The Invisible Internet Project

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Moscow, Russia

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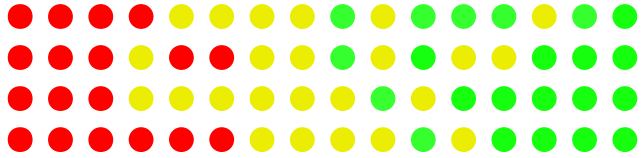
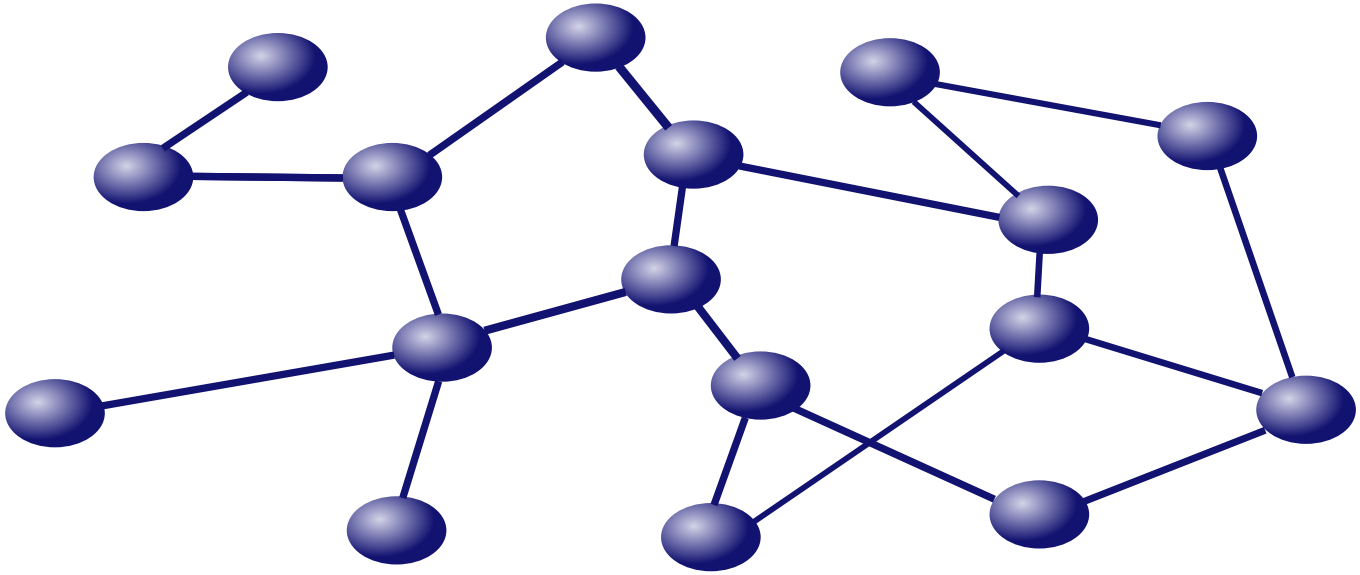
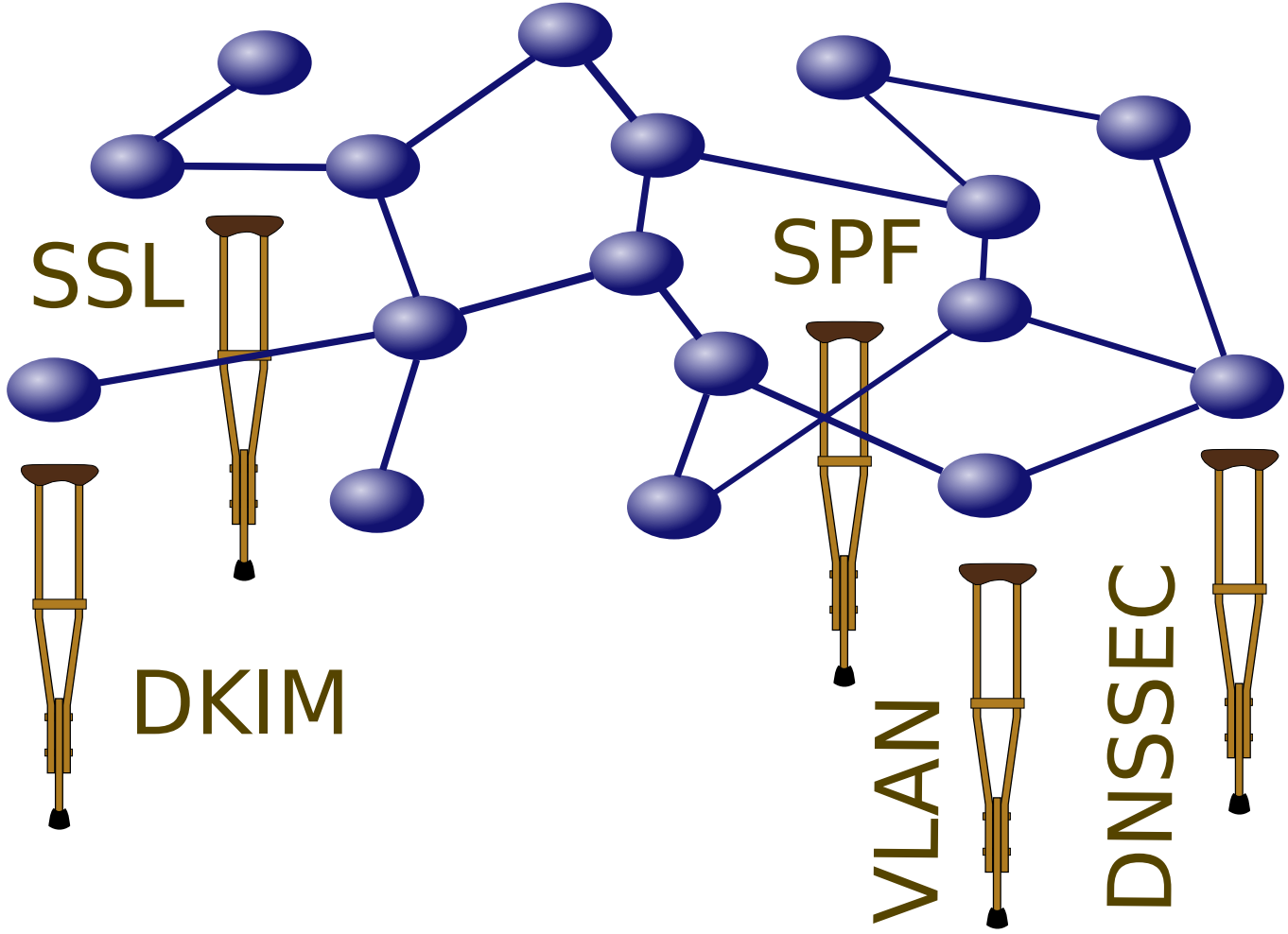


