted-third-party ?

User*

- Internet service
- Device
- IS gateway
- IS interface

snowpack | How our VIPN works without trusted-third-party ?

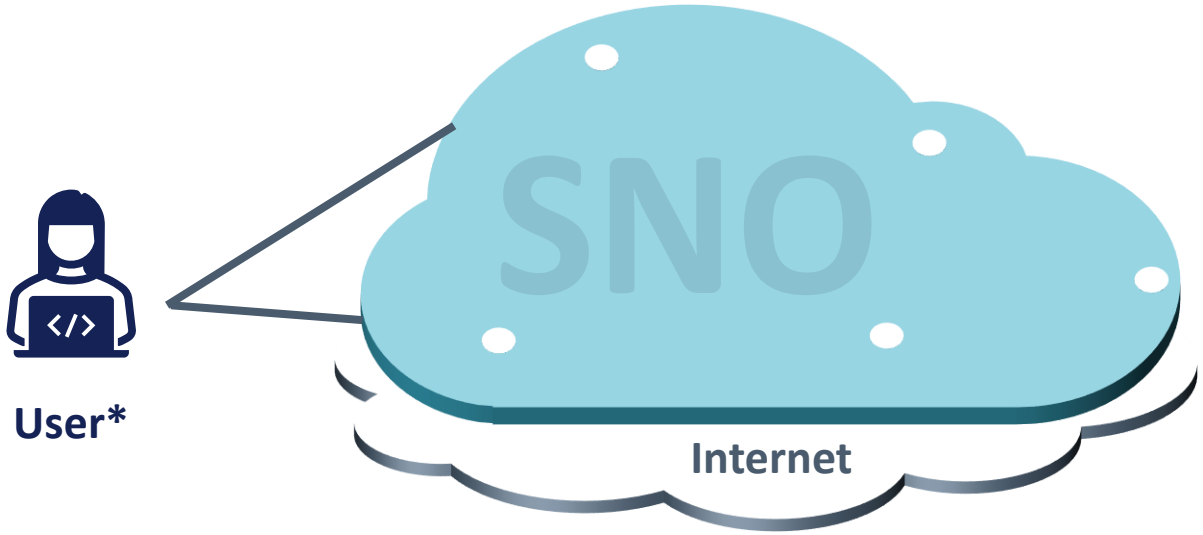
Communicating through SNO

User*

- Internet service
- Device
- IS gateway
- IS interface

snowpack | How our VIPN works without trusted-third-party ?

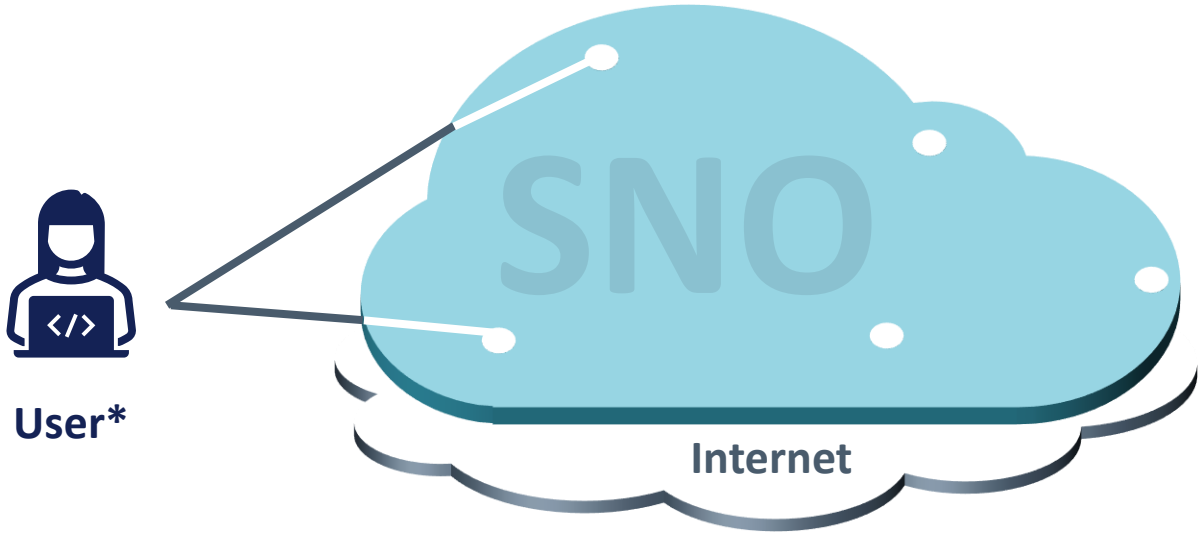
Communicating through SNO



- Internet service
- Device
- IS gateway
- IS interface

snowpack | How our VIPN works without trusted-third-party ?

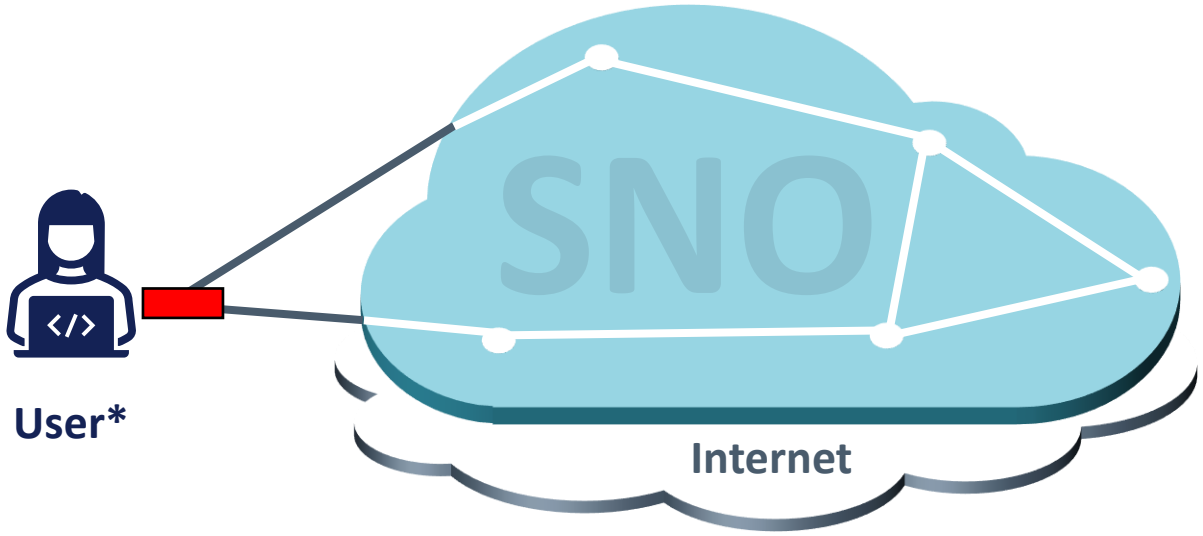
Communicating through SNO



- Internet service
- Device
- IS gateway
- IS interface

snowpack | How our VIPN works without trusted-third-party ?

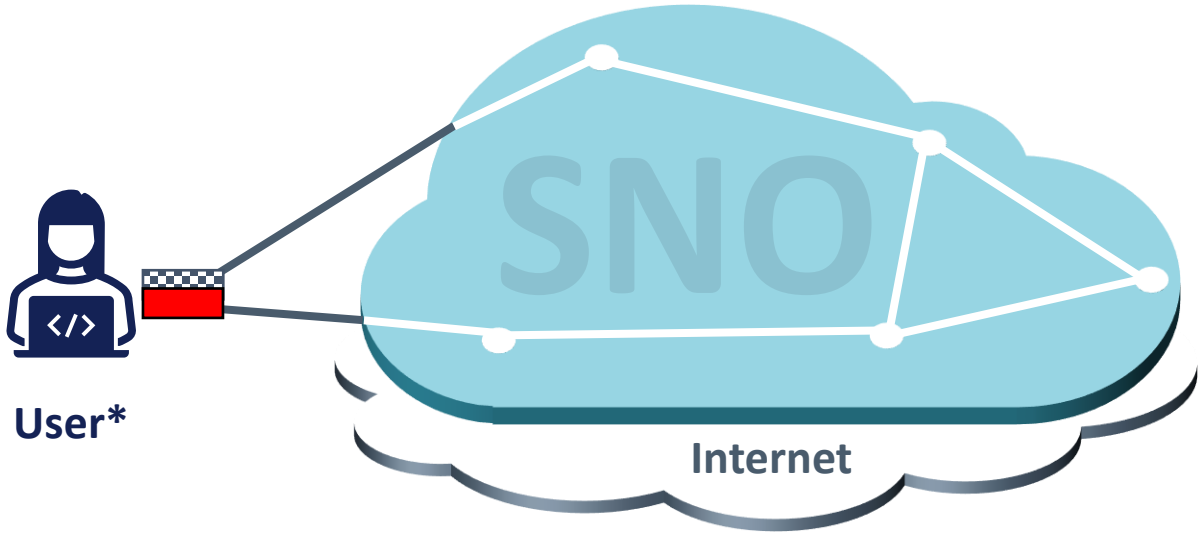
Communicating through SNO



- Internet service
- Device
- IS gateway
- IS interface

snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO

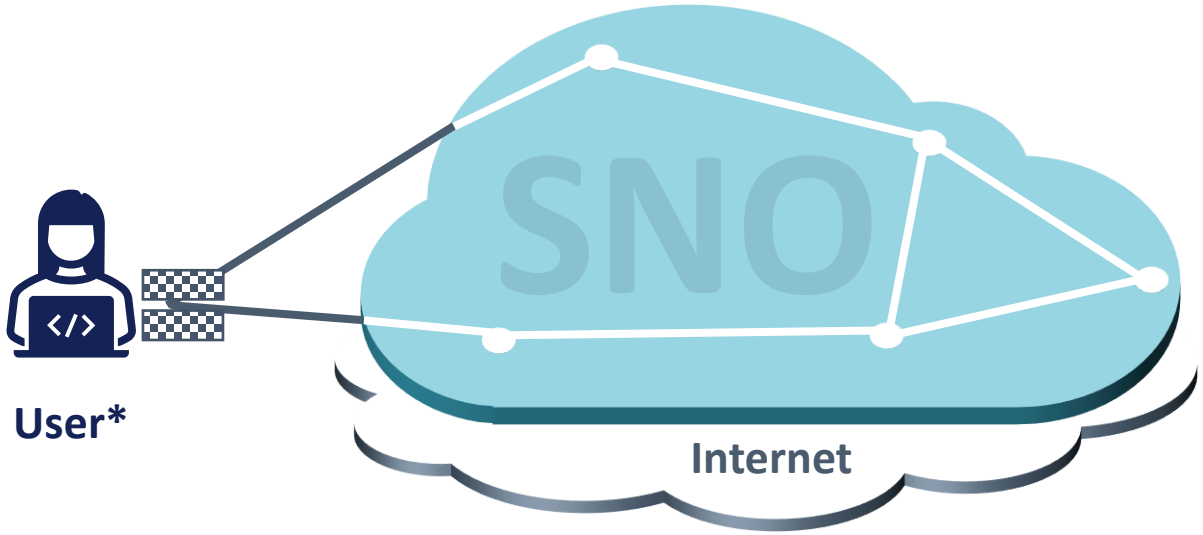


- Internet service
- Device
- IS gateway
- IS interface

: *Content message*

snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO

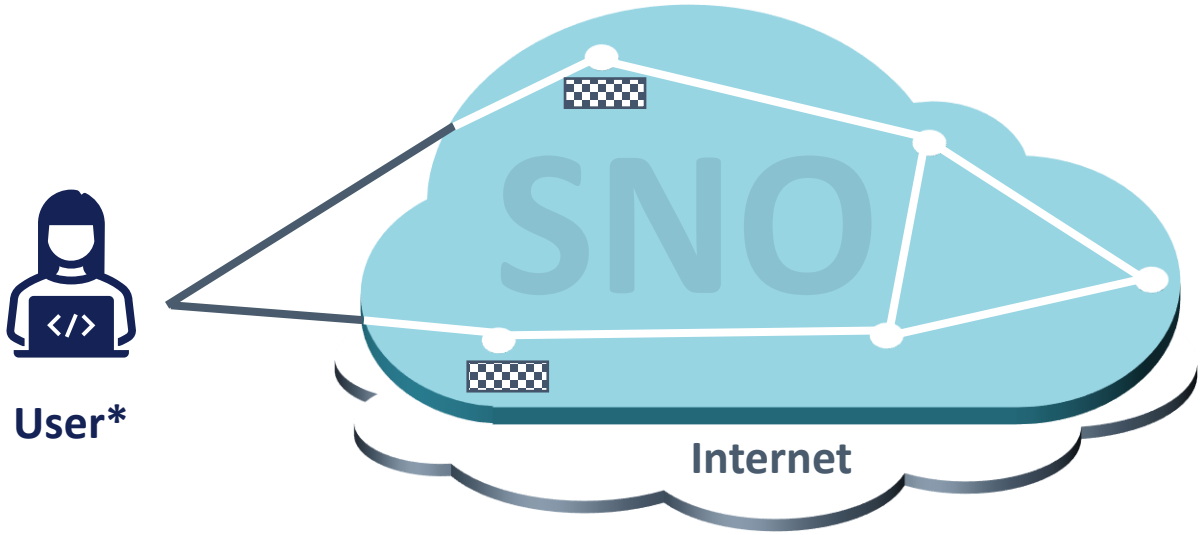


- Internet service
- Device
- IS gateway
- IS interface

: *Content message*

snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



- Internet service
- Device
- IS gateway
- IS interface

: *Content message*

snowpack | How our VIPN works without trusted-third-party ?

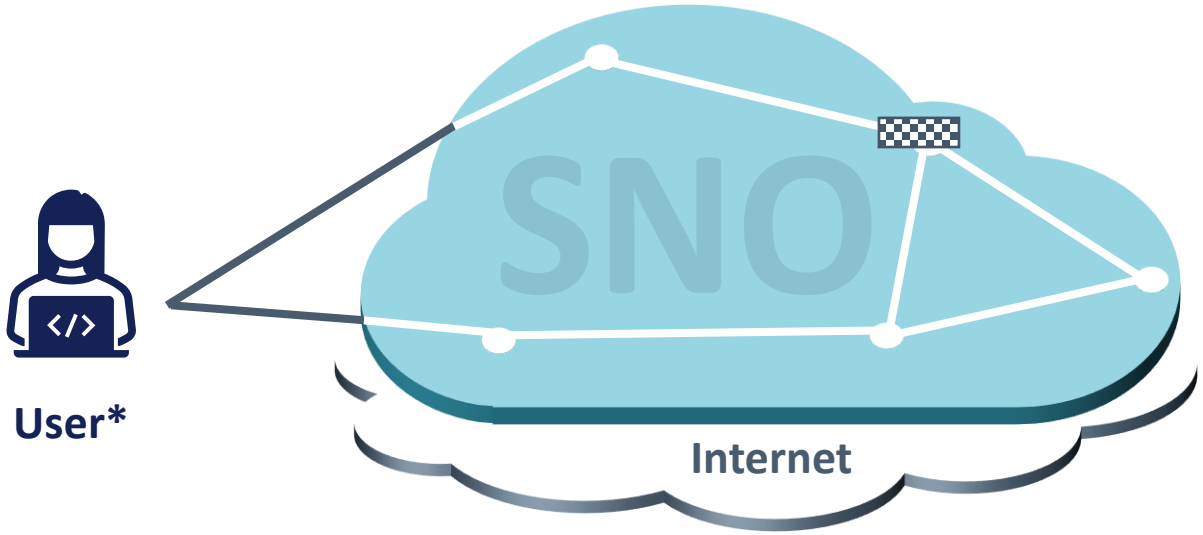
Communicating through SNO

- Internet service
- Device
- IS gateway
- IS interface

: *Content message*

snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO

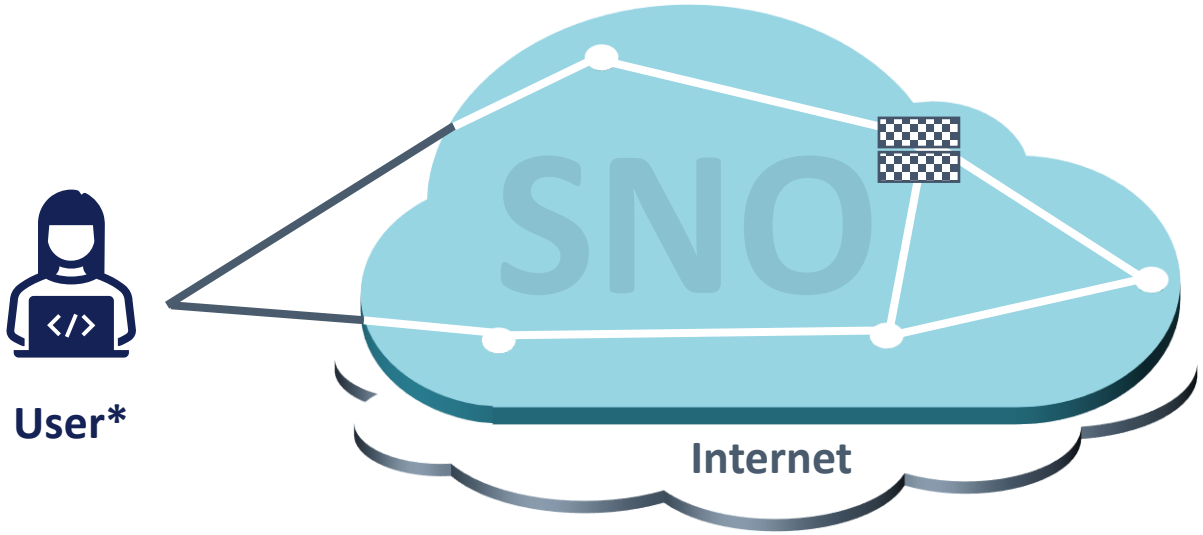


- Internet service
- Device
- IS gateway
- IS interface

: *Content message*

snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO

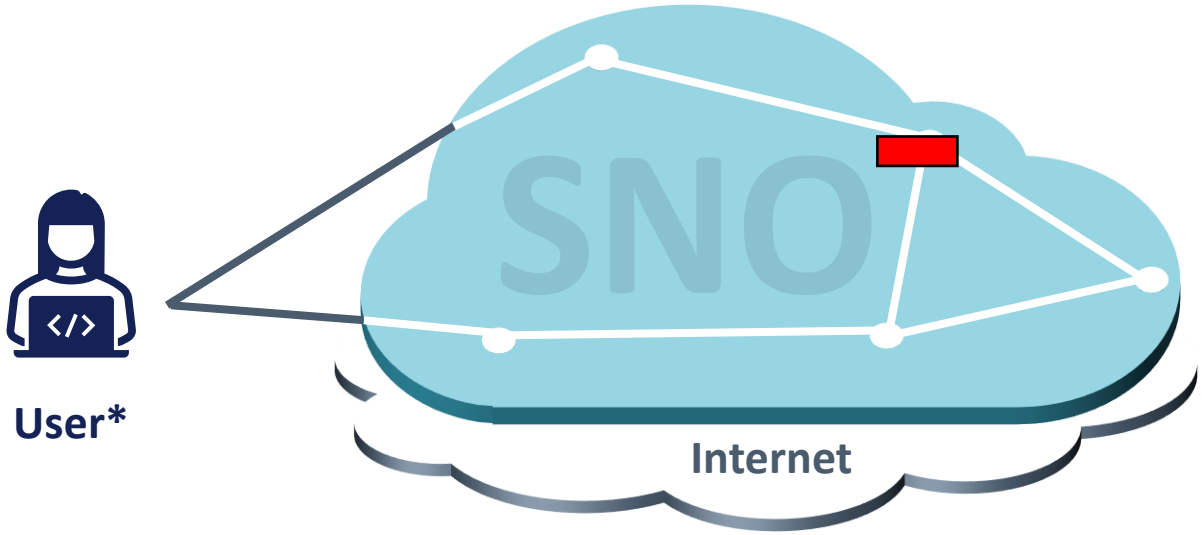


- Internet service
- Device
- IS gateway
- IS interface

: *Content message*

snowpack | How our VIPN works without trusted-third-party ?