The Arpanet



- Designed to withstand external infrastructure damage
- No internal threats considered

The Internet



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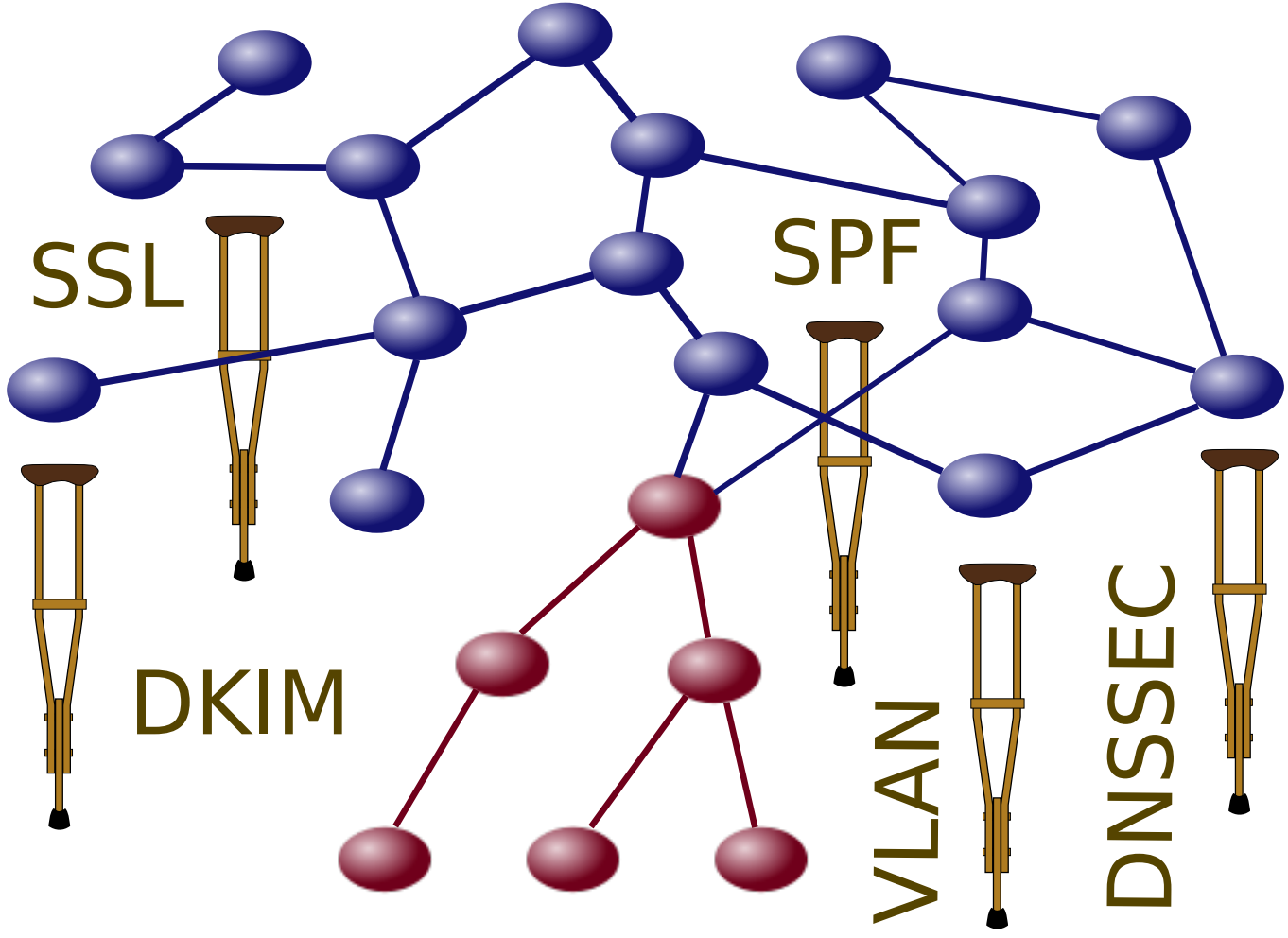
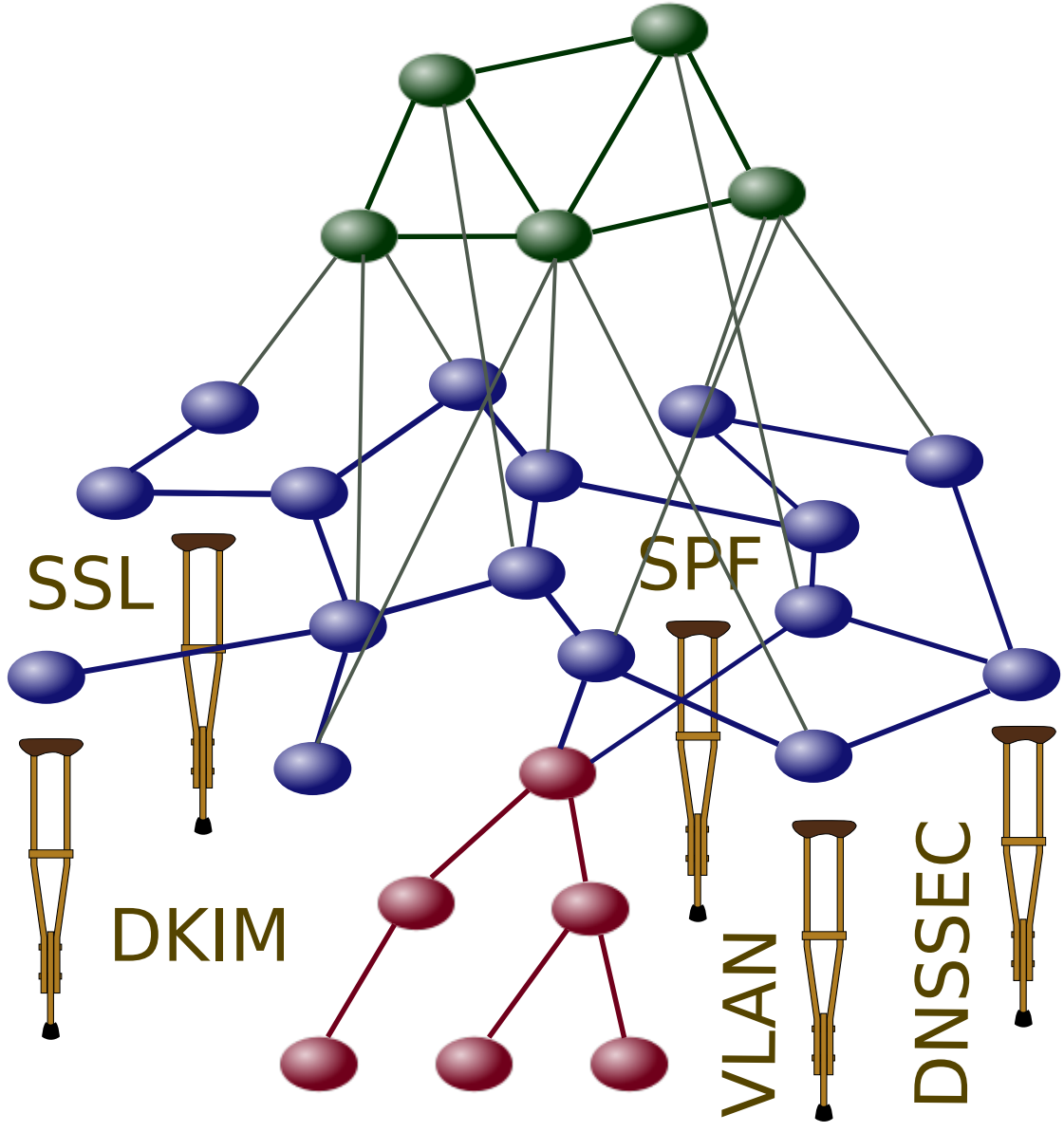


The Tor



The Tor

Pros:

- First world-wide overlay network
- Hidden services
- Scale

Cons:

- Entry/exit points
- Asymmetric:
  ~ 8‘000 nodes[1] [1] : ~ 4‘500‘000 users [2]
- Highly centralized: only **10** directory servers [3]

[1] relays + bridges

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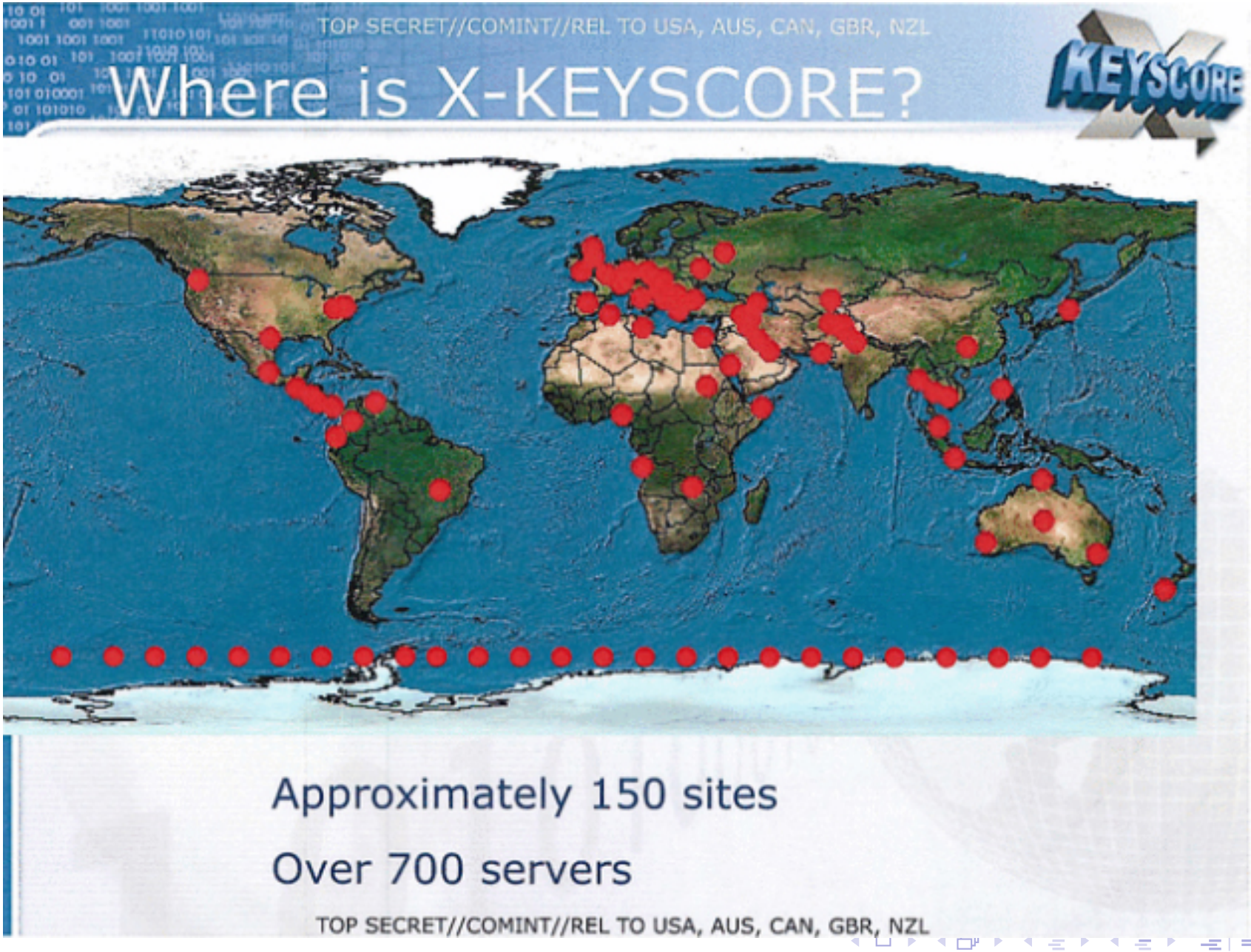
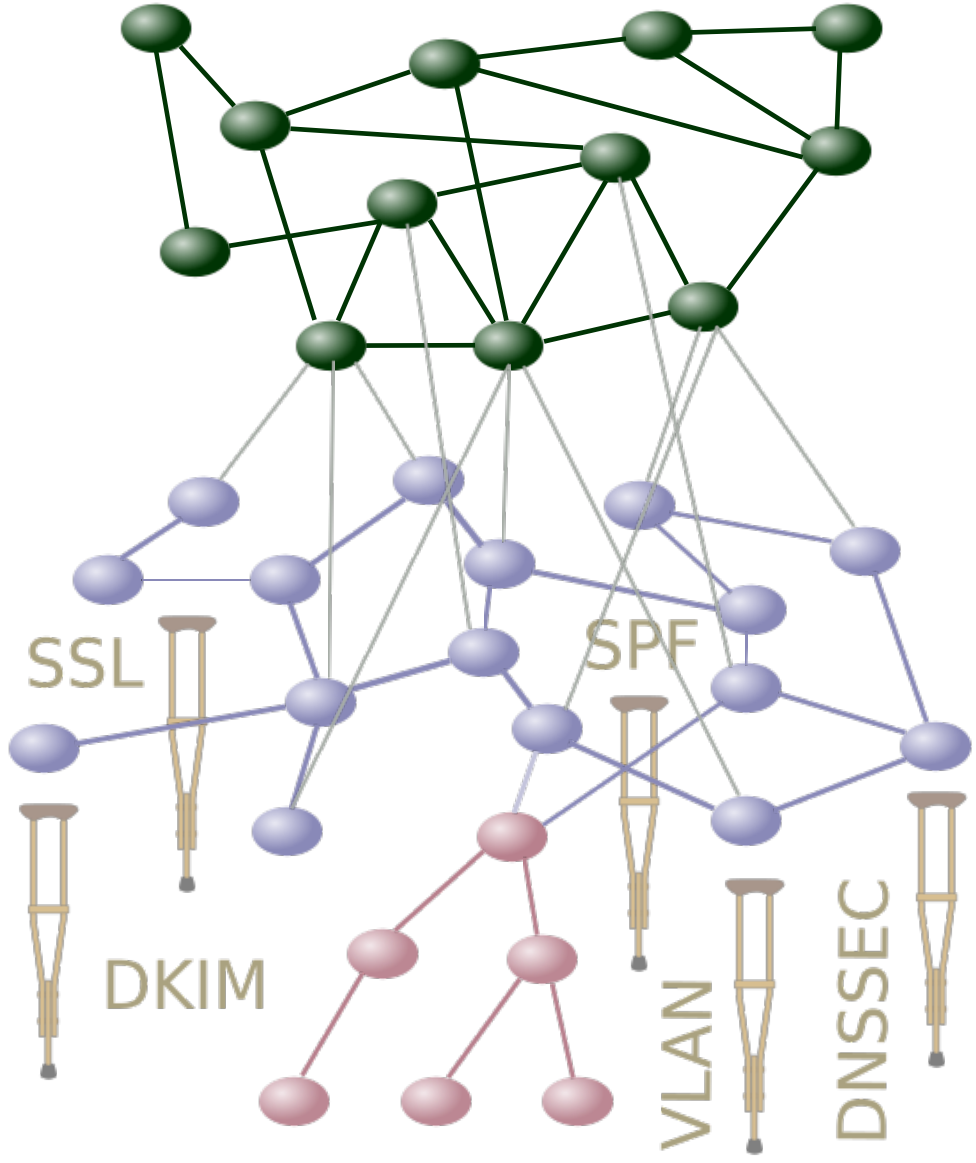
Global Surveillance