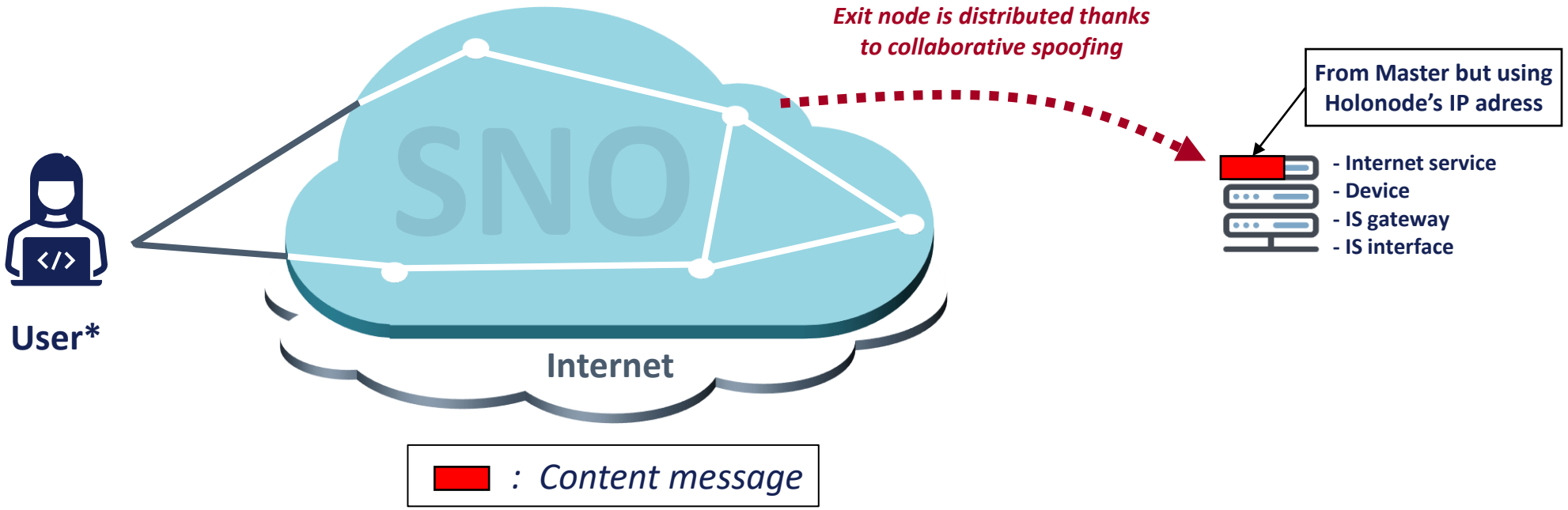
Communicating through SNO



- Internet service
- Device
- IS gateway
- IS interface

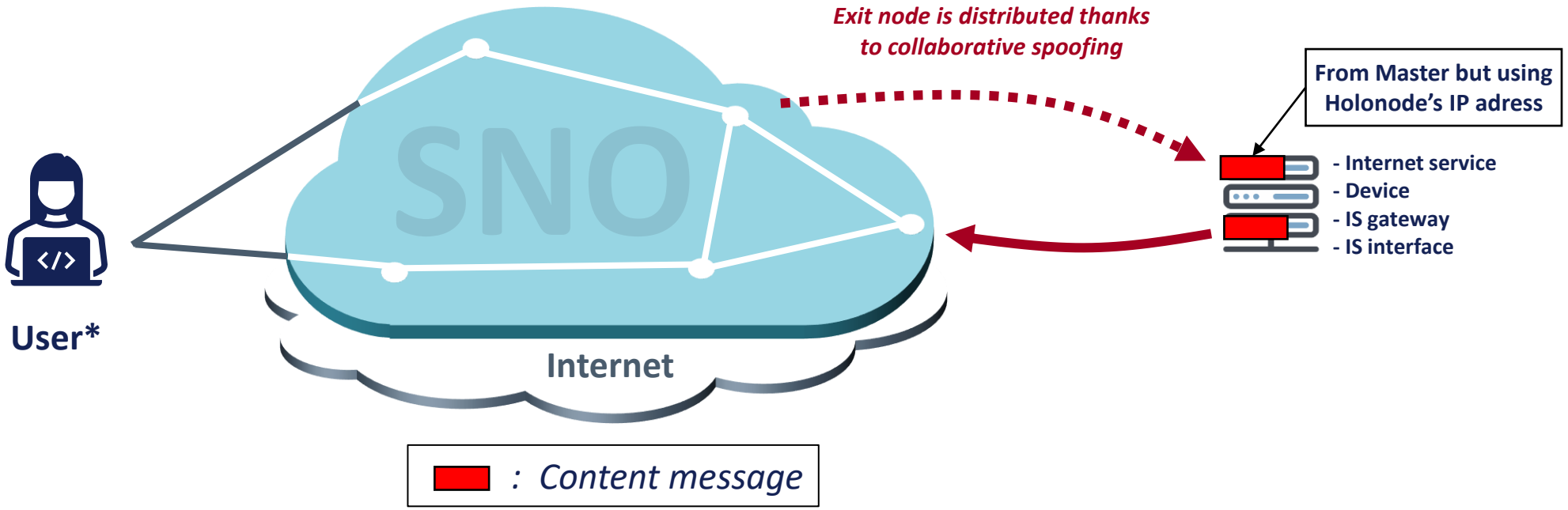
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



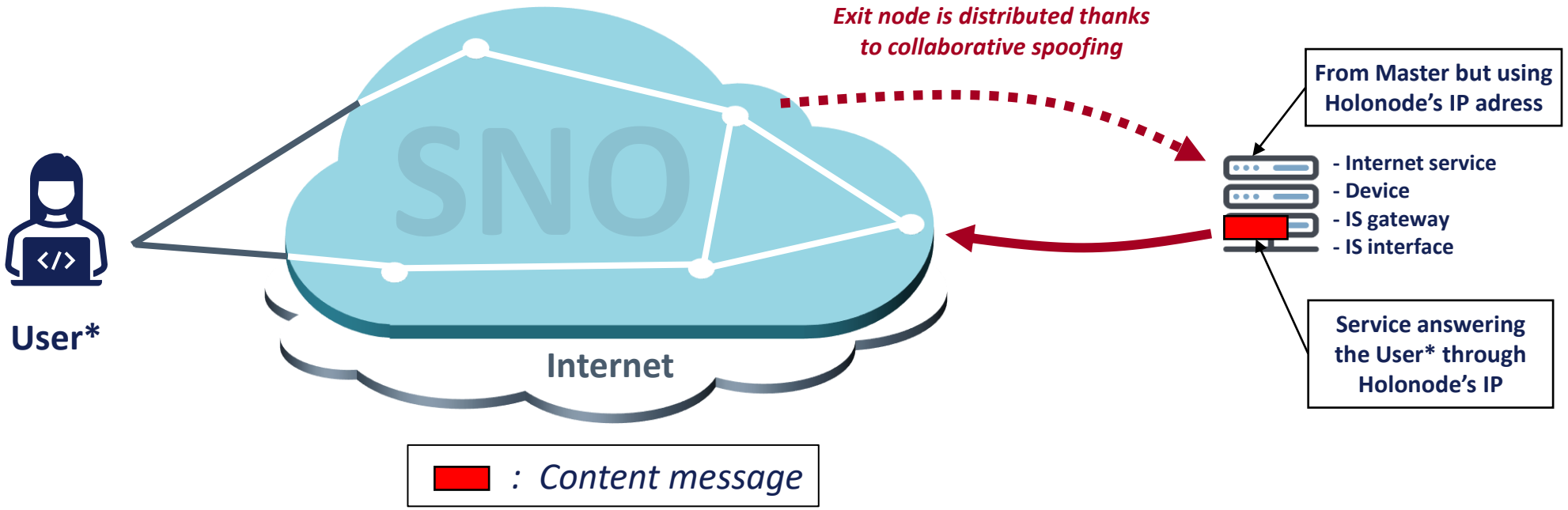
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



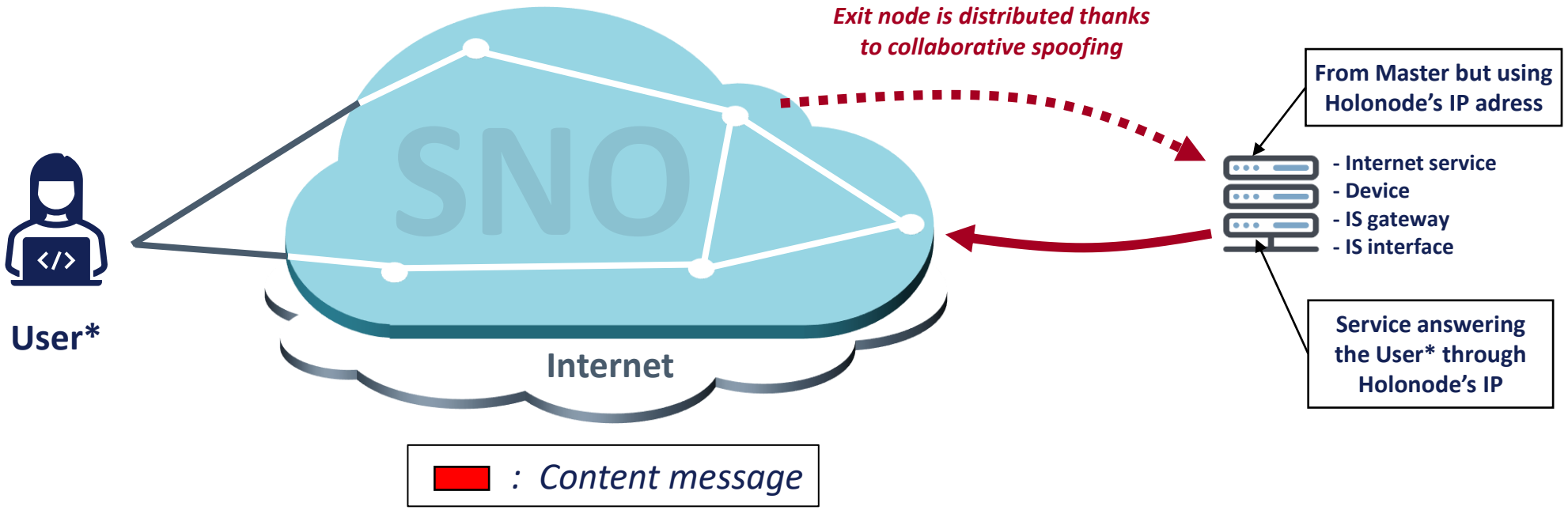
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



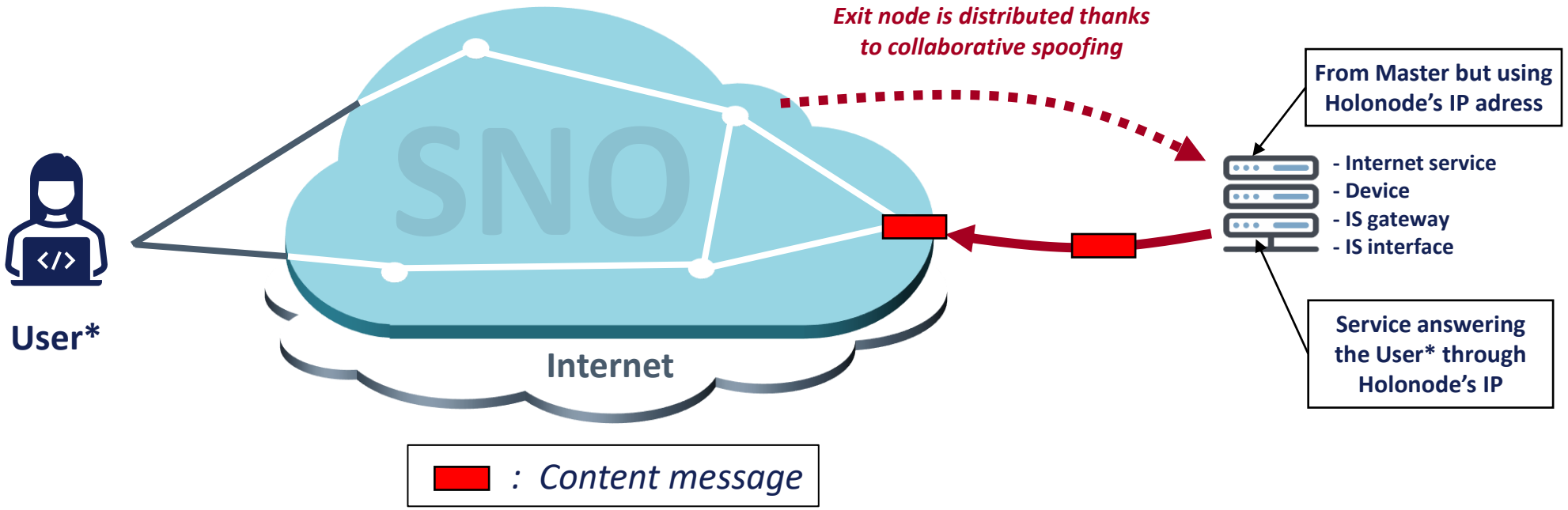
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



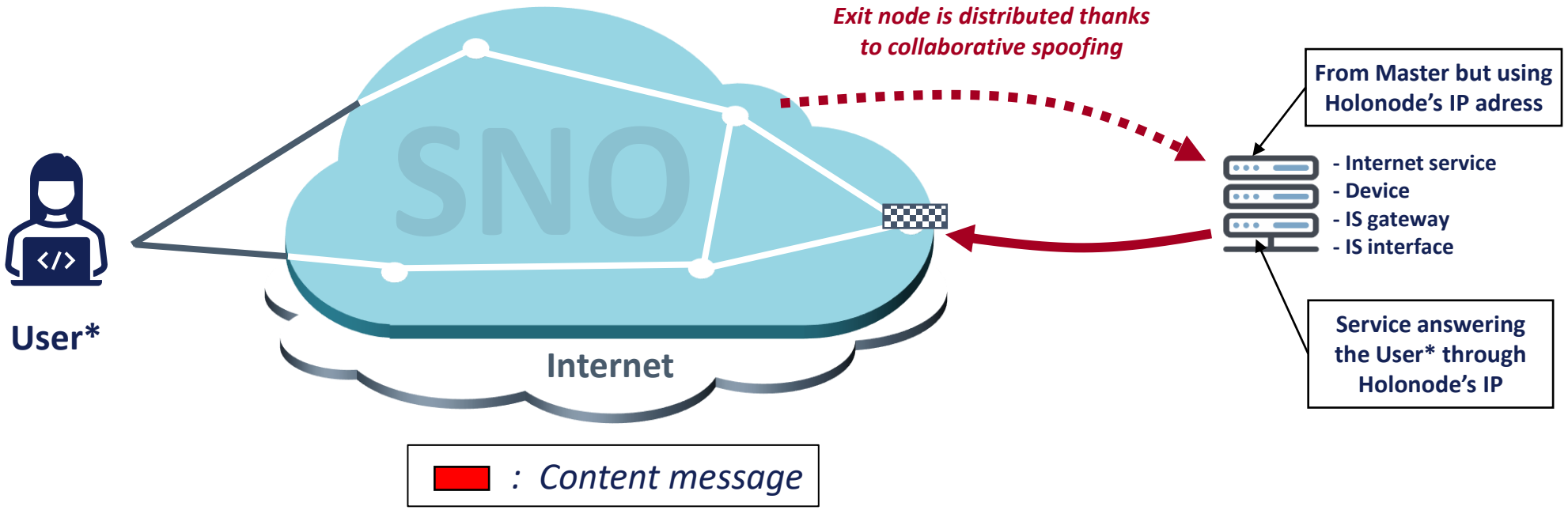
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



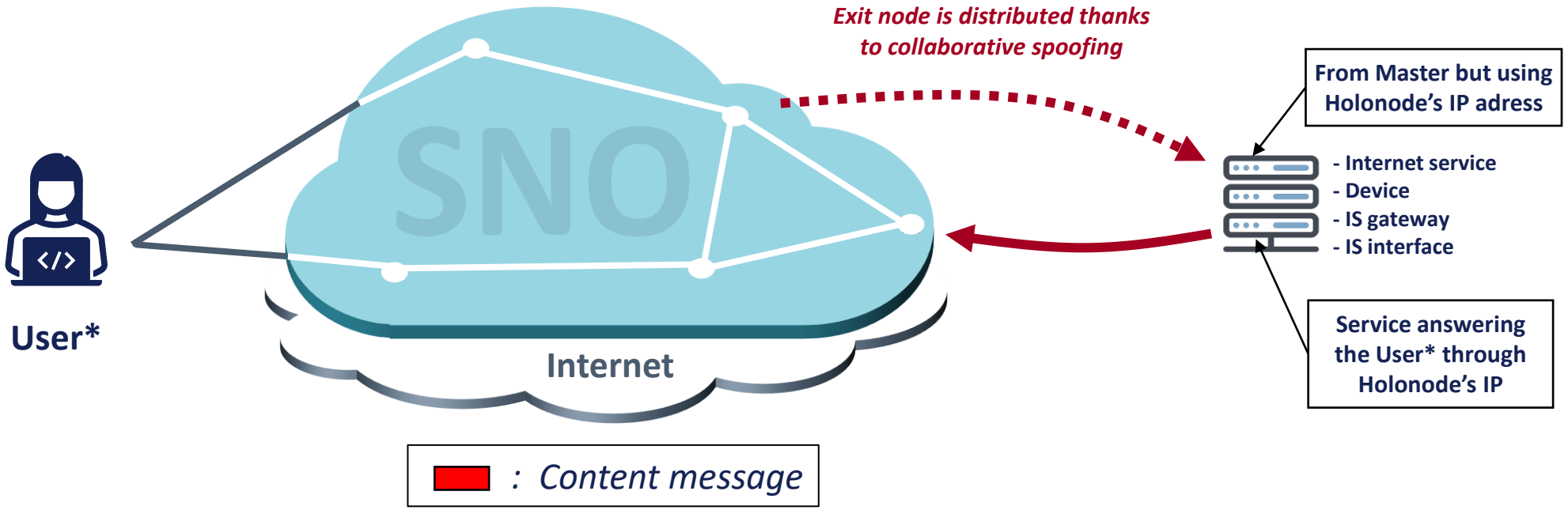
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



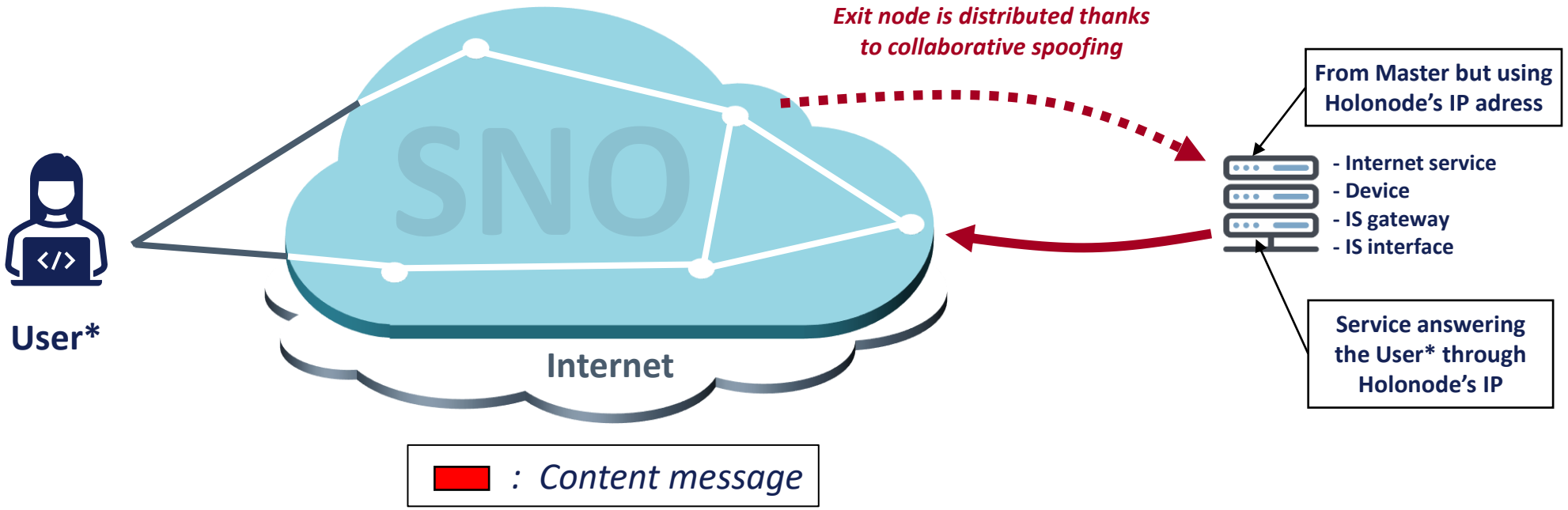
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



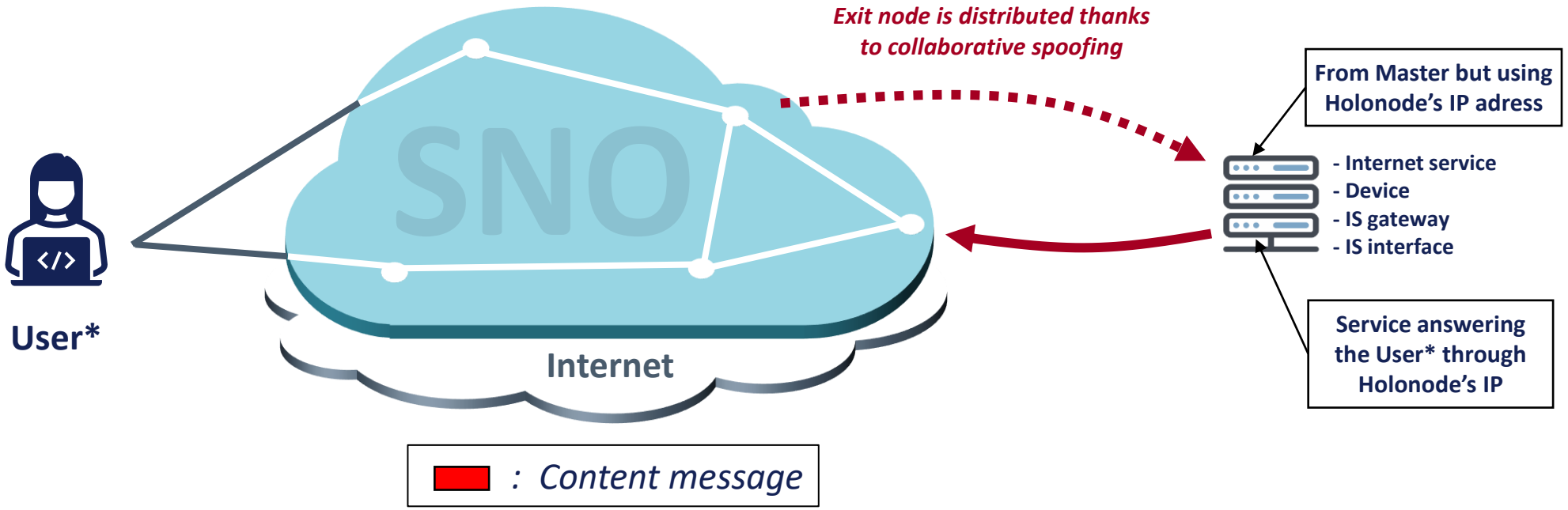
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



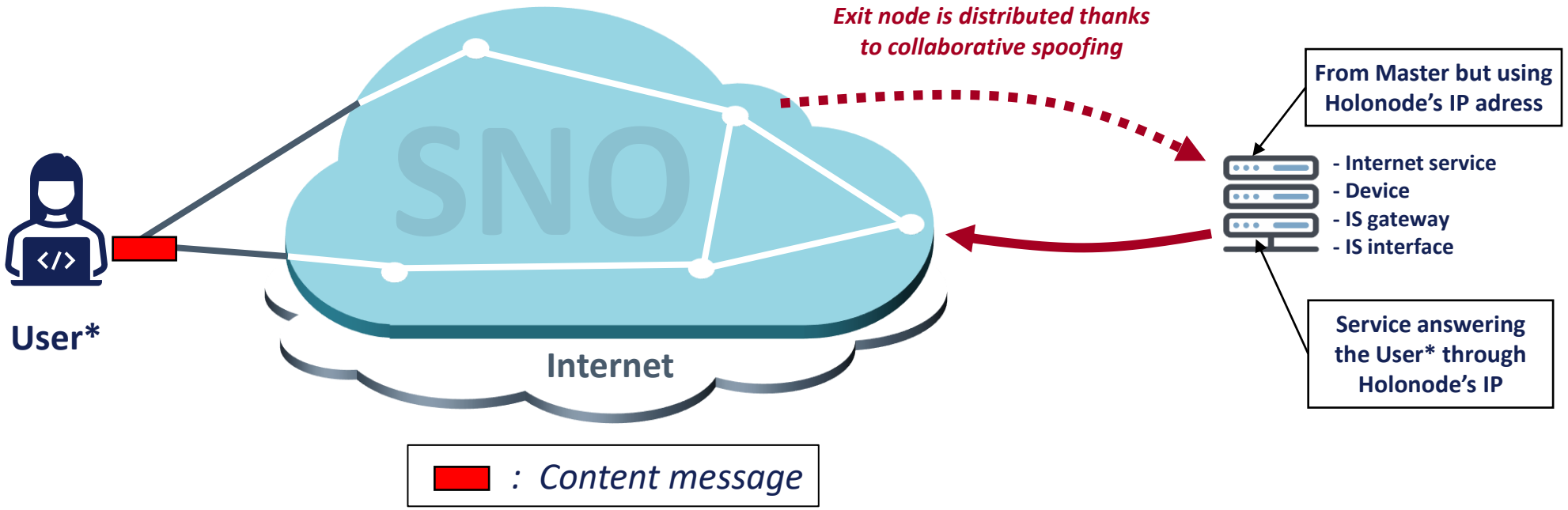
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



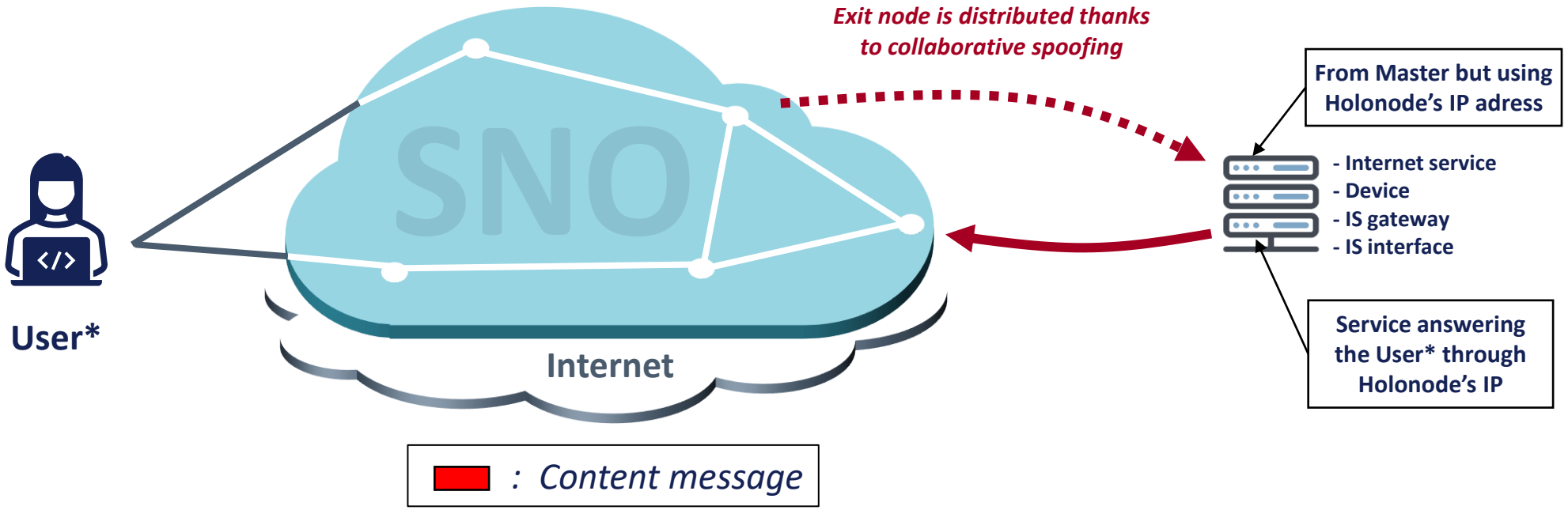
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



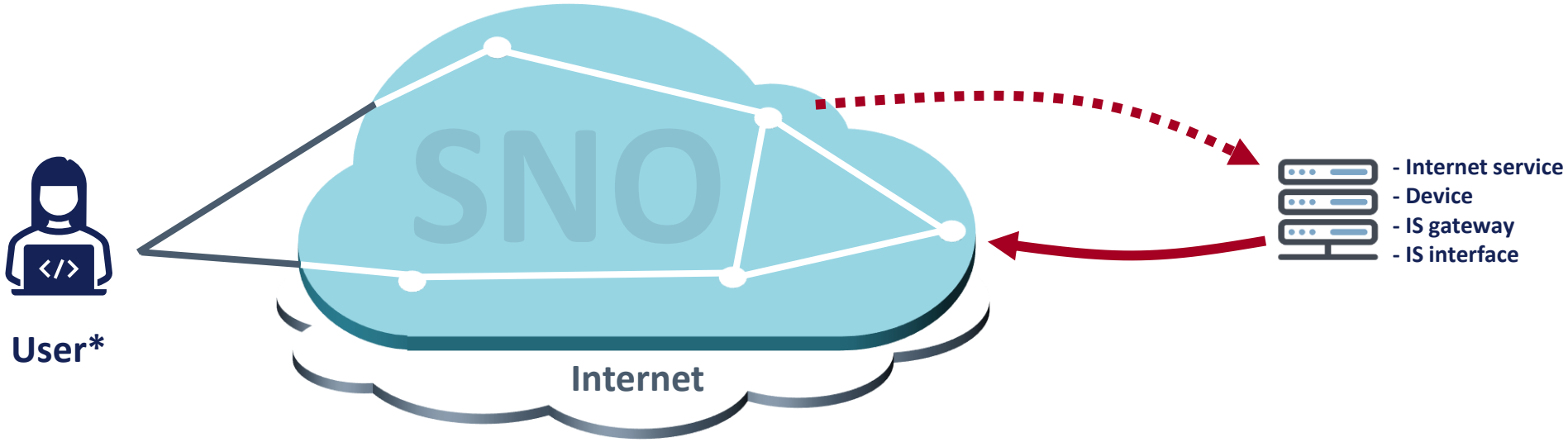
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



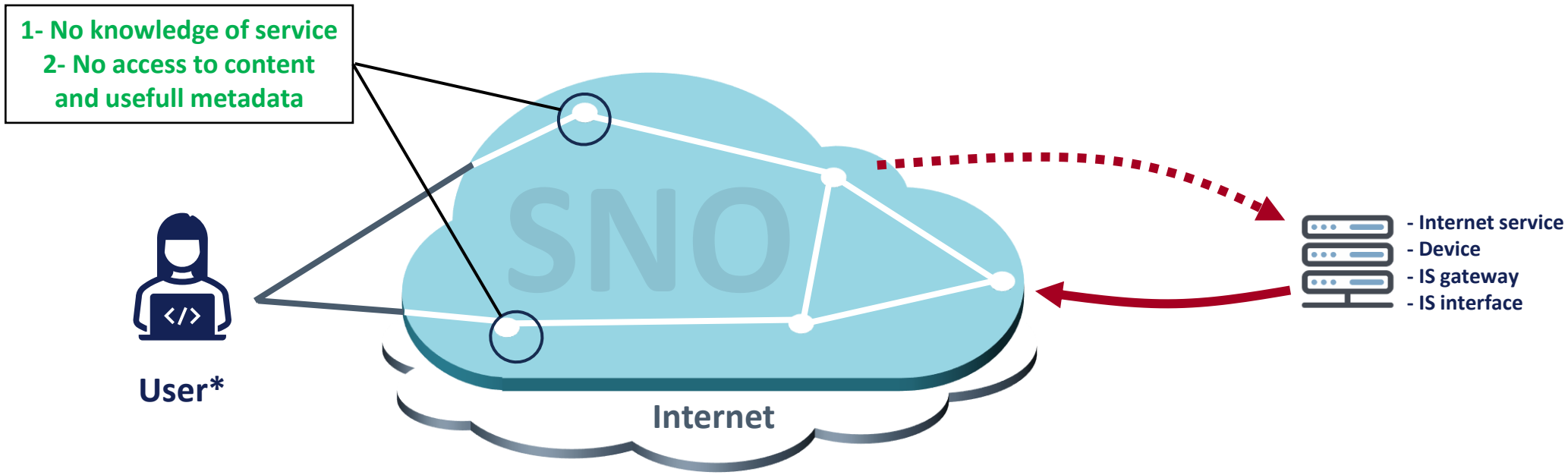
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



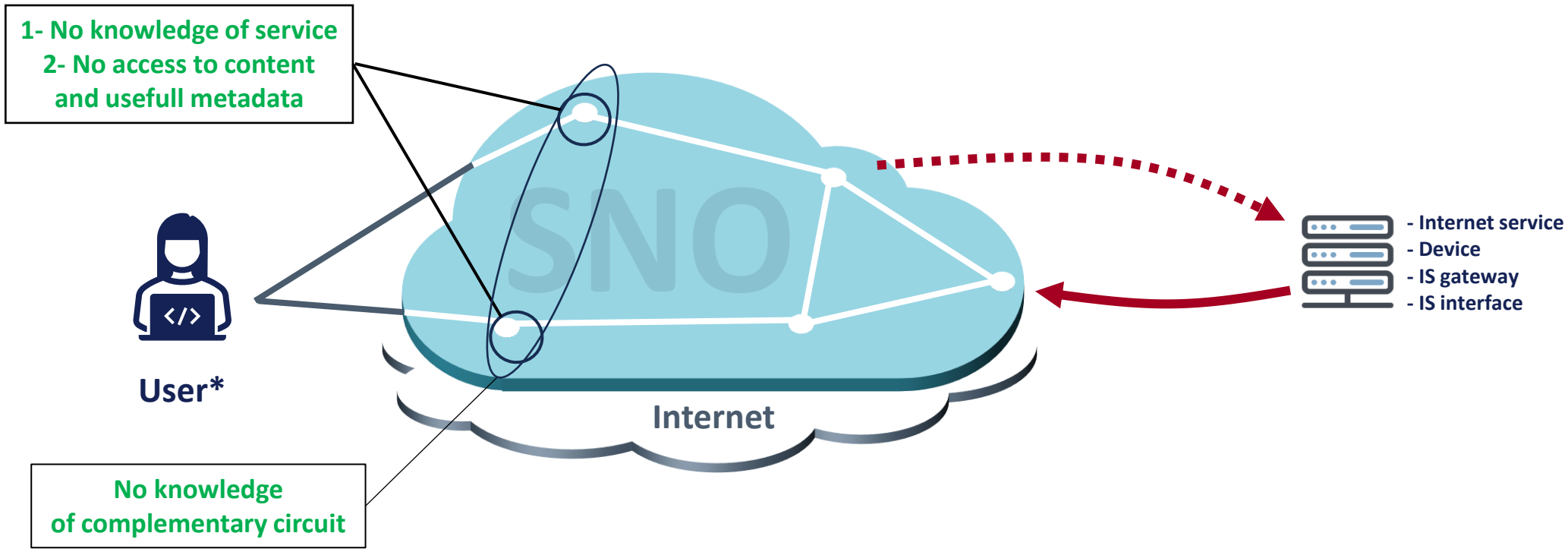
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



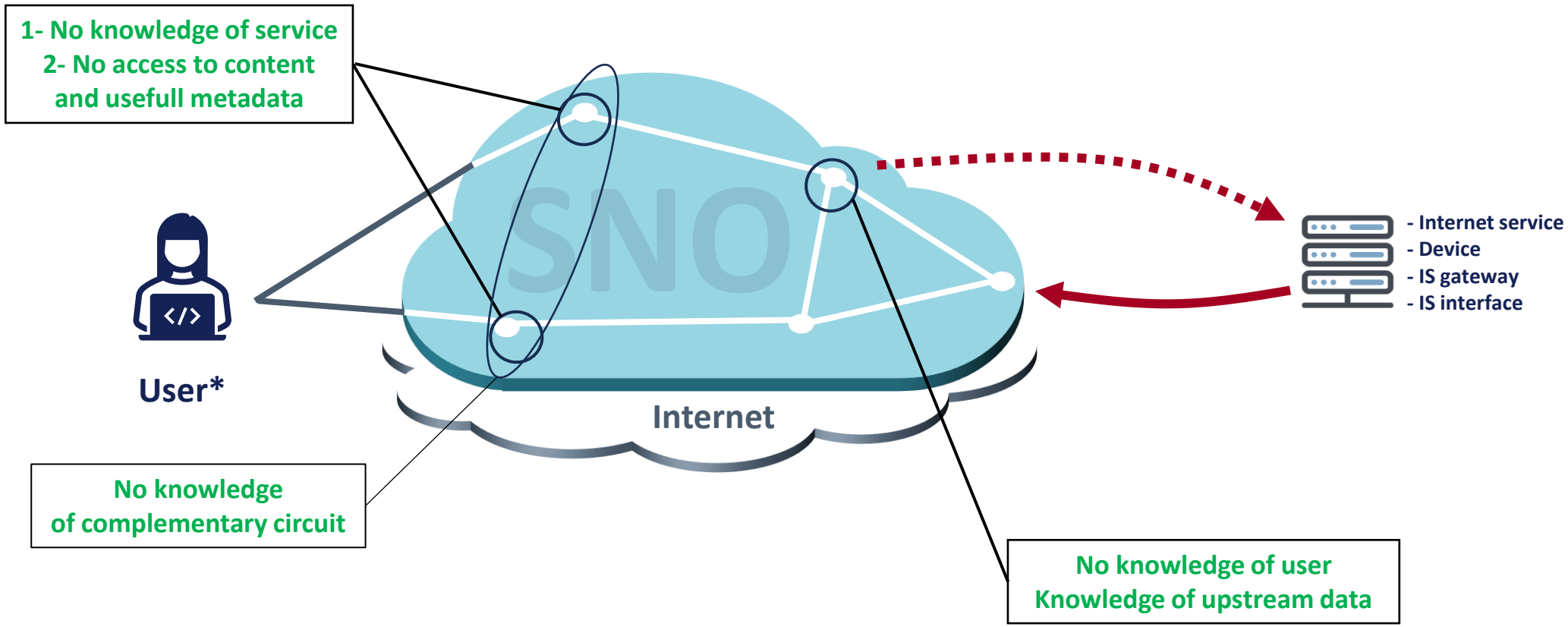
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



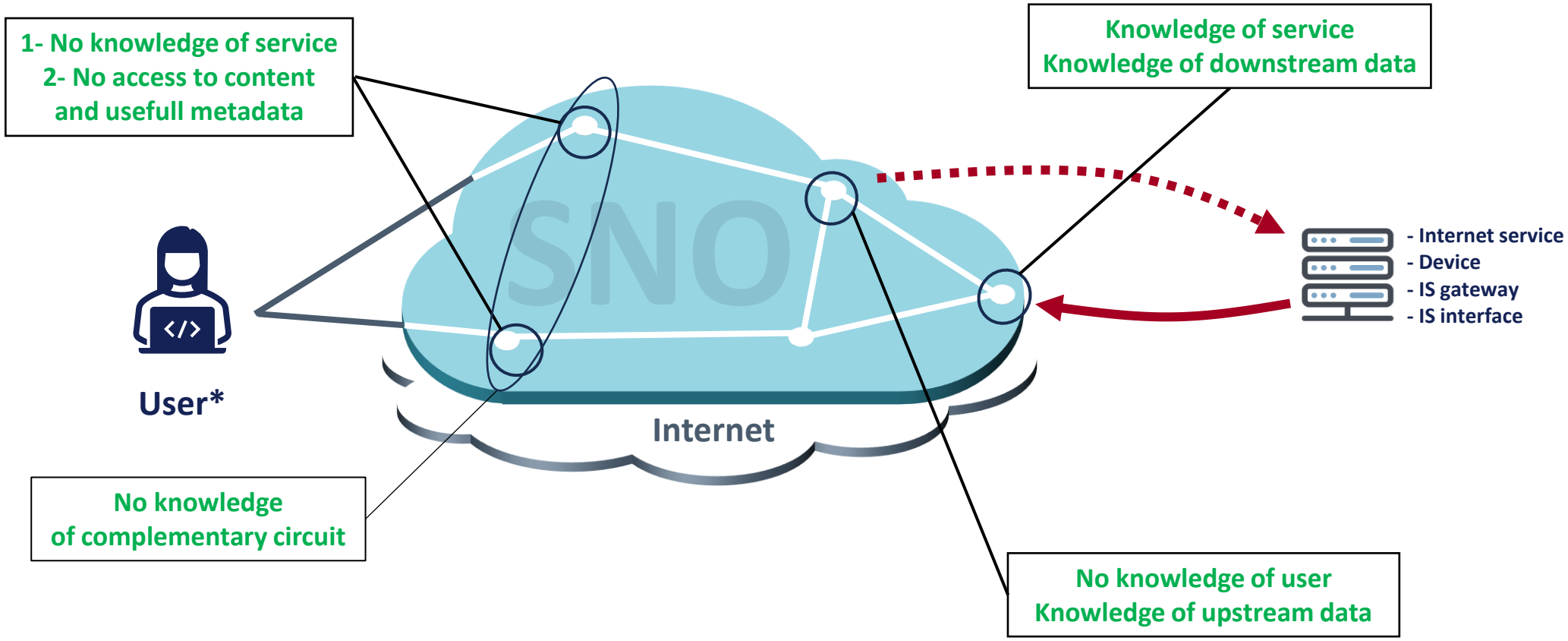
snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO

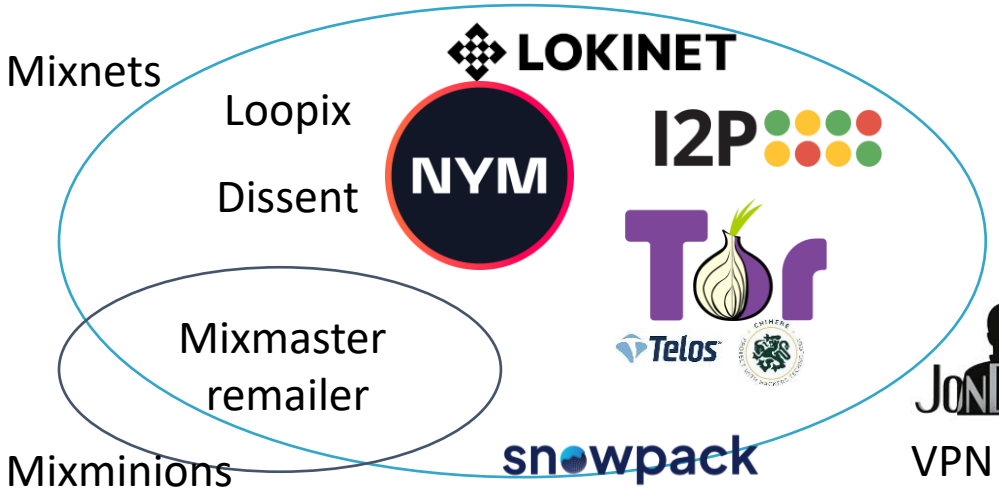


snowpack | How our VIPN works without trusted-third-party ?

Communicating through SNO



From classical networking to Anonymity Networks Overview



VPNs

CyberGhost

ExpressVPN

NordVPN

JONDONYM

VPN Chains

Decentralized
VPN (dVPN)

orchid

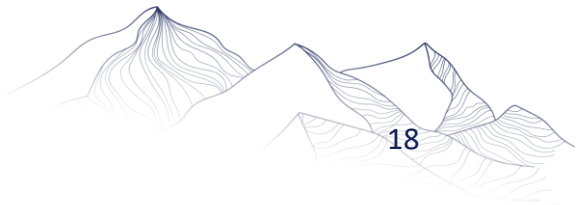
hopr

mysterium network

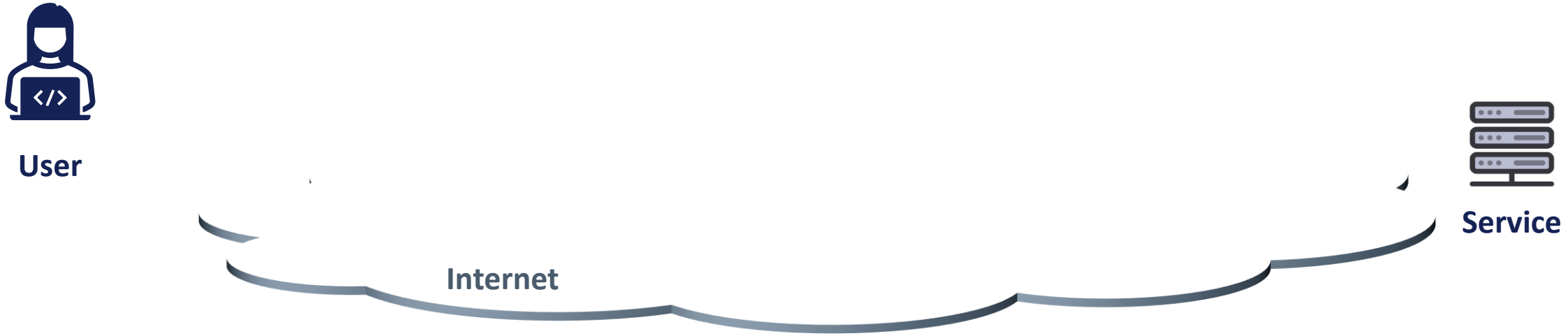
Freenet

IPFS

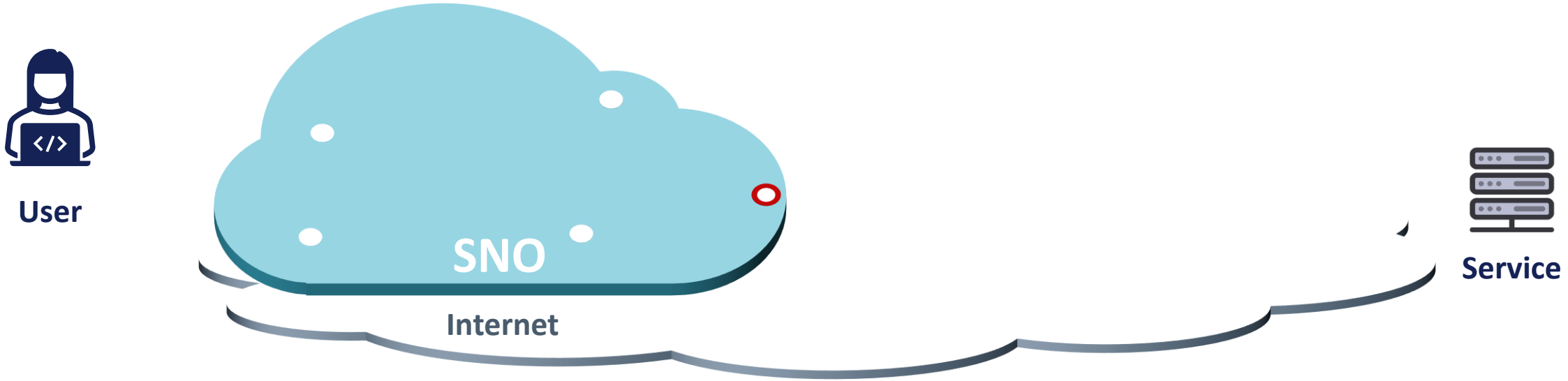
snowpack | Also feasible to combine different solutions



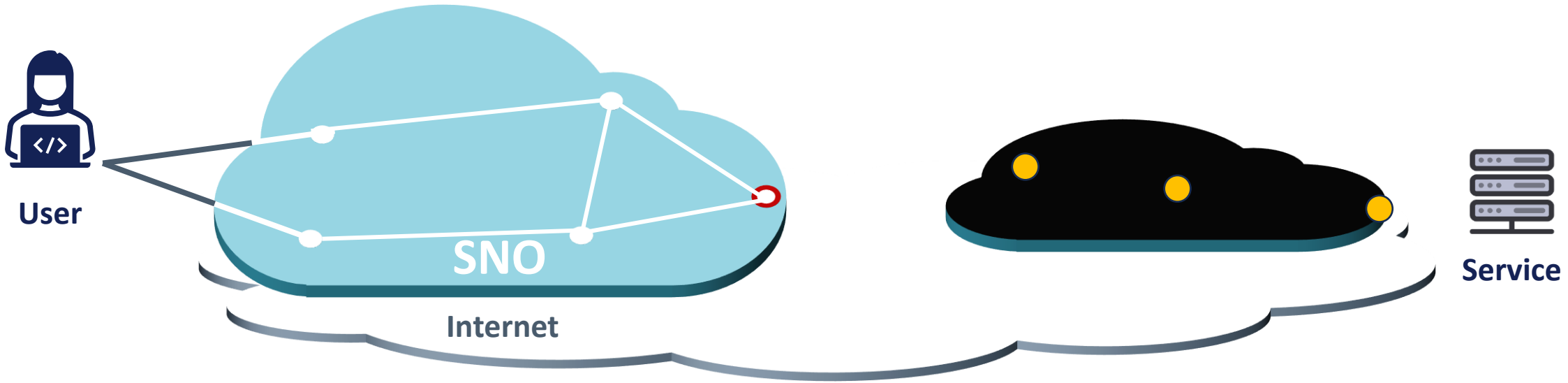
snowpack | Also feasible to combine different solutions