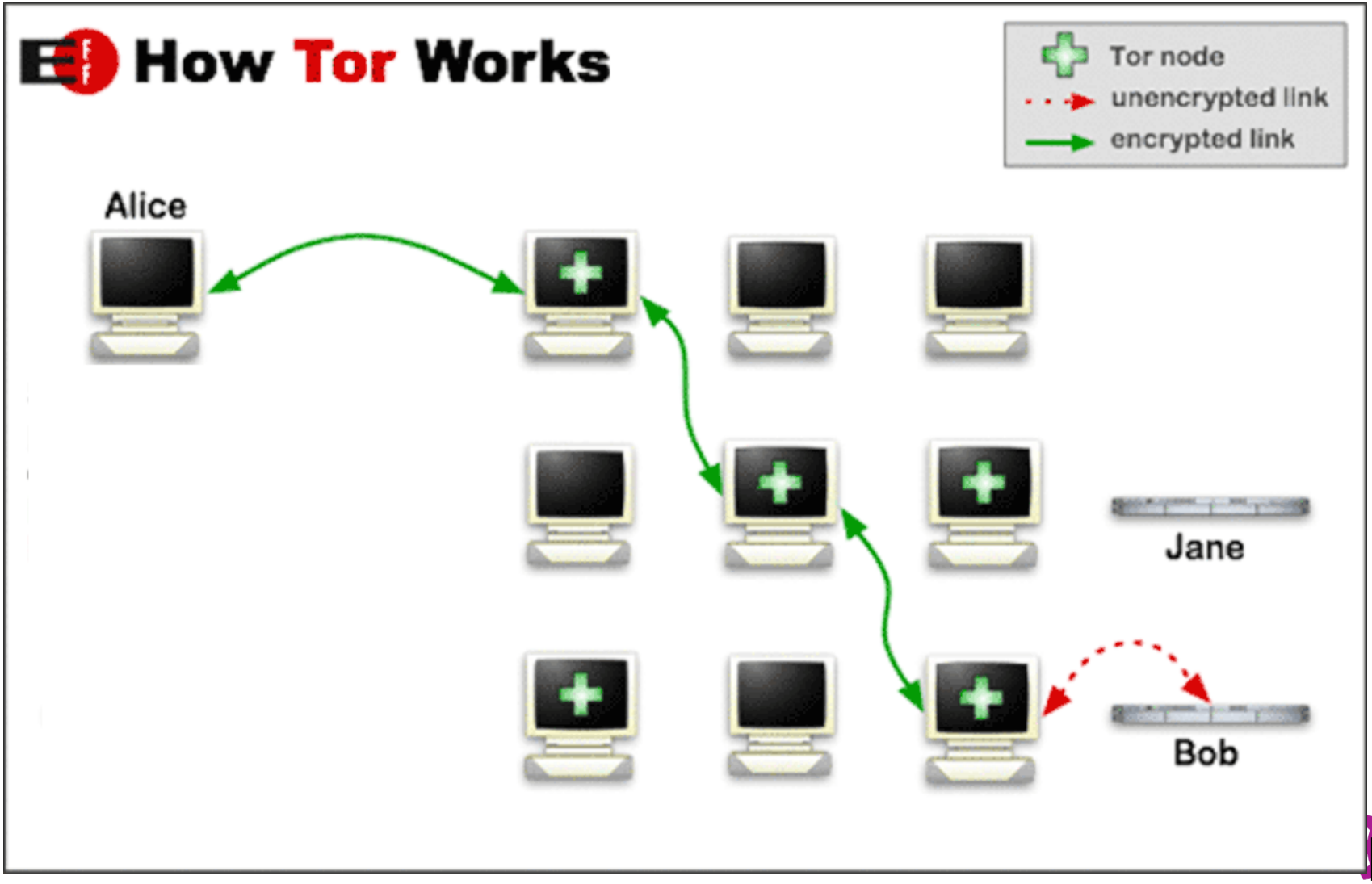
The I2P



The I2P Design

- No entry/exit nodes [4]
- Full decentralization
- Use minimal trust possible
- Wide range of protocols supported: TCP, UDP, RAW…
- $\sim 50‘000 \div 60‘000$ nodes [5, 6]
  - In order just to monitor network special research is required [7]
- Unidirectional tunnels