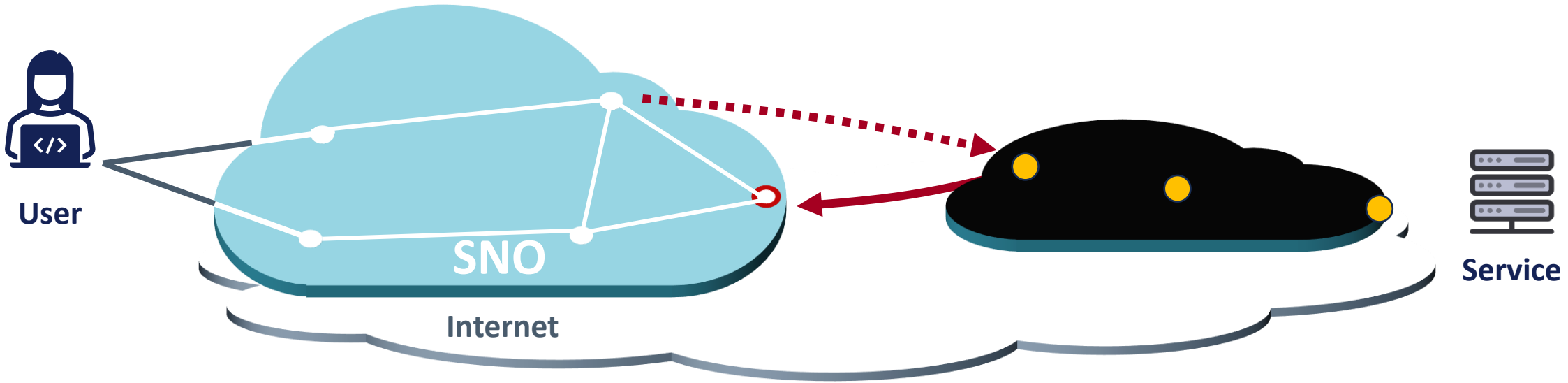
snowpack | Also feasible to combine different solutions



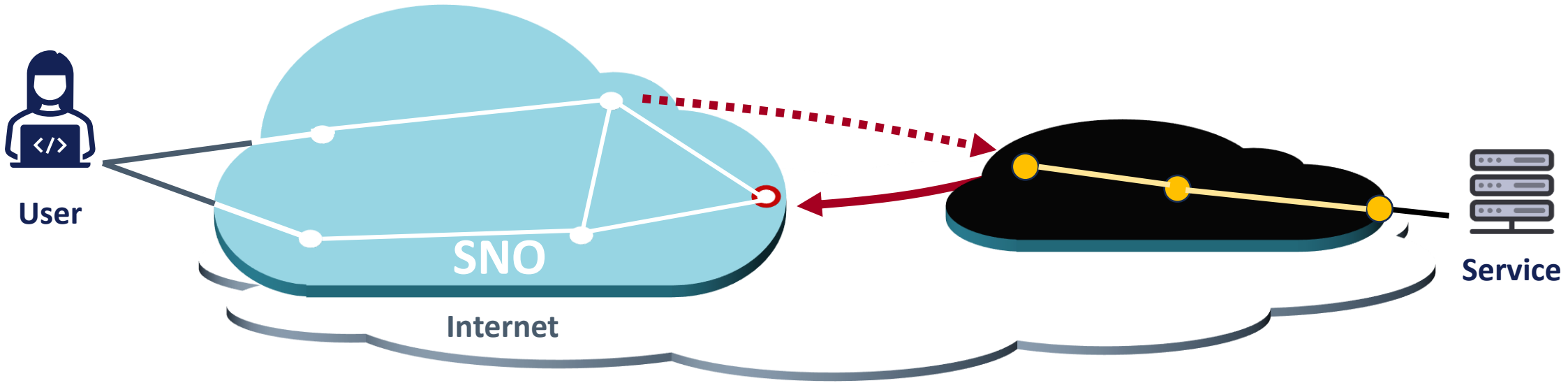
snowpack | Also feasible to combine different solutions



snowpack | Also feasible to combine different solutions



snowpack | Also feasible to combine different solutions

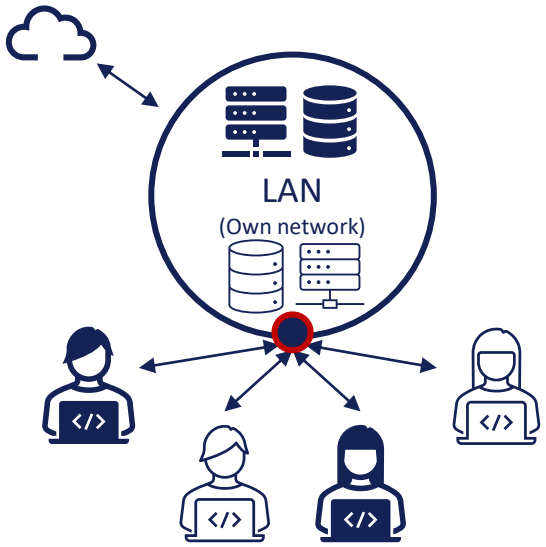


snowpack

Secure end-to-end communications

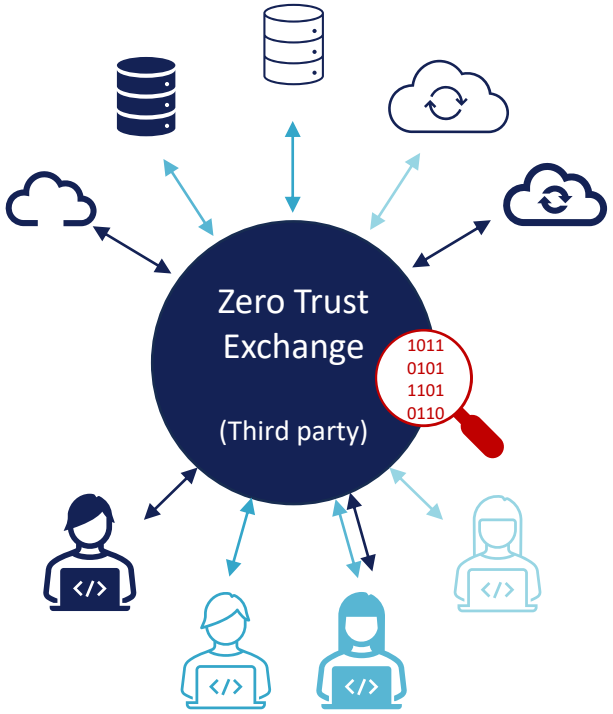
Solutions and interests of VIPN

snowpack | Comparisons …



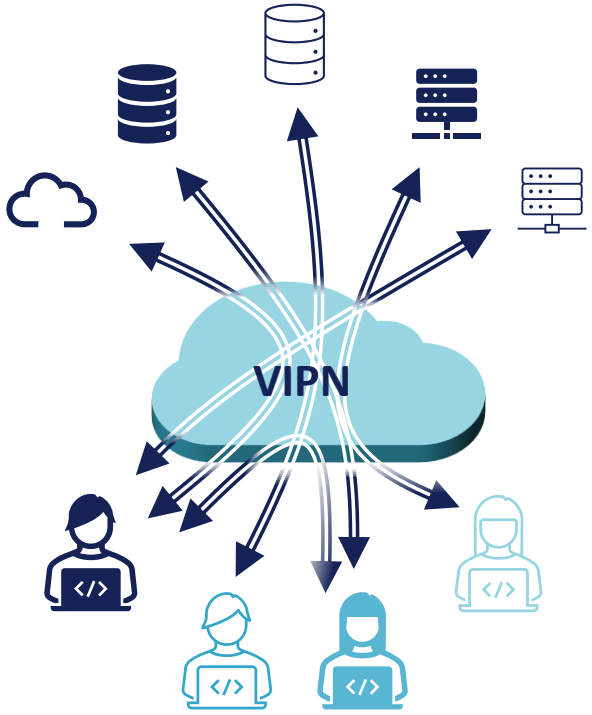
VPN architecture

Full control <u>but</u>
- **Designed for centralized architectures**
- **Access rights management mayhem**
- **Gateway is vulnerable**



SASE architecture

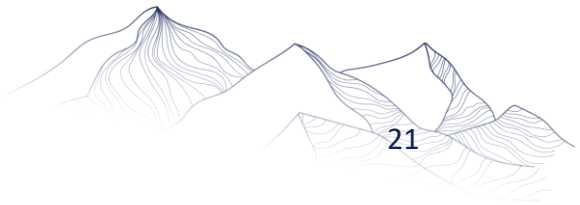
Designed for decentralized architectures with easy access right management & resilience
<u>but</u>
- **Requires to trust the Service provider**



VIPN architecture

Full control <u>and</u>
- **Easy access rights management**
- **No trusted third party**
- **Resilient**
- **Invisibility!**

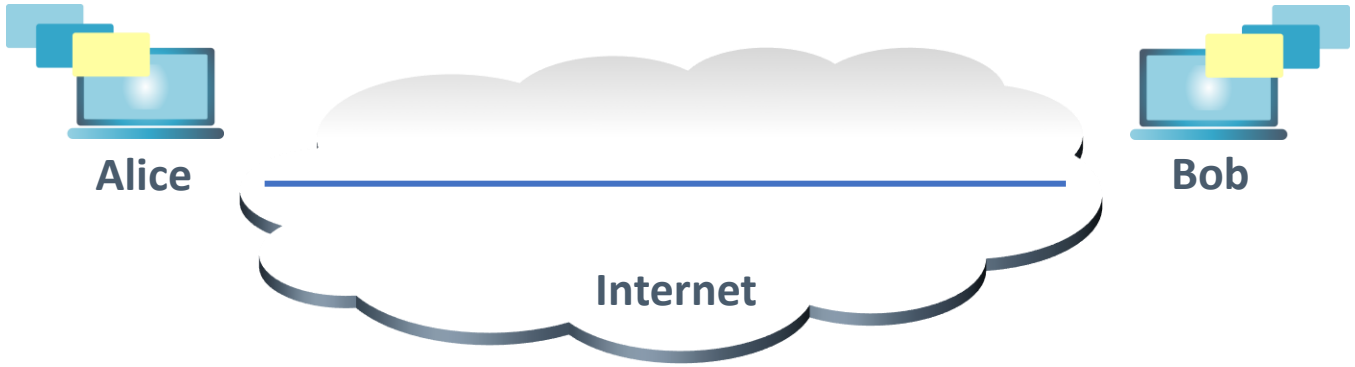
snowpack | Tunnel mode



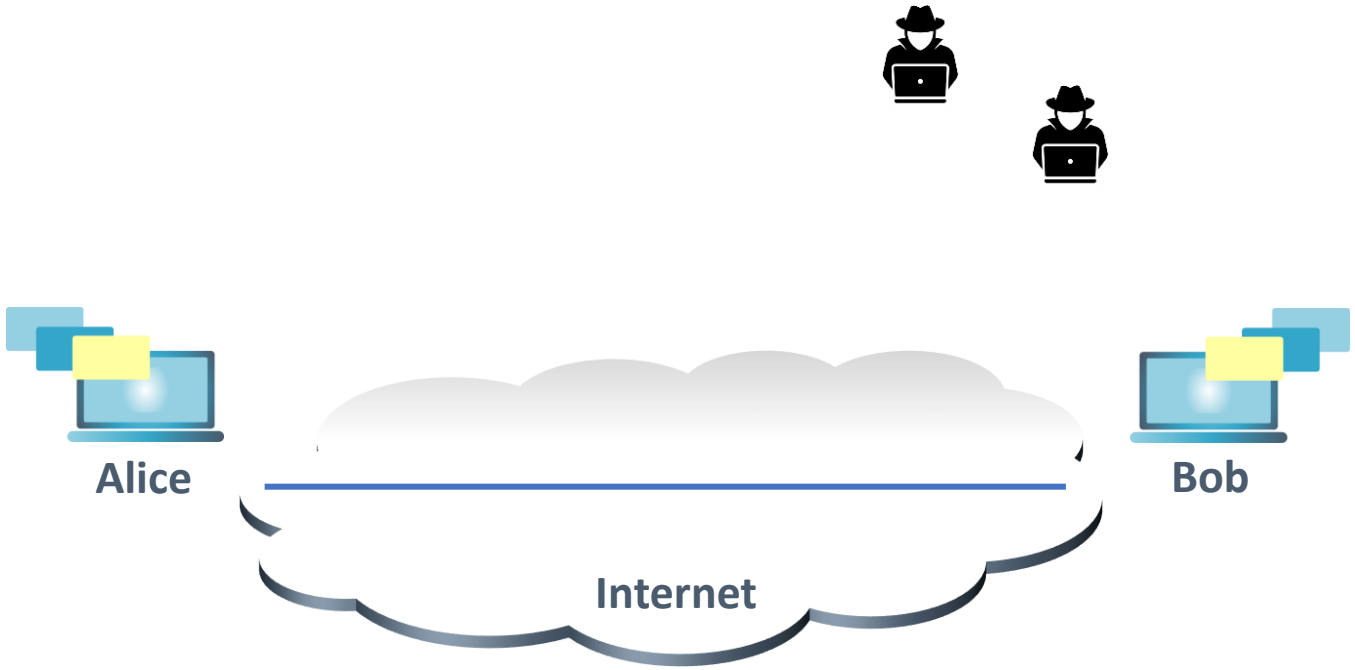
snowpack | Tunnel mode

snowpack | Tunnel mode

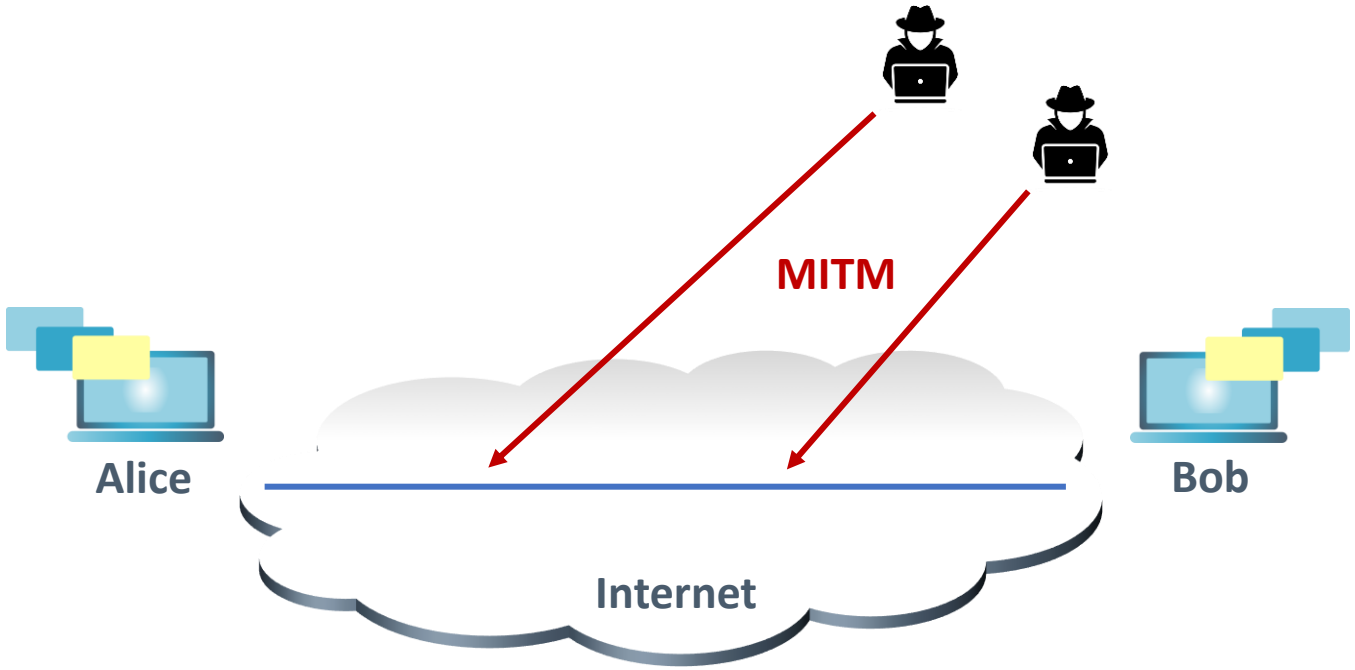
snowpack | Tunnel mode



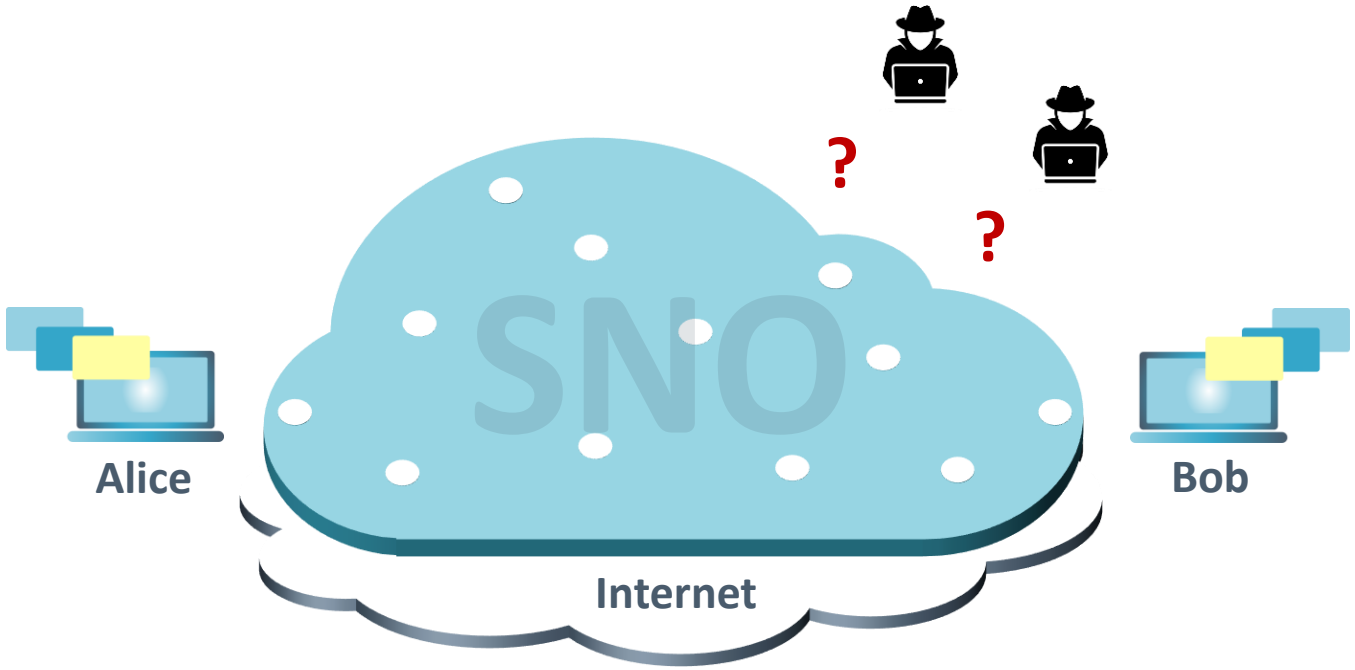
snowpack | Tunnel mode



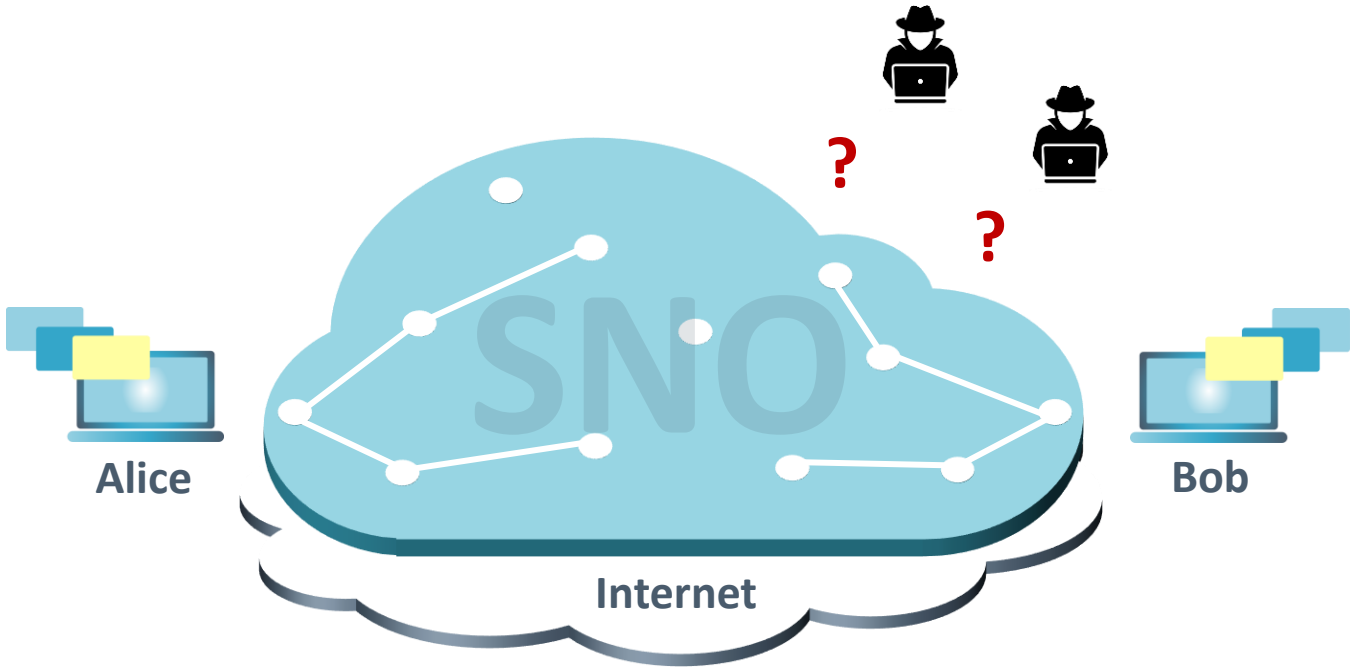
snowpack | Tunnel mode



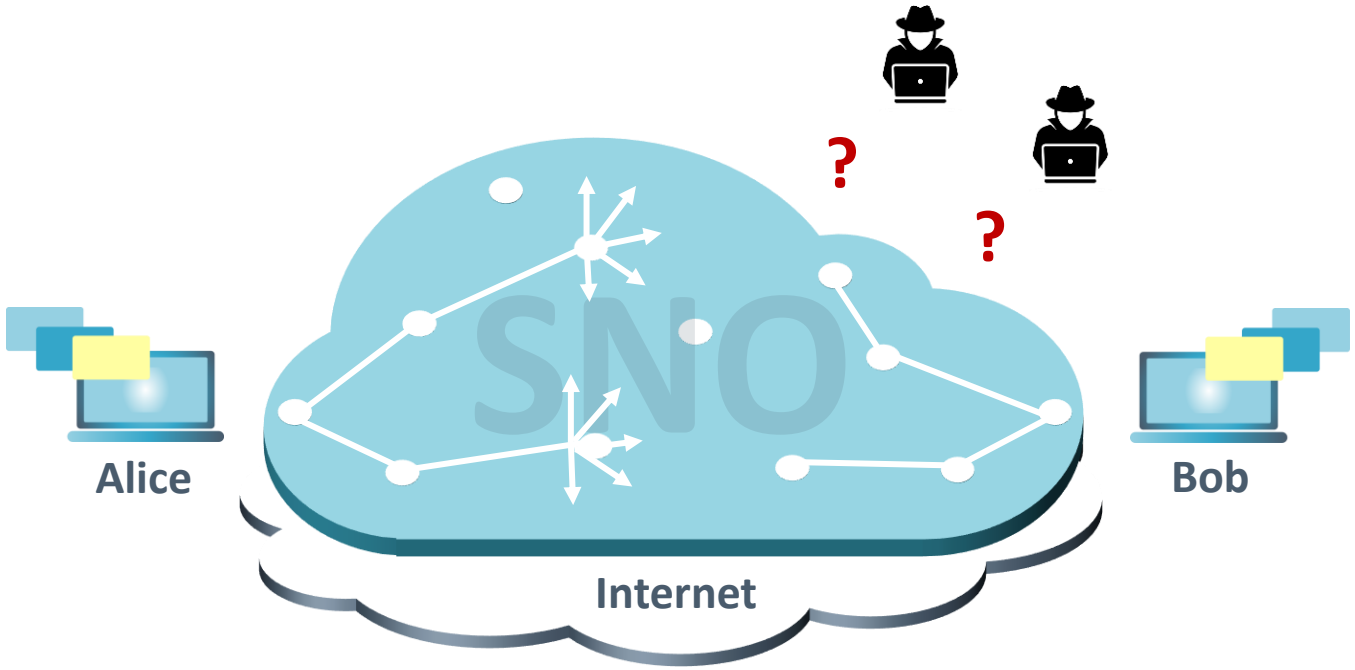
snowpack | Tunnel mode



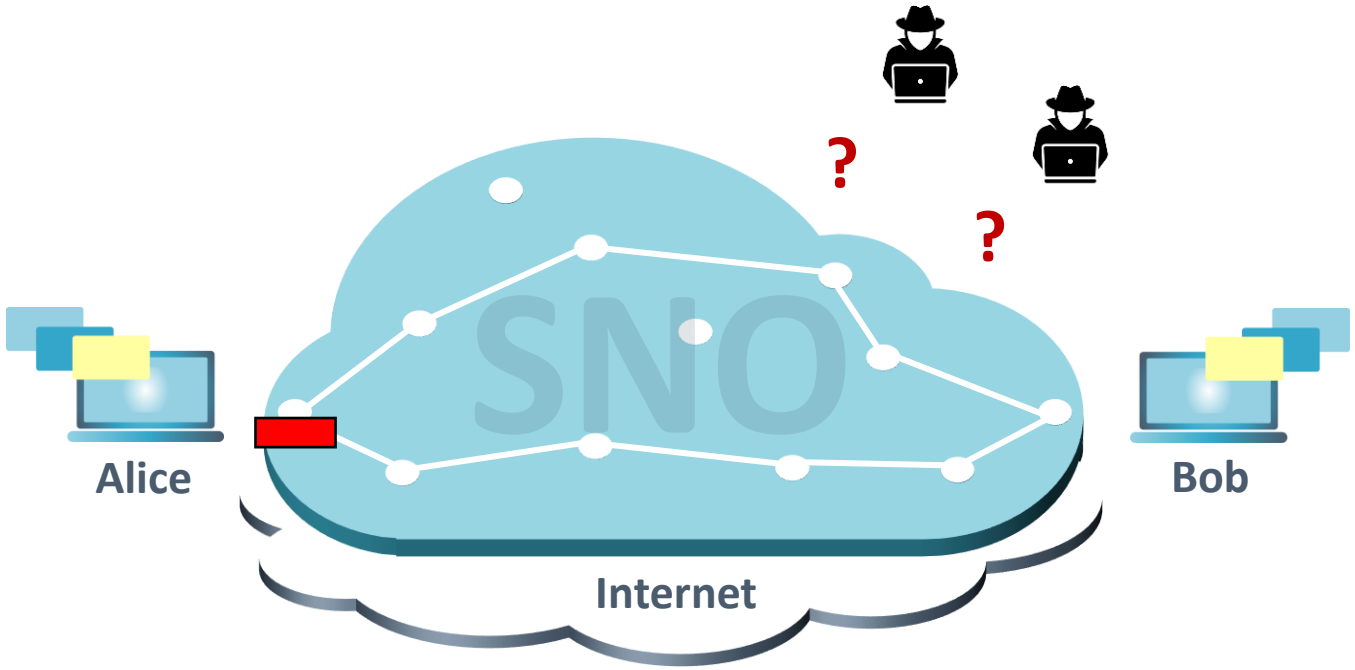
snowpack | Tunnel mode



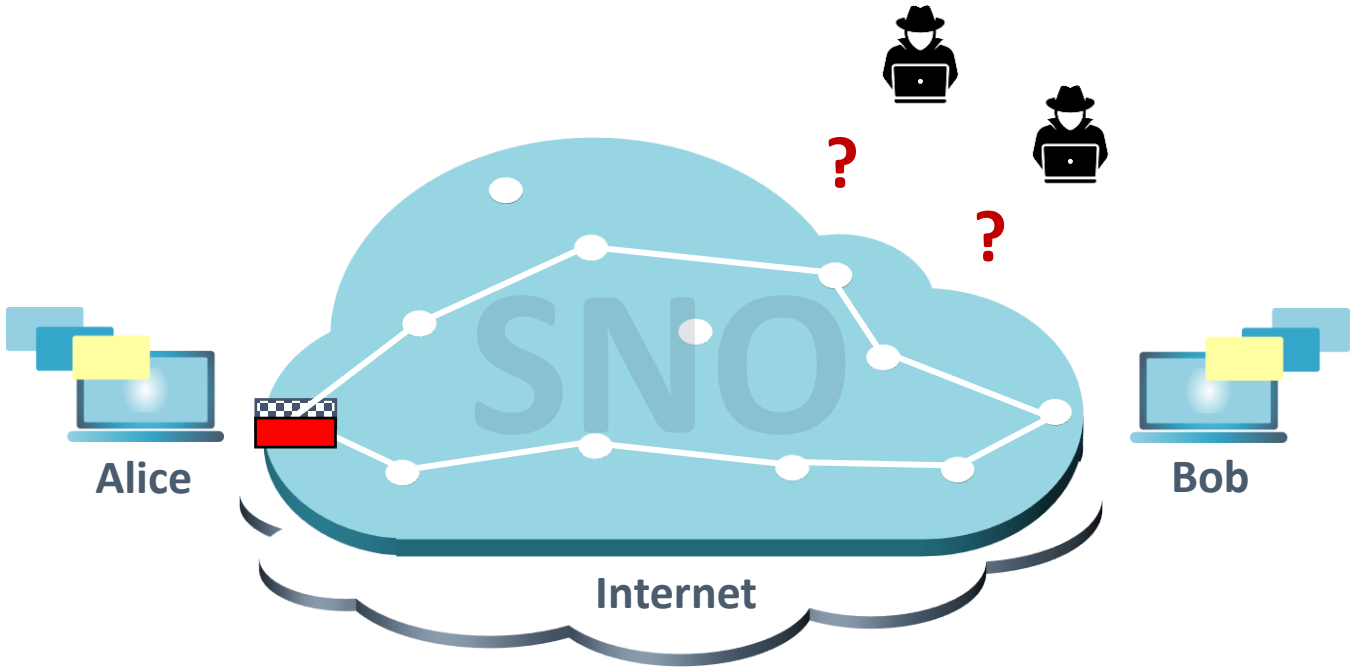
snowpack | Tunnel mode



snowpack | Tunnel mode

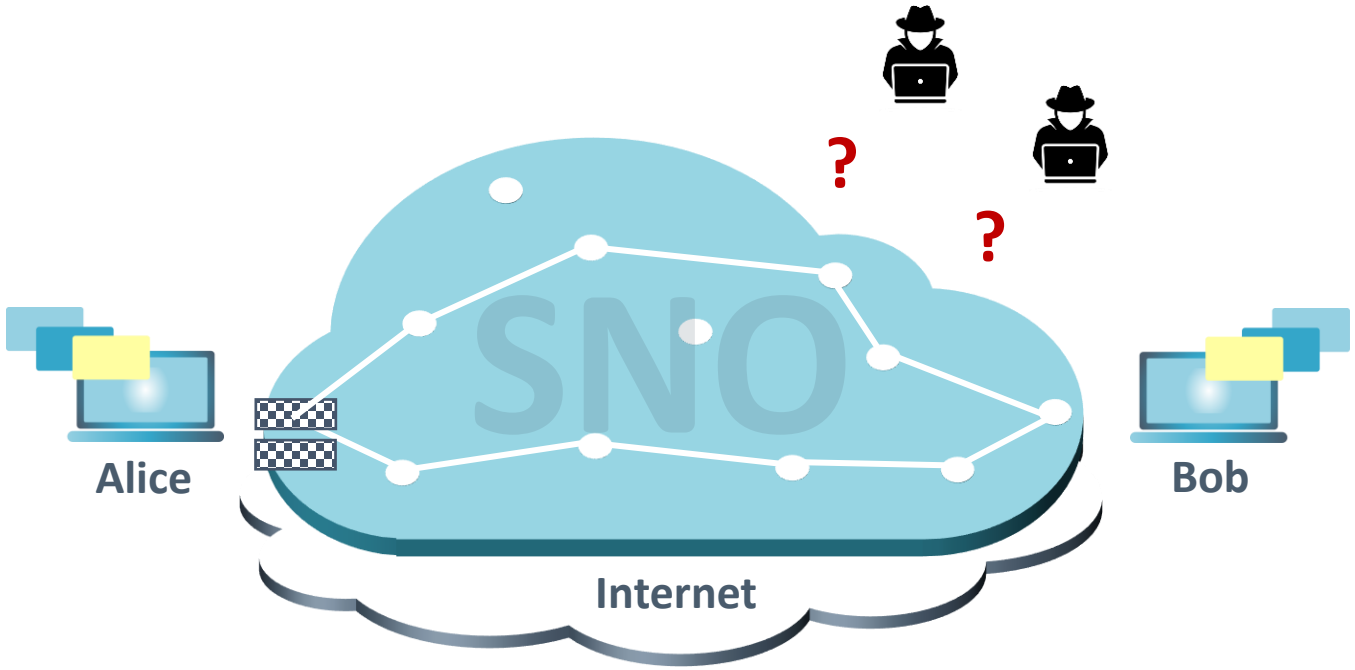


snowpack | Tunnel mode



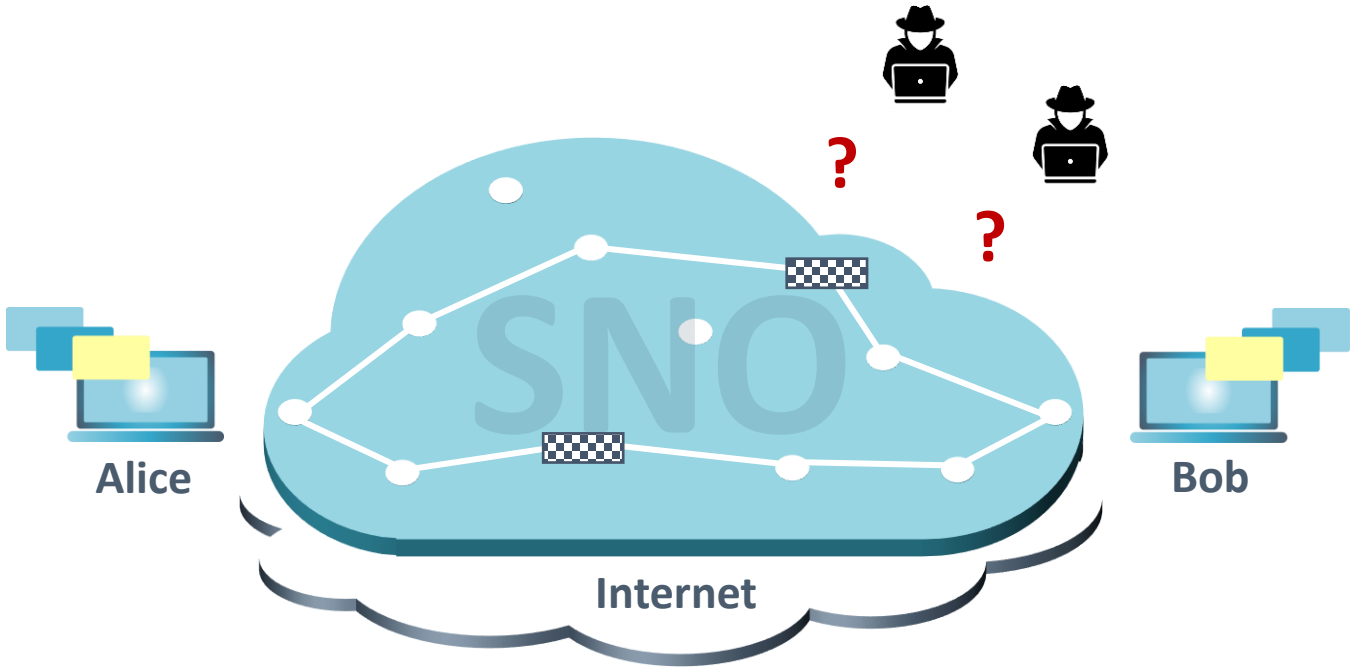
Snowflakes ( ) move through SNO

snowpack | Tunnel mode



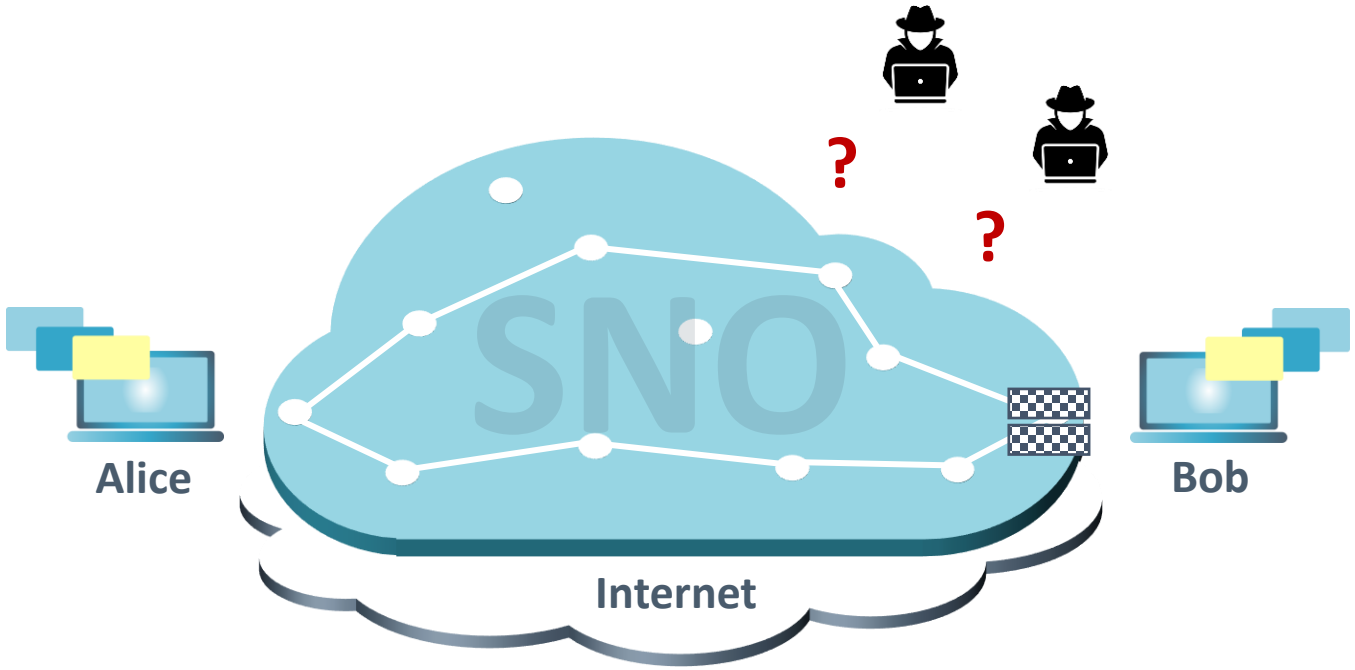
Snowflakes (▩) move through SNO

snowpack | Tunnel mode



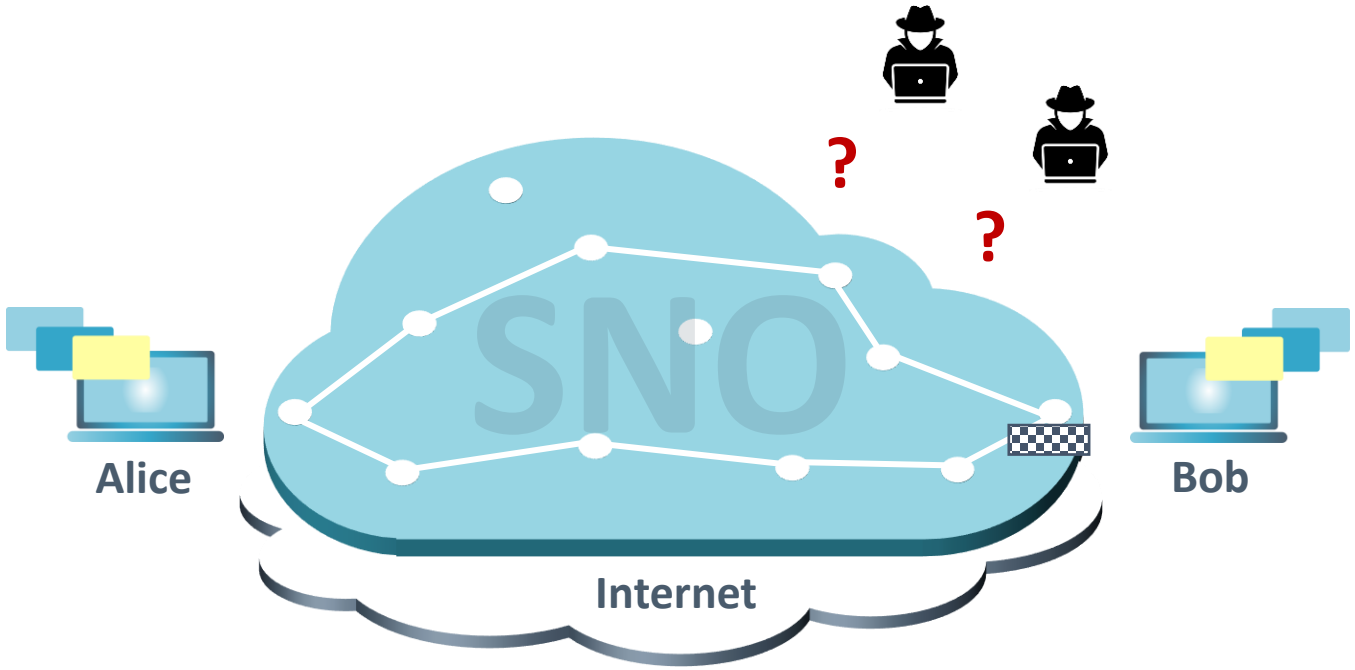
Snowflakes ( ) move through SNO

snowpack | Tunnel mode



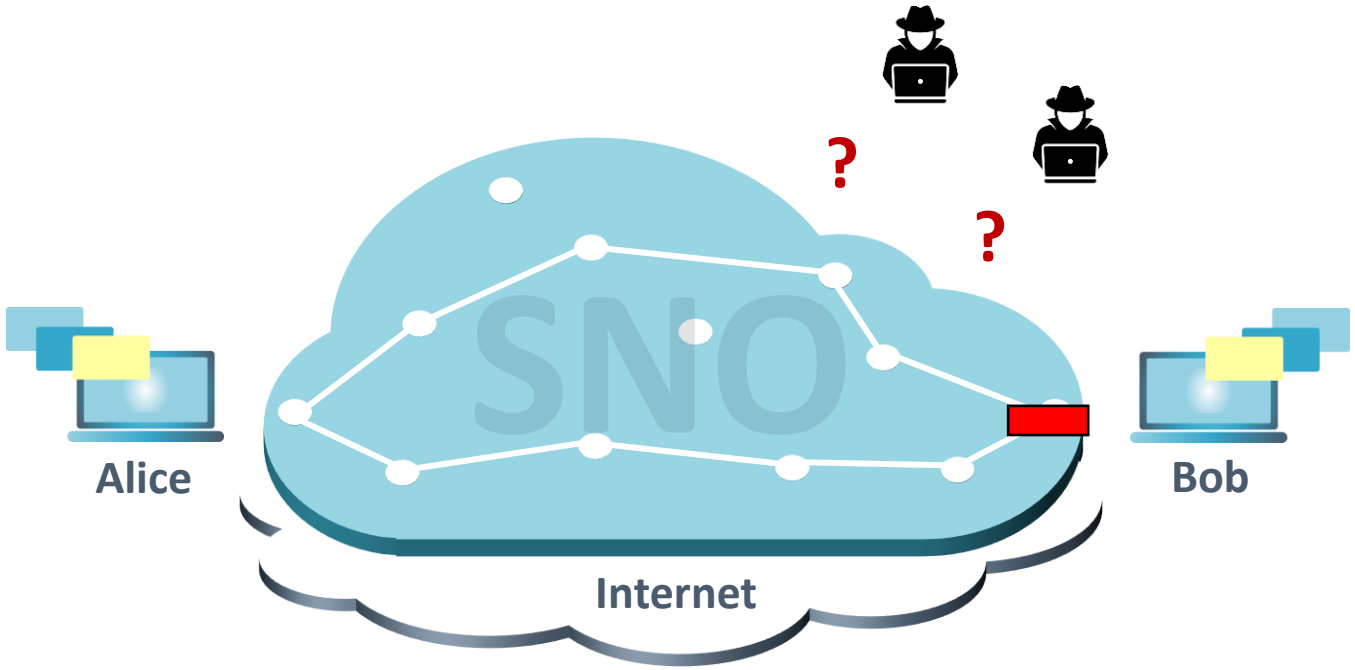
Snowflakes (▩) move through SNO

snowpack | Tunnel mode



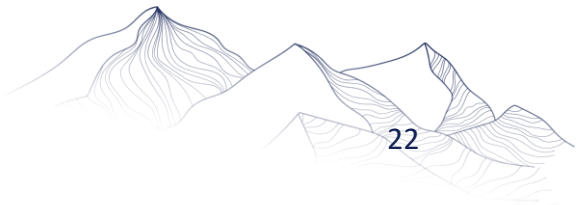