The Onion Routing



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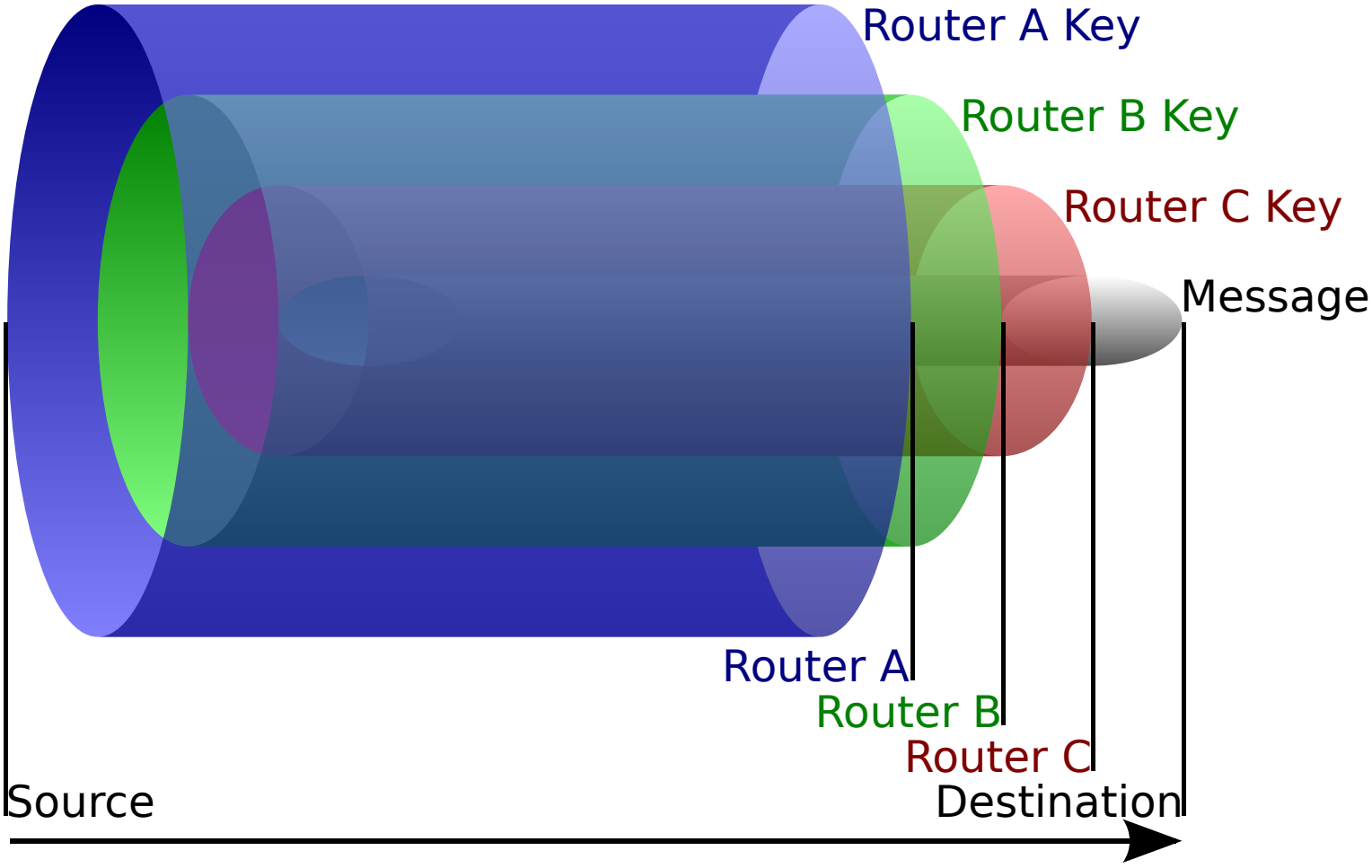
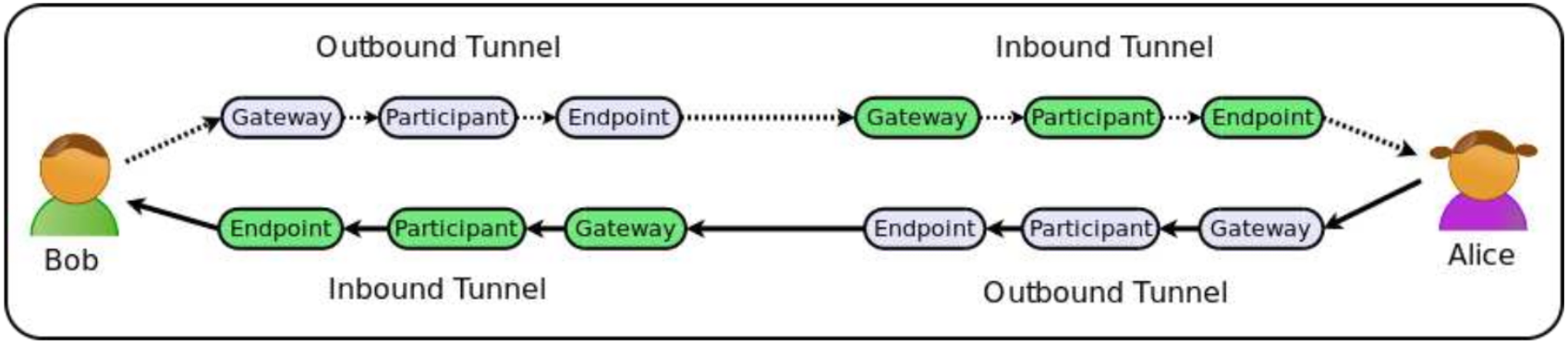