Snowflakes (▩) move through SNO

snowpack | Tunnel mode

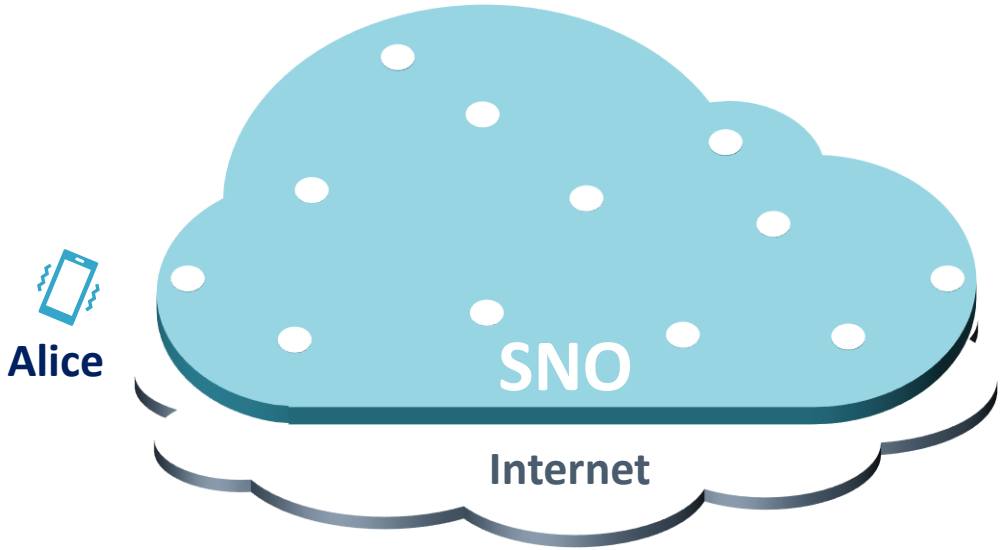


Snowflakes (▩) move through SNO

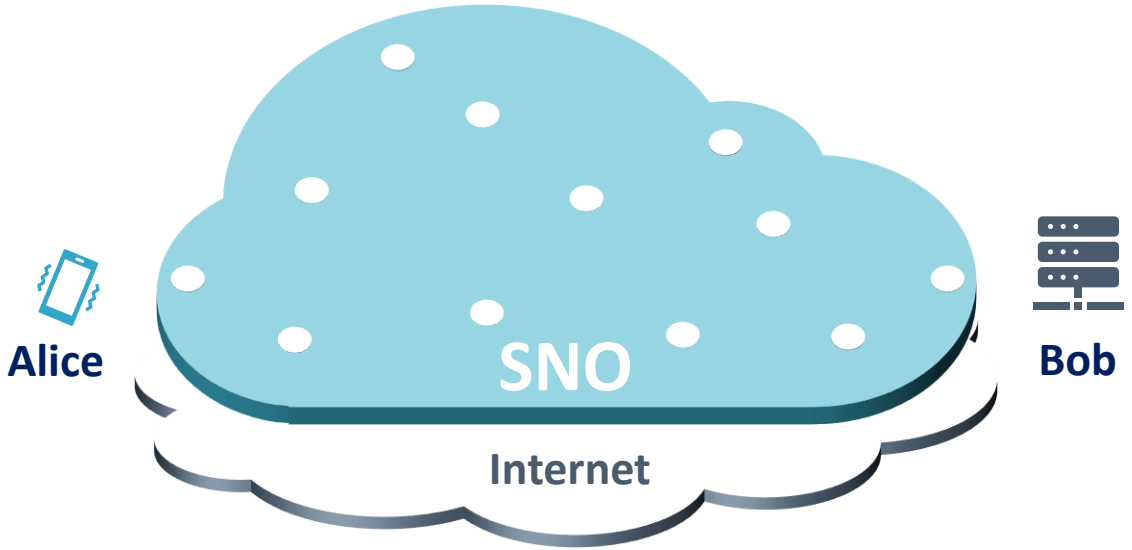
snowpack | Tunnel mode: Initial rdv points exchange implementation



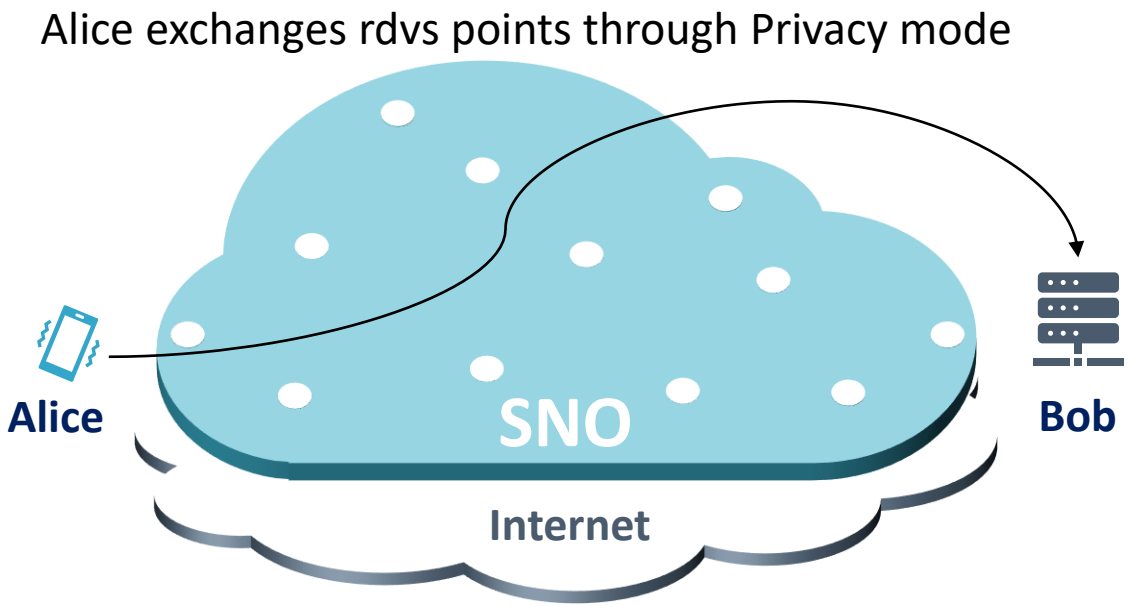
snowpack | Tunnel mode: Initial rdv points exchange implementation



snowpack | Tunnel mode: Initial rdv points exchange implementation

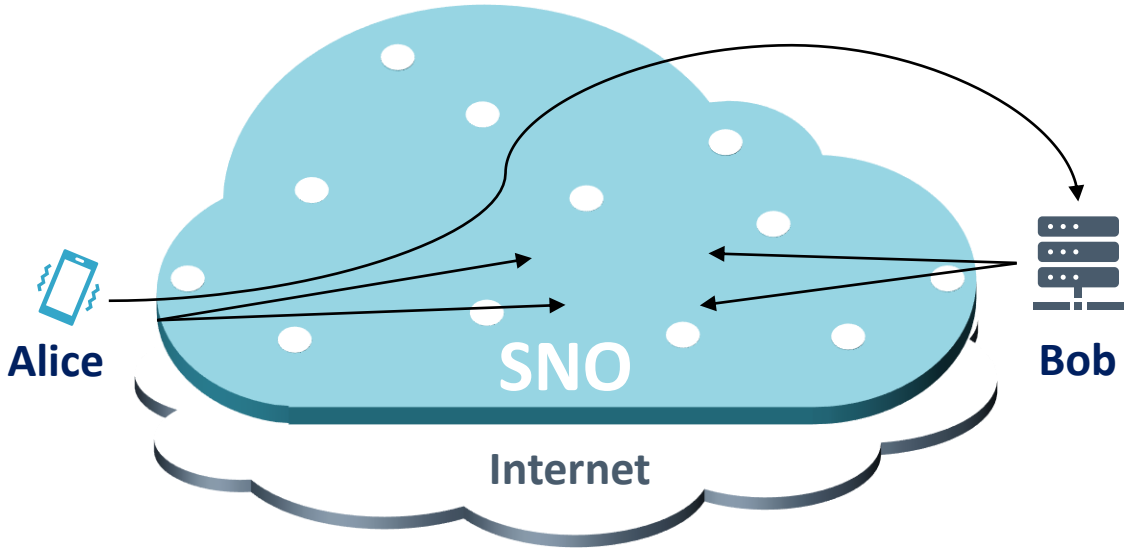


snowpack | Tunnel mode: Initial rdv points exchange implementation



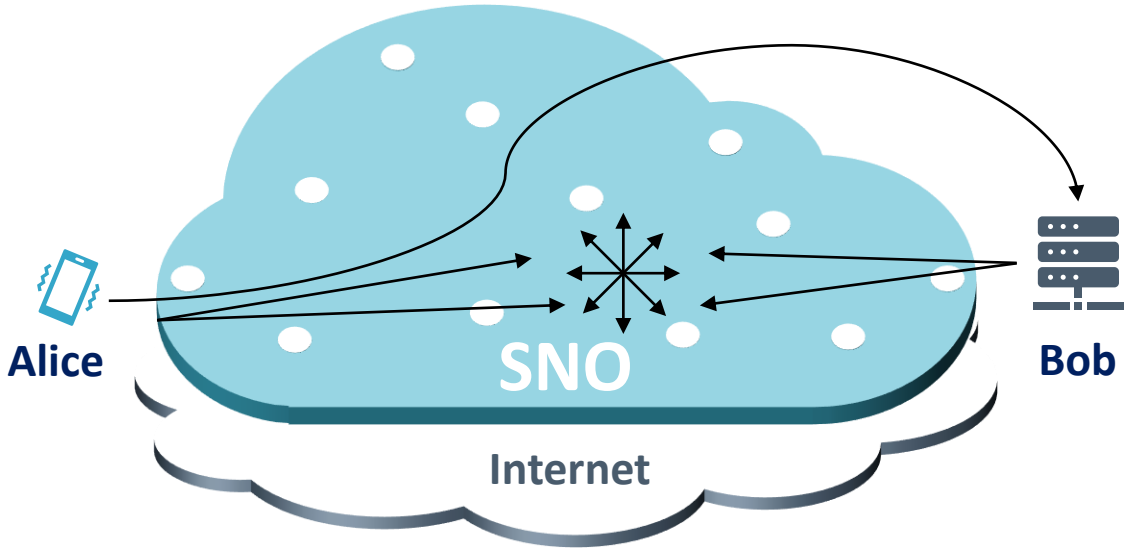
snowpack | Tunnel mode: Initial rdv points exchange implementation

Alice exchanges rdvs points through Privacy mode

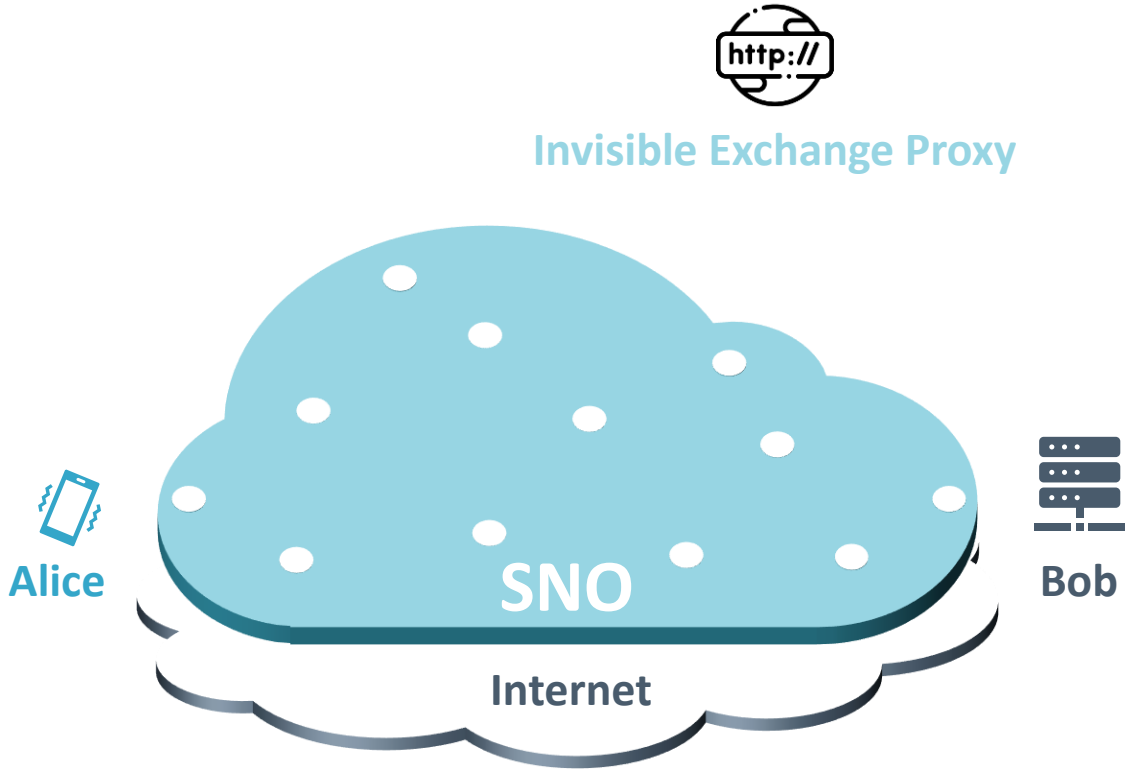


snowpack | Tunnel mode: Initial rdv points exchange implementation

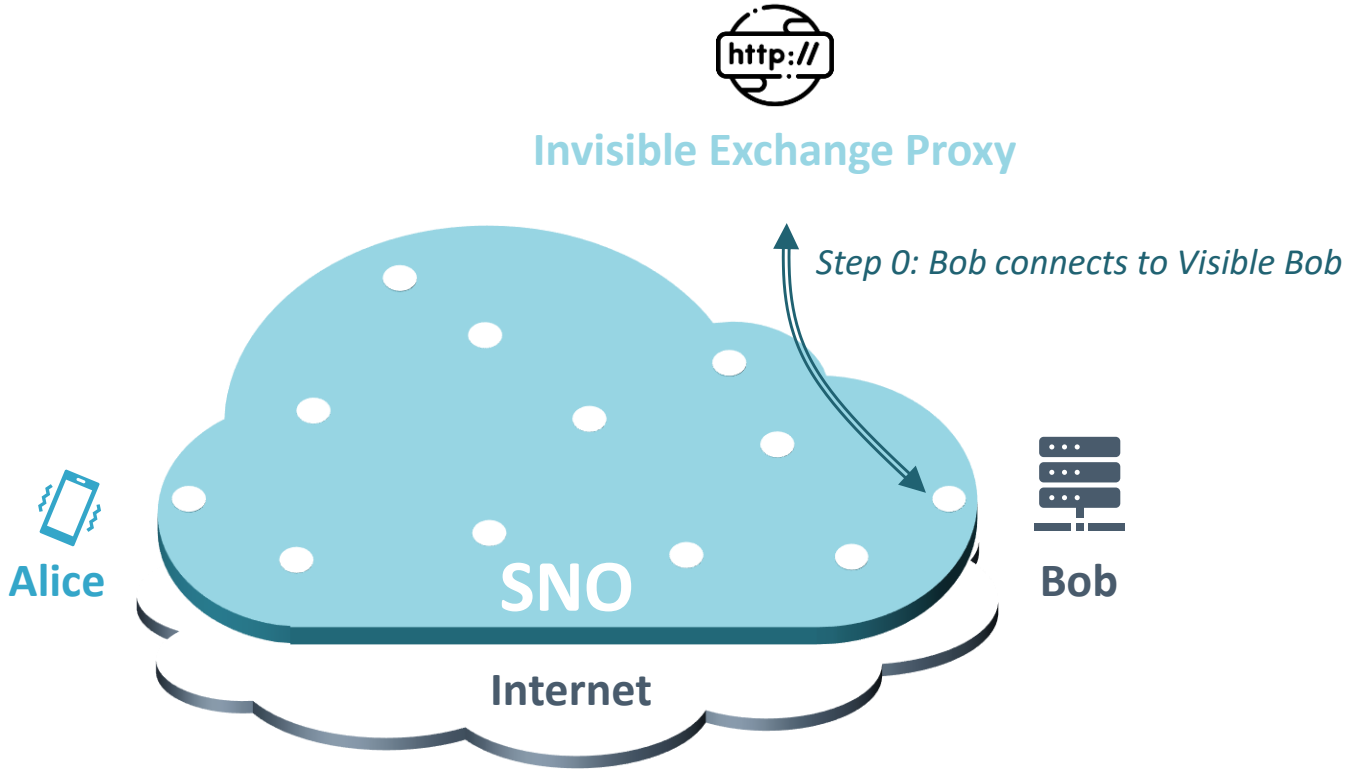
Alice exchanges rdvs points through Privacy mode



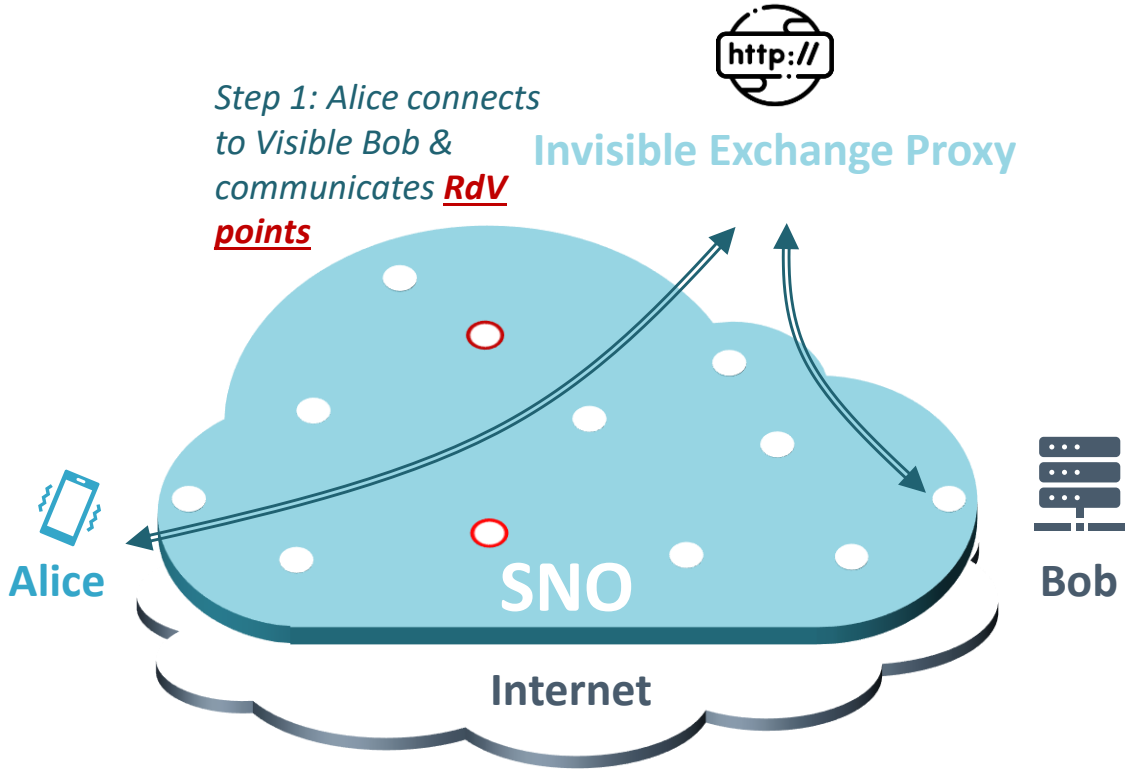
snowpack | Tunnel mode: Upcoming rdv points exchange implementation



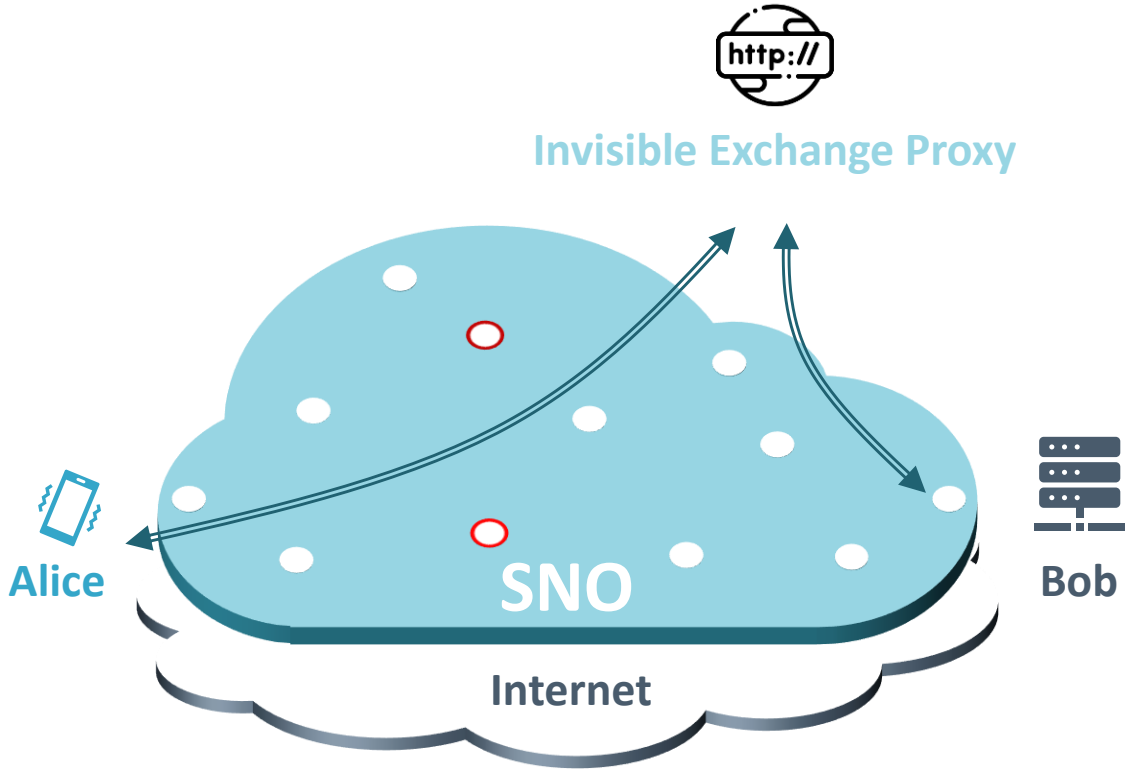
snowpack | Tunnel mode: Upcoming rdv points exchange implementation



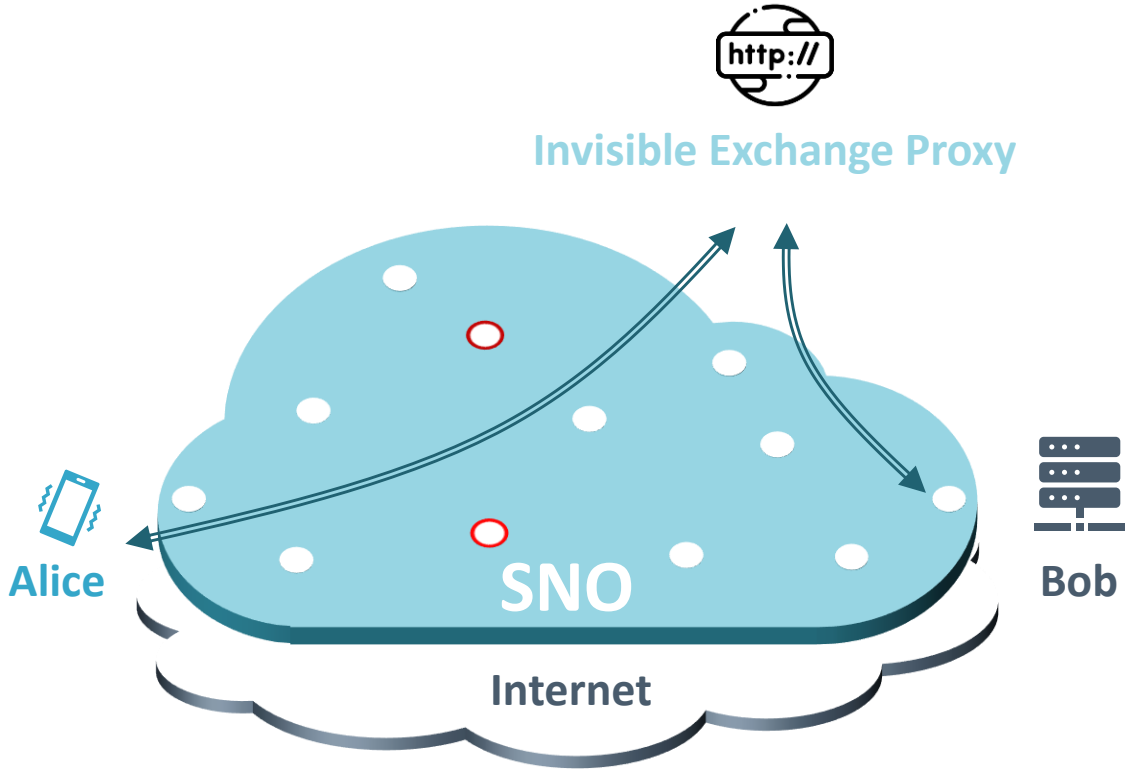
snowpack | Tunnel mode: Upcoming rdv points exchange implementation



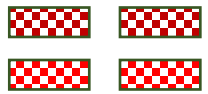
snowpack | Tunnel mode: Upcoming rdv points exchange implementation



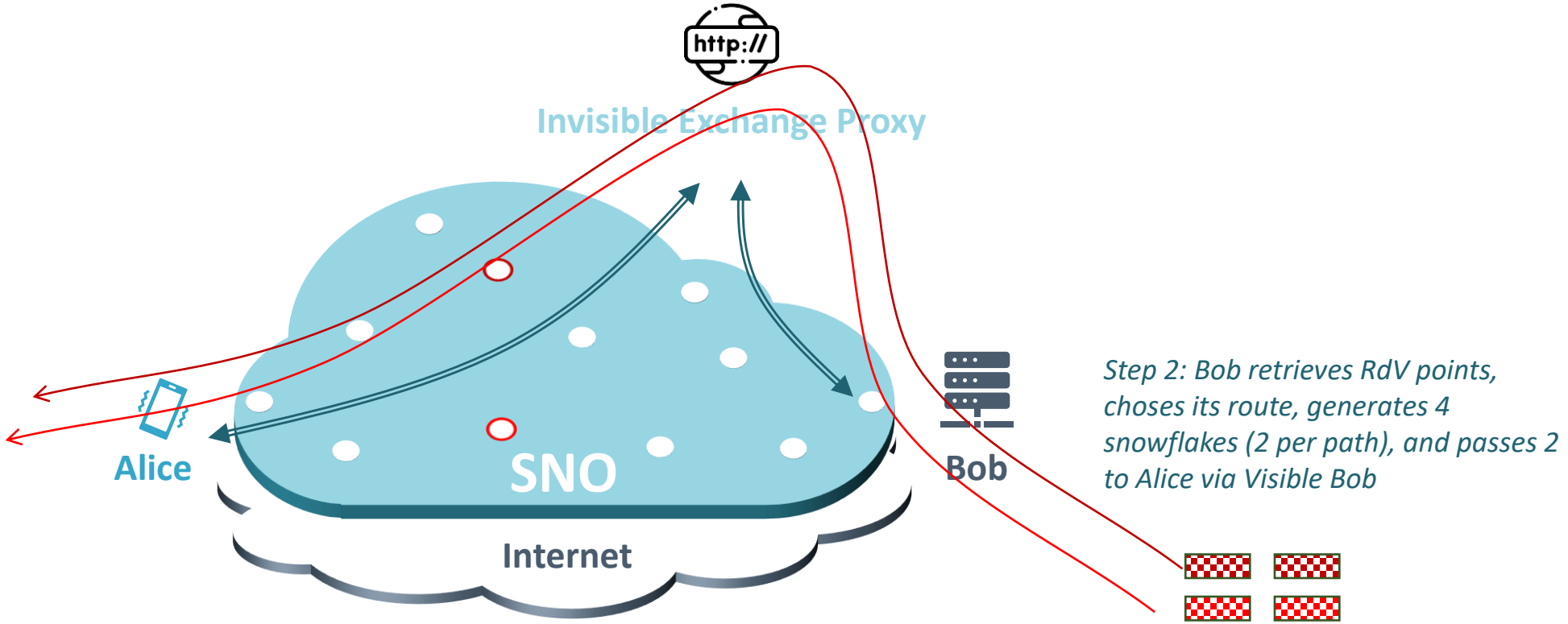
snowpack | Tunnel mode: Upcoming rdv points exchange implementation



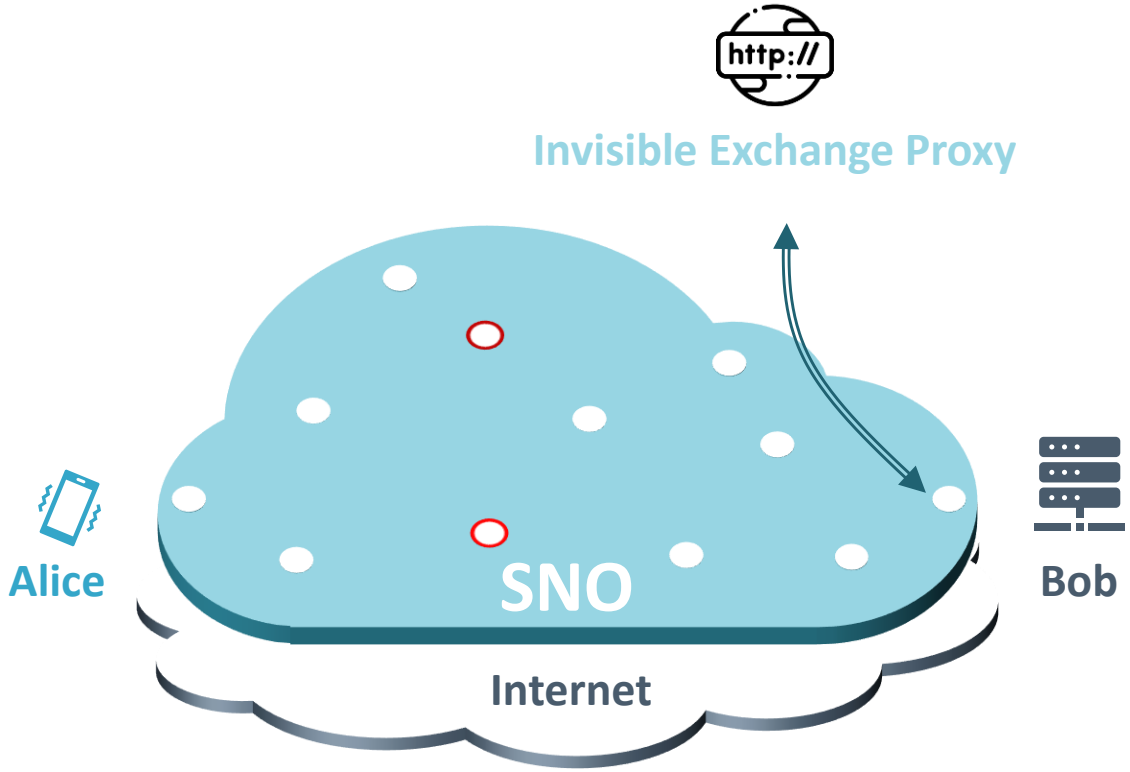
Step 2: Bob retrieves RdV points, choses its route, generates 4 snowflakes (2 per path), and passes 2 to Alice via Visible Bob



snowpack | Tunnel mode: Upcoming rdv points exchange implementation

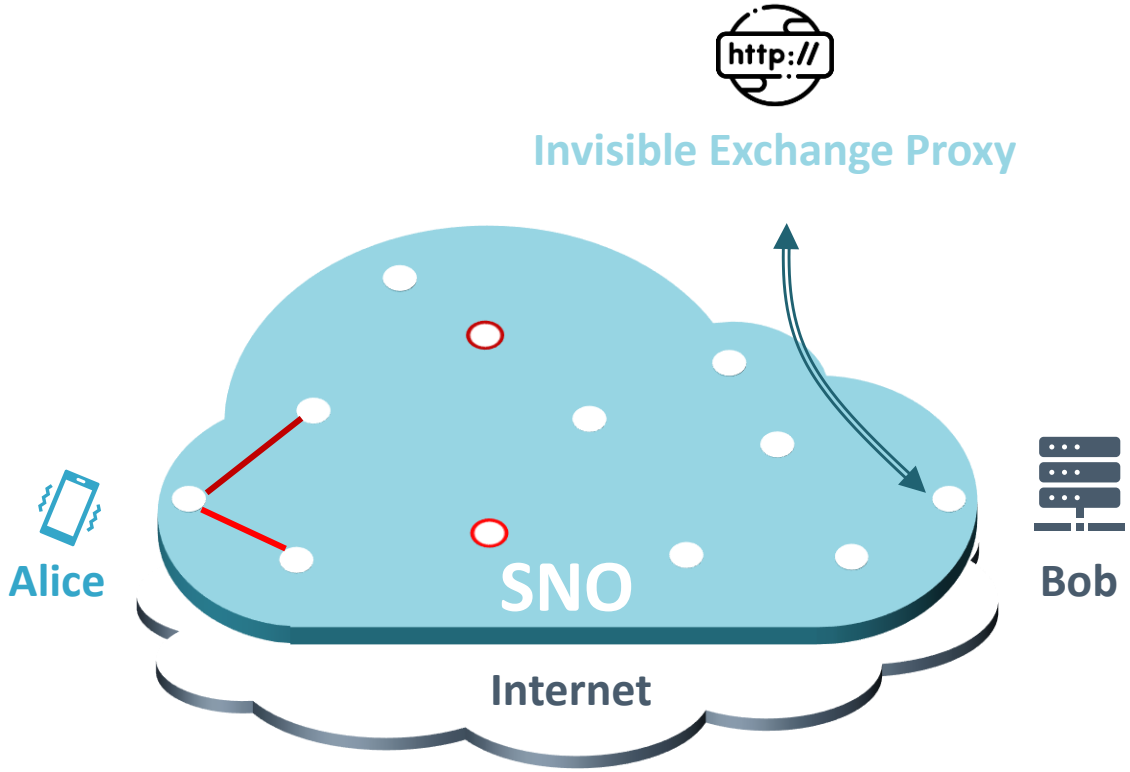


snowpack | Tunnel mode: Upcoming rdv points exchange implementation



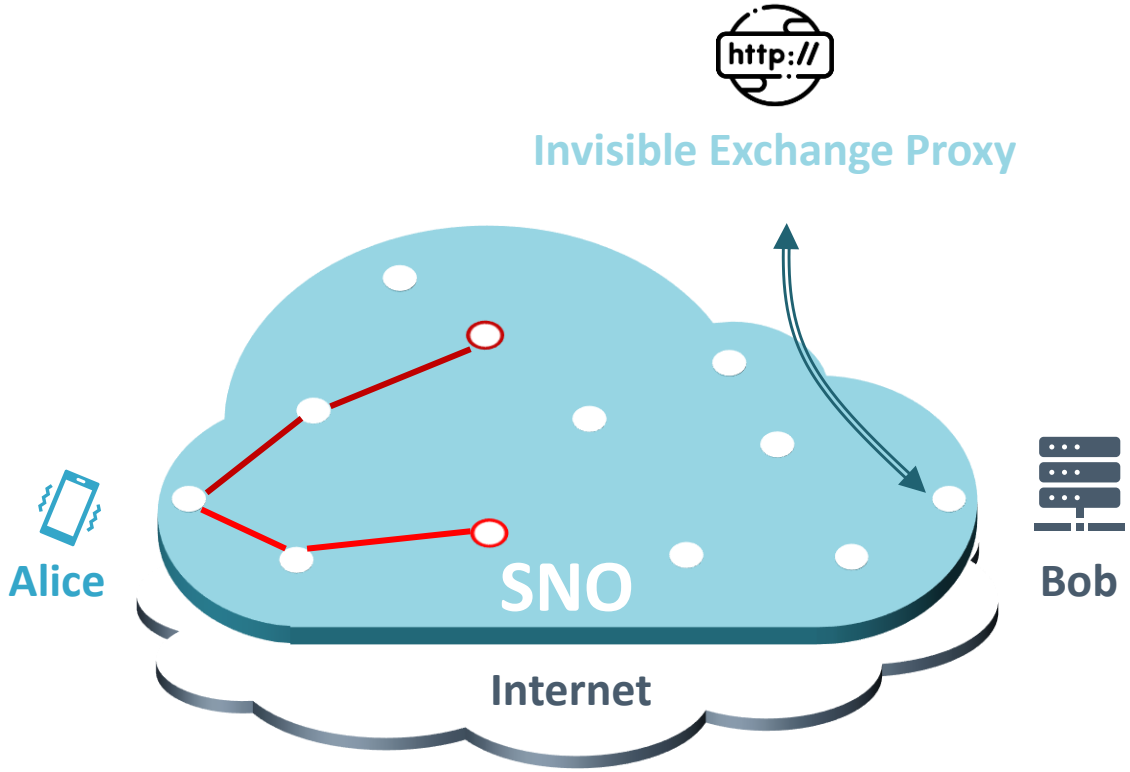
snowpack | Tunnel mode: Upcoming rdv points exchange implementation

Step 3.2: Alice creates its route part



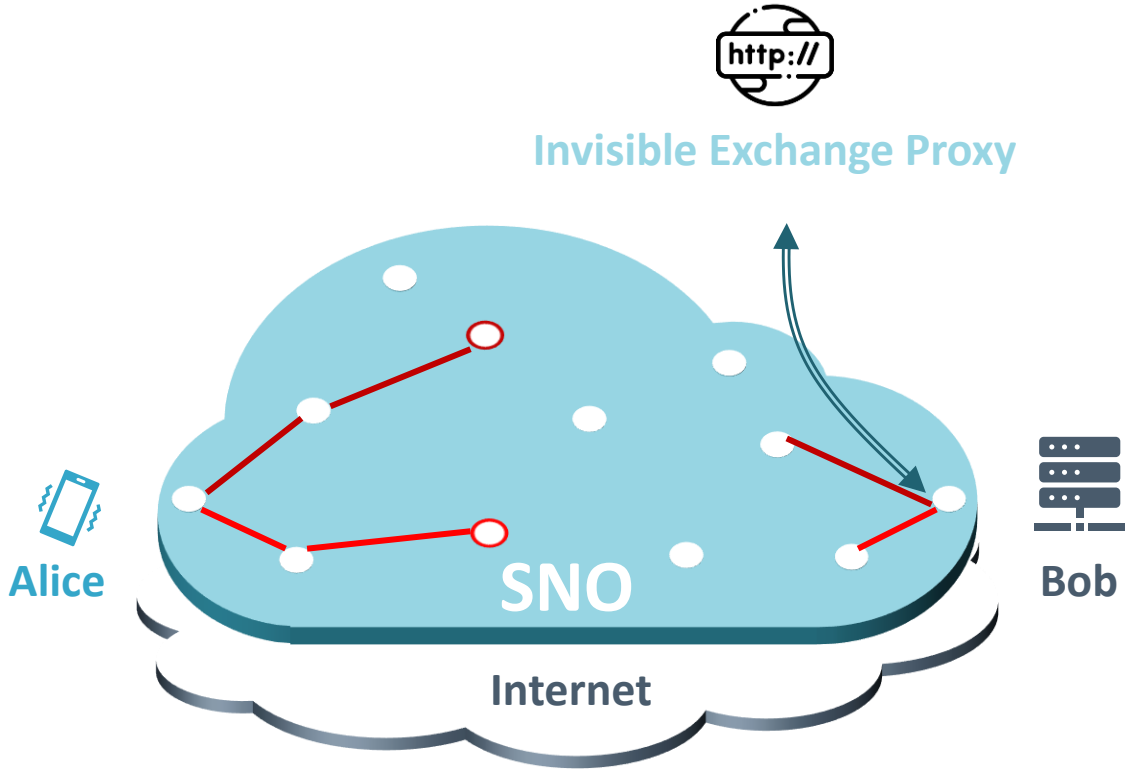
snowpack | Tunnel mode: Upcoming rdv points exchange implementation

Step 3.2: Alice creates its route part



snowpack | Tunnel mode: Upcoming rdv points exchange implementation

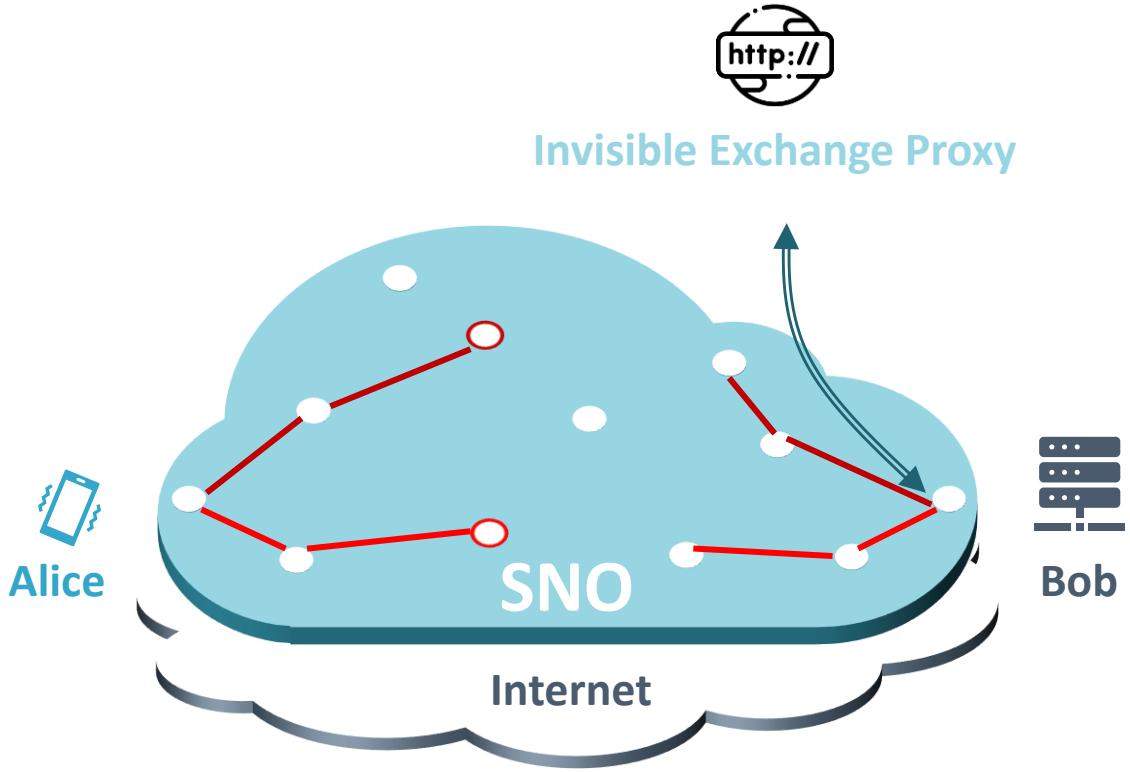
Step 3.2: Alice creates its route part



Step 3.1: Bob creates its route part

snowpack | Tunnel mode: Upcoming rdv points exchange implementation

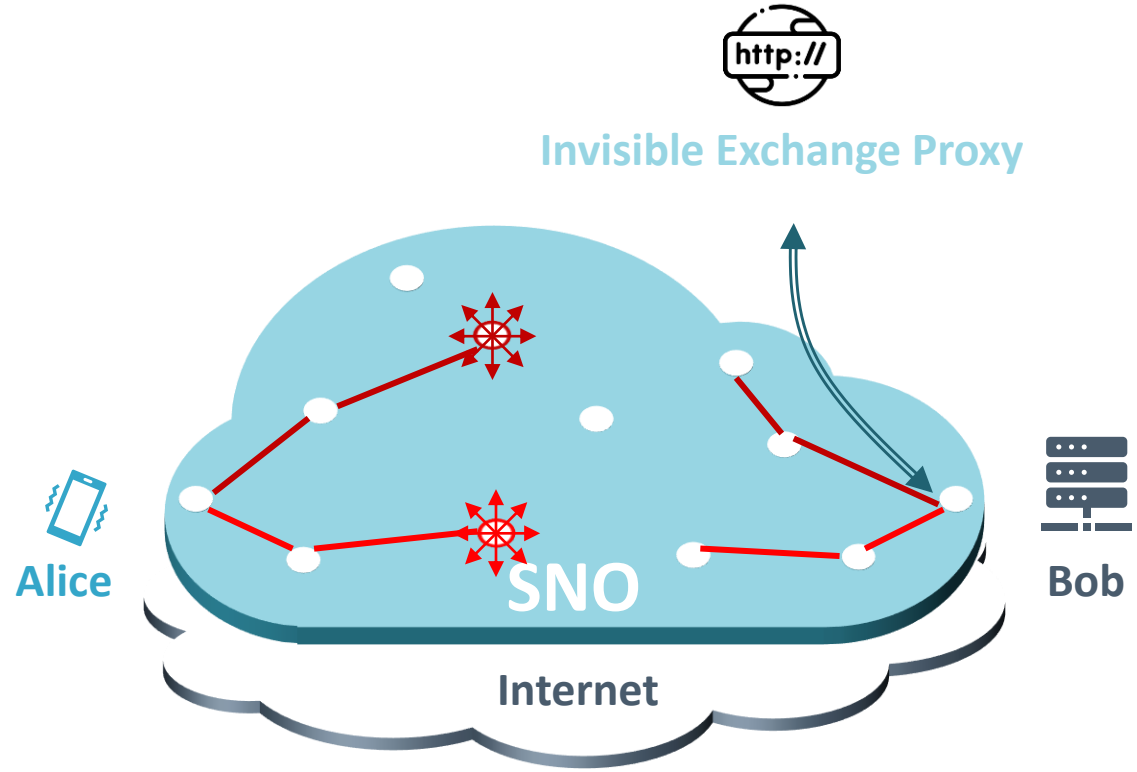
Step 3.2: Alice creates its route part



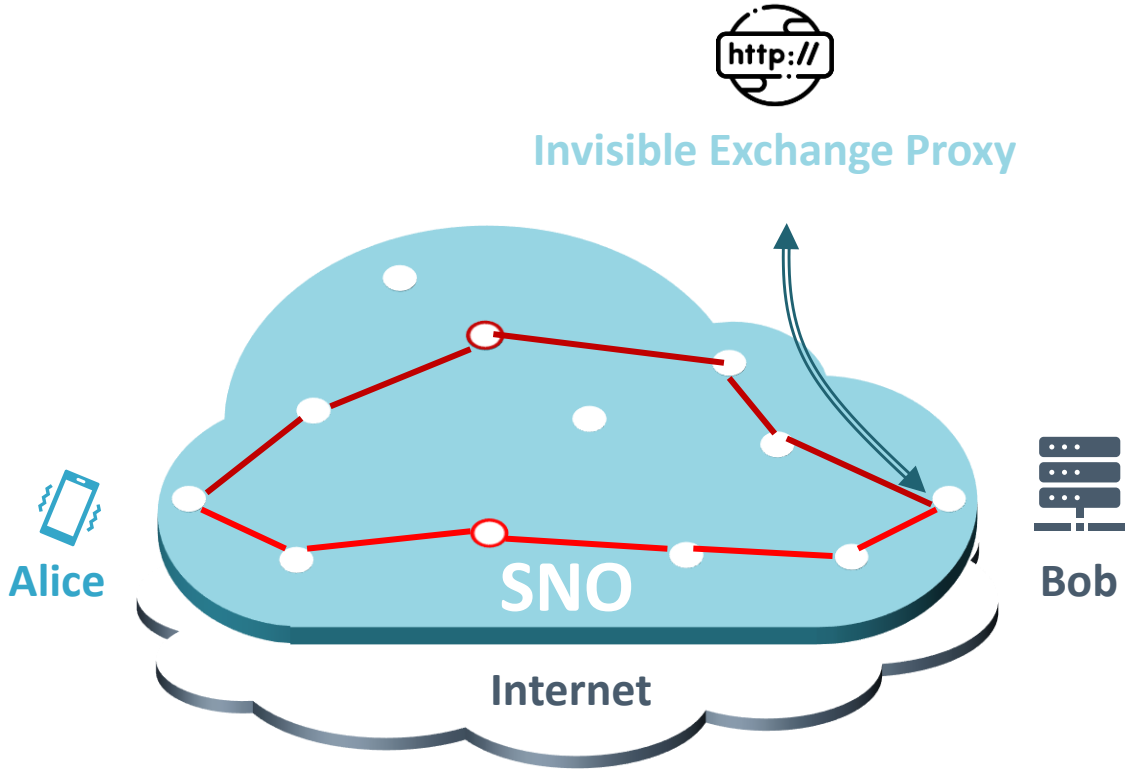
Step 3.1: Bob creates its route part

snowpack | Tunnel mode: Upcoming rdv points exchange implementation

Step 3.3: Alice-Bob routes finalized thanks to autodicovery snowflakes



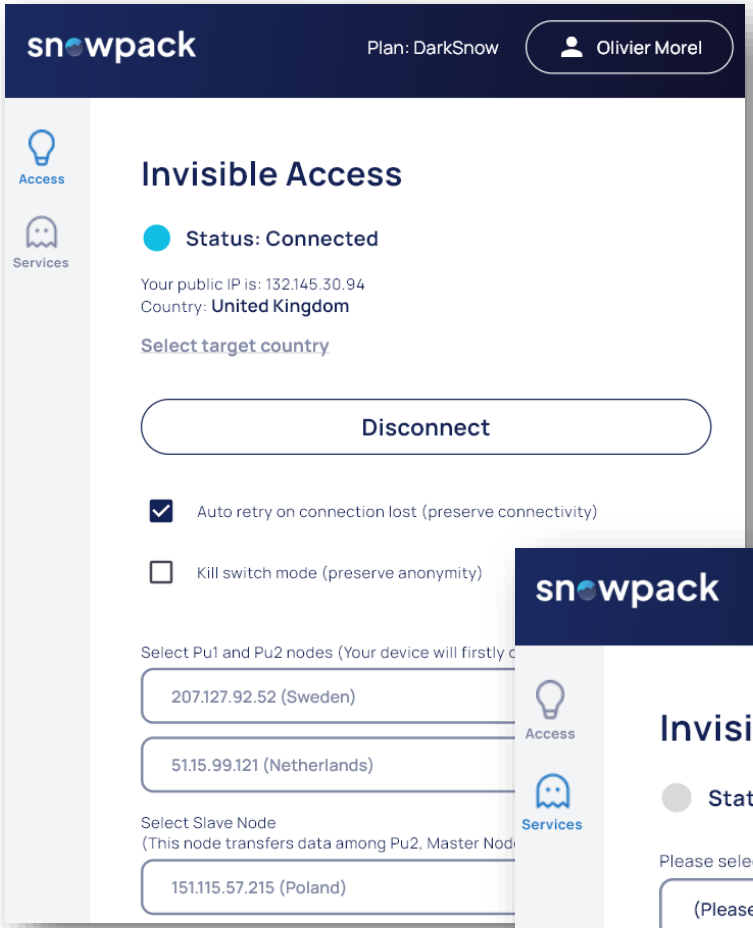
snowpack | Tunnel mode: Upcoming rdv points exchange implementation

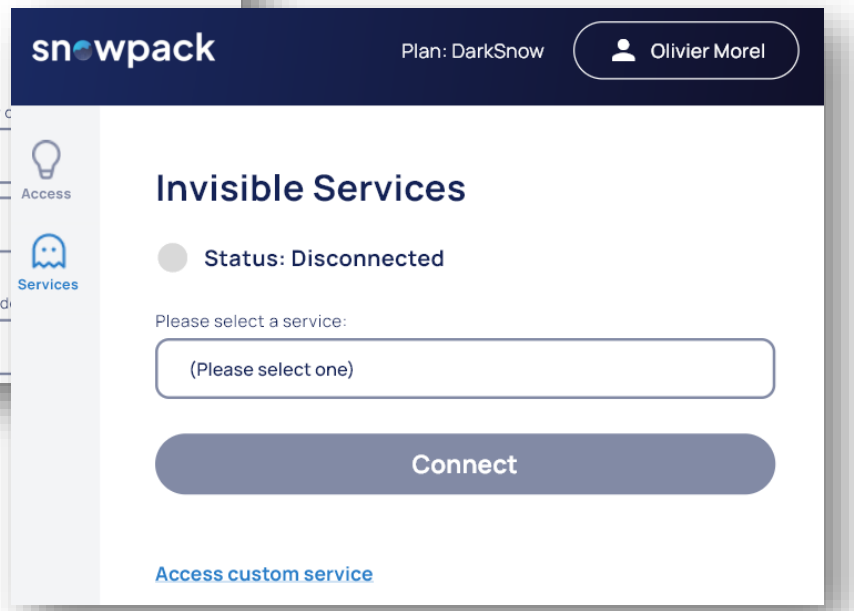


snowpack

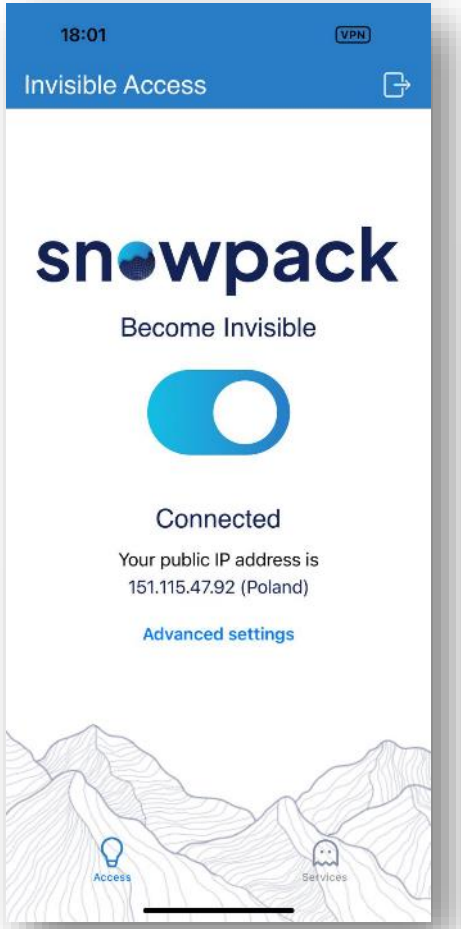
Technical Challenges & usecases

snowpack | VIPN: deeptech but very user friendly …



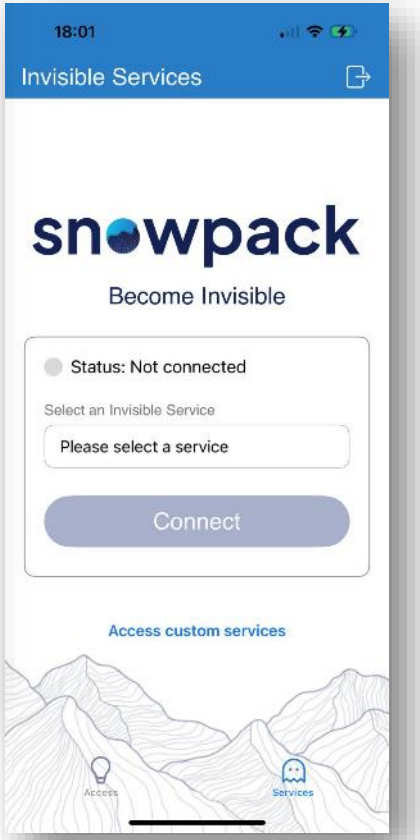


(Also available on Linux and MAC OS)

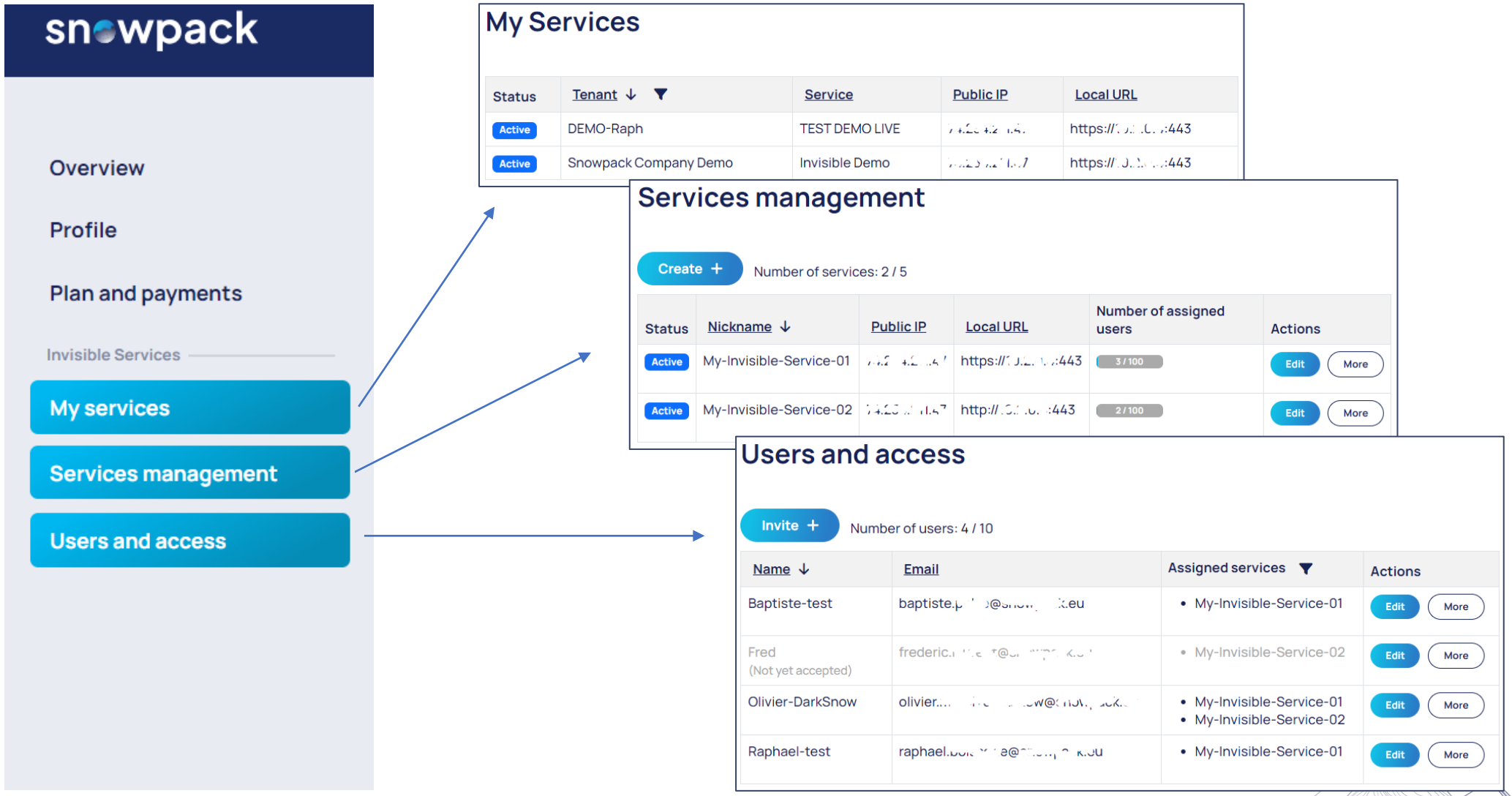


iOS

(Also available on Android)

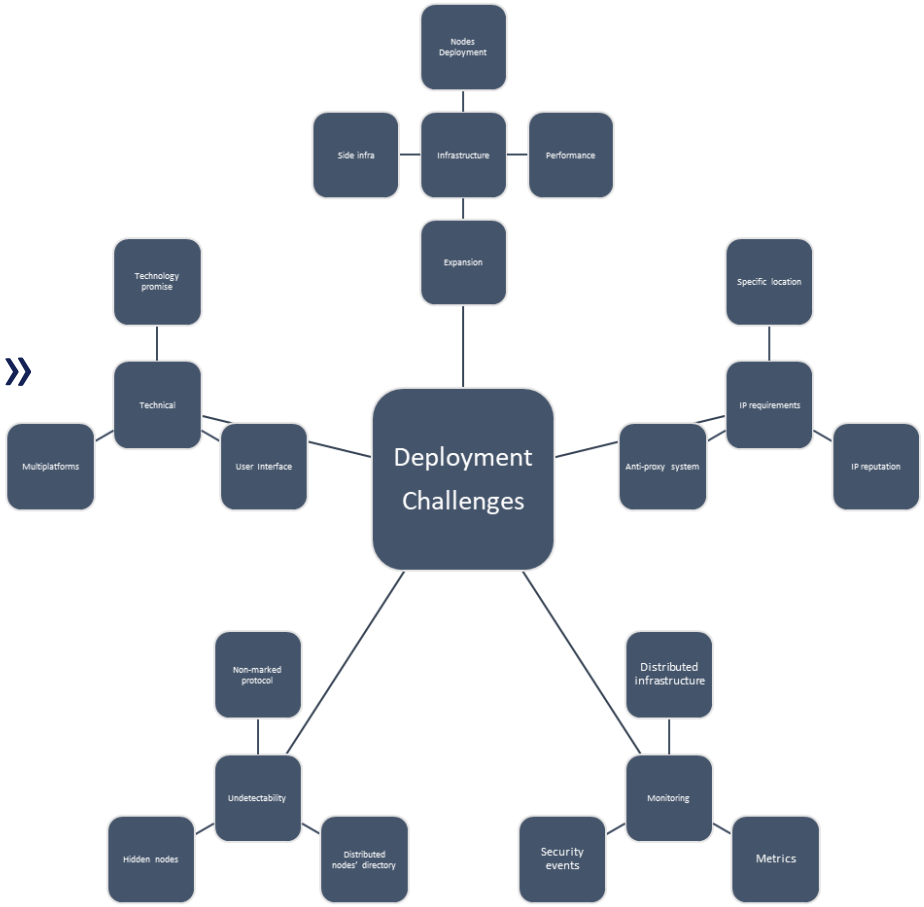


snowpack | ...and easy to install and manage!

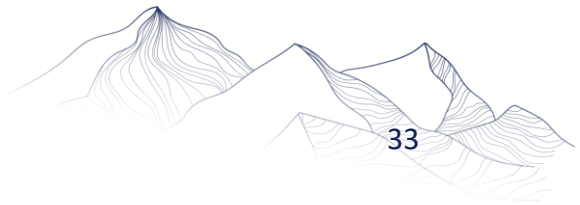


snowpack | Why it is not only that ?

- ❑Specific user requirements
  - →Complex expansion at local levels
- ❑Captchas & proxies detector (netflix, youtube, crowdsec…)
  - → IP quality & reputation
- ❑Anonymity networks' users are not all « clean »
  - →IP reputation
- ❑State-grade actors & censorship
  - →Embed protocol censorship (e.g. TLS1.3)
  - →Specific protocol detection
  - →Nodes repository
- ❑Manage multi-operators infrastructure
  - → Verify that the code running is the proper one



Some of our Usecases



Some of our Usecases

Business Intelligence

Snowpack protects you when you analyse your competitors or when reviewing your market even on extrateritorial website,

It is impossible to trace you back thanks to our robust threat model.

snowpack Some of our Usecases

Business Intelligence

Snowpack protects you when you analyse your competitors or when reviewing your market even on extrateritorial website,

It is impossible to trace you back thanks to our robust threat model.

Partners collaborations

While sharing data with partners, if it implies any interactions with their systems, hide your identity to eventual attacker monitoring your network.

Avoid identification of your servers or collaborations.

snowpack Some of our Usecases

Business Intelligence

Snowpack protects you when you analyse your competitors or when reviewing your market even on extrateritorial website,

It is impossible to trace you back thanks to our robust threat model.

Partners collaborations

While sharing data with partners, if it implies any interactions with their systems, hide your identity to eventual attacker monitoring your network.

Avoid identification of your servers or collaborations.

Secure your remote workers access

Cloak your Information System to protect your collaborators and your IS.

Remote workers don’t become targets.

snowpack Some of our Usecases

Business Intelligence

Snowpack protects you when you analyse your competitors or when reviewing your market even on extrateritorial website,

It is impossible to trace you back thanks to our robust threat model.

Partners collaborations

While sharing data with partners, if it implies any interactions with their systems, hide your identity to eventual attacker monitoring your network.

Avoid identification of your servers or collaborations.

Secure your remote workers access

Cloak your Information System to protect your collaborators and your IS.

Remote workers don’t become targets.

Expose services to partners that don’t want to be disclosed as client

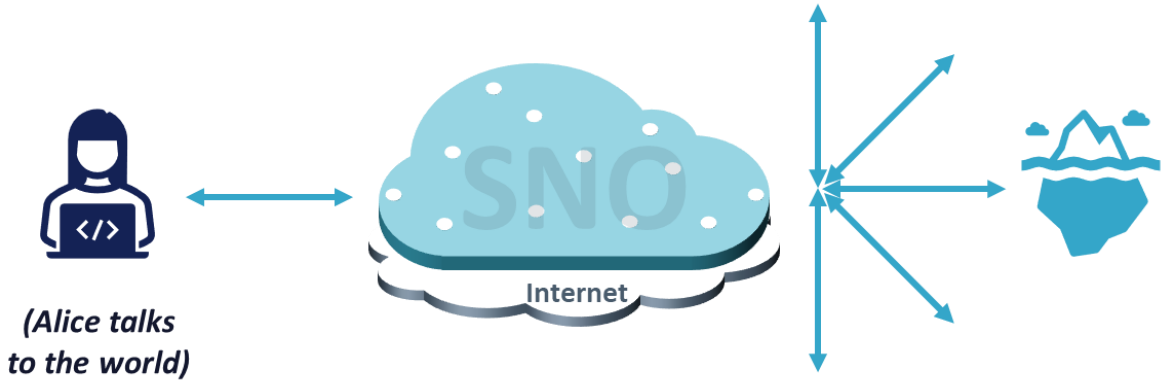
Transform your sensitive services for valuable clients into Invisible Services to avoid their identity disclosed while accessing your service.

Offer SaaS with low risk.

snowpack | Contexts of usage : Invisible Access

Invisible Access

Hide users and their Internet operations



- Protect sensitive **users** : *corporate VIPs, soldiers in operation, remote access, lawyers, journalists, etc.*
- Help professionals with a strong **invisibility** needs for their operations: *Red Team, Cyber Threat Intelligence, Investigation on clear/deep/dark, Law enforcement agencies, etc.*

Users protection
Data protection
Communications protection
Activities protection
Secrets protection

snowpack | Contexts of usage : Invisible Services & Infra

Invisible Services & Infra

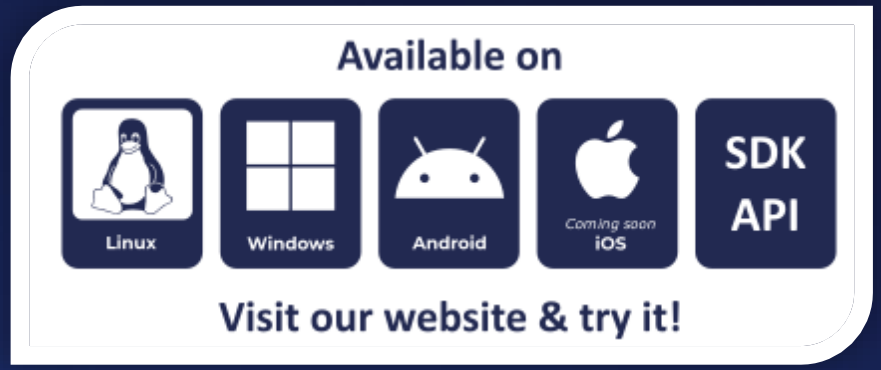
Hide the attack surface of your information system

- Make **sensitive business services** exposed on the Internet invisible to hackers: *websites, APIs, web services, etc.*
- **Protect exposed infrastructure components** (*servers, end-points, VPN, etc.*) from Internet attacks (*e.g. scan, DDoS, 0day*).

Regulatory compliance
(NIS2/DORA, DSP2 …)
Cyber Insurance
(Prevention, Remediation)
Supply Chain Security
Obsolescence
(IT/OT, …)

snowpack

Don’t trust us, test us !

Baptiste POLVÉ – Co-founder & CTO
baptiste.polve@snowpack.eu

WWW.SNOWPACK.EU