[9]

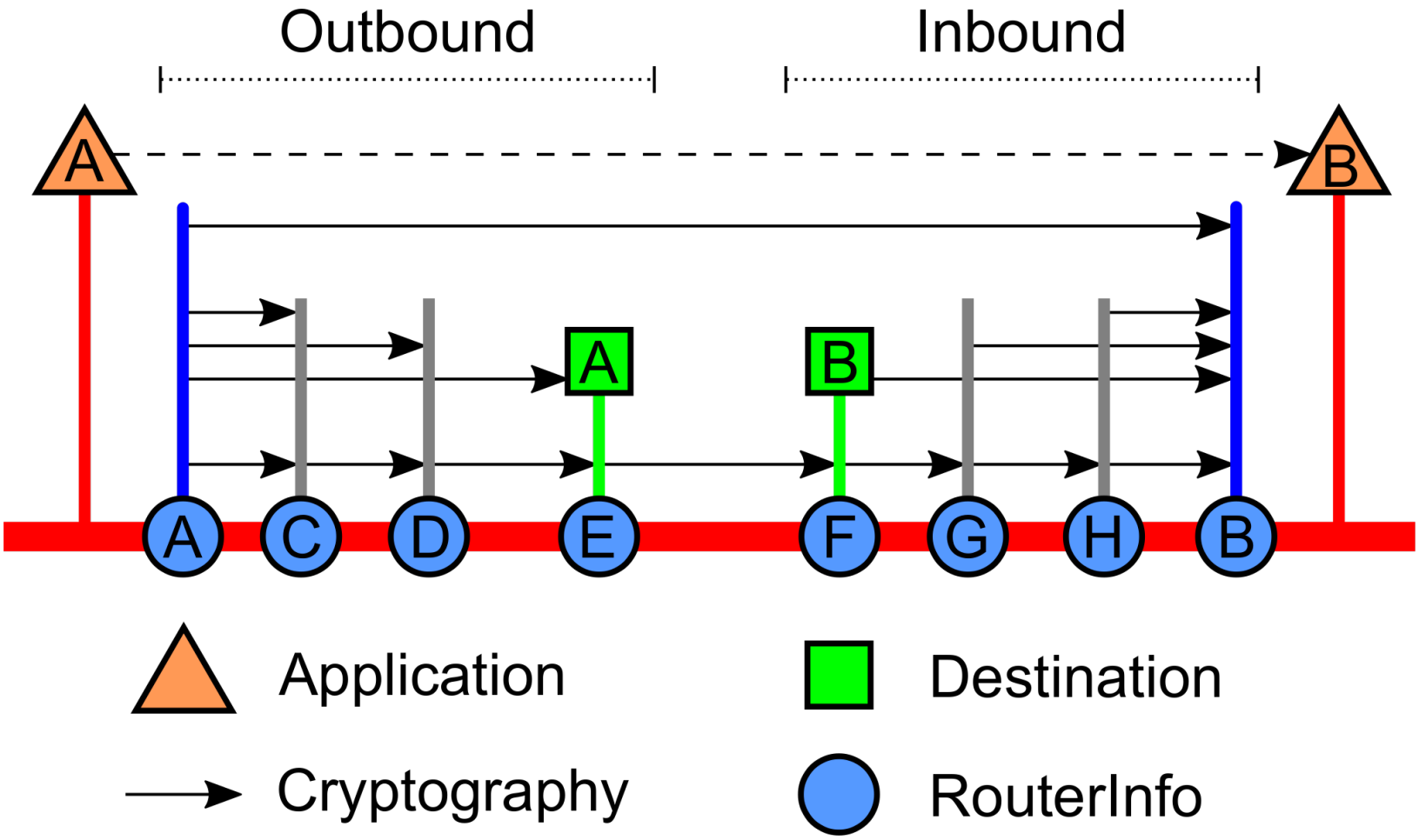
The I2P Tunnels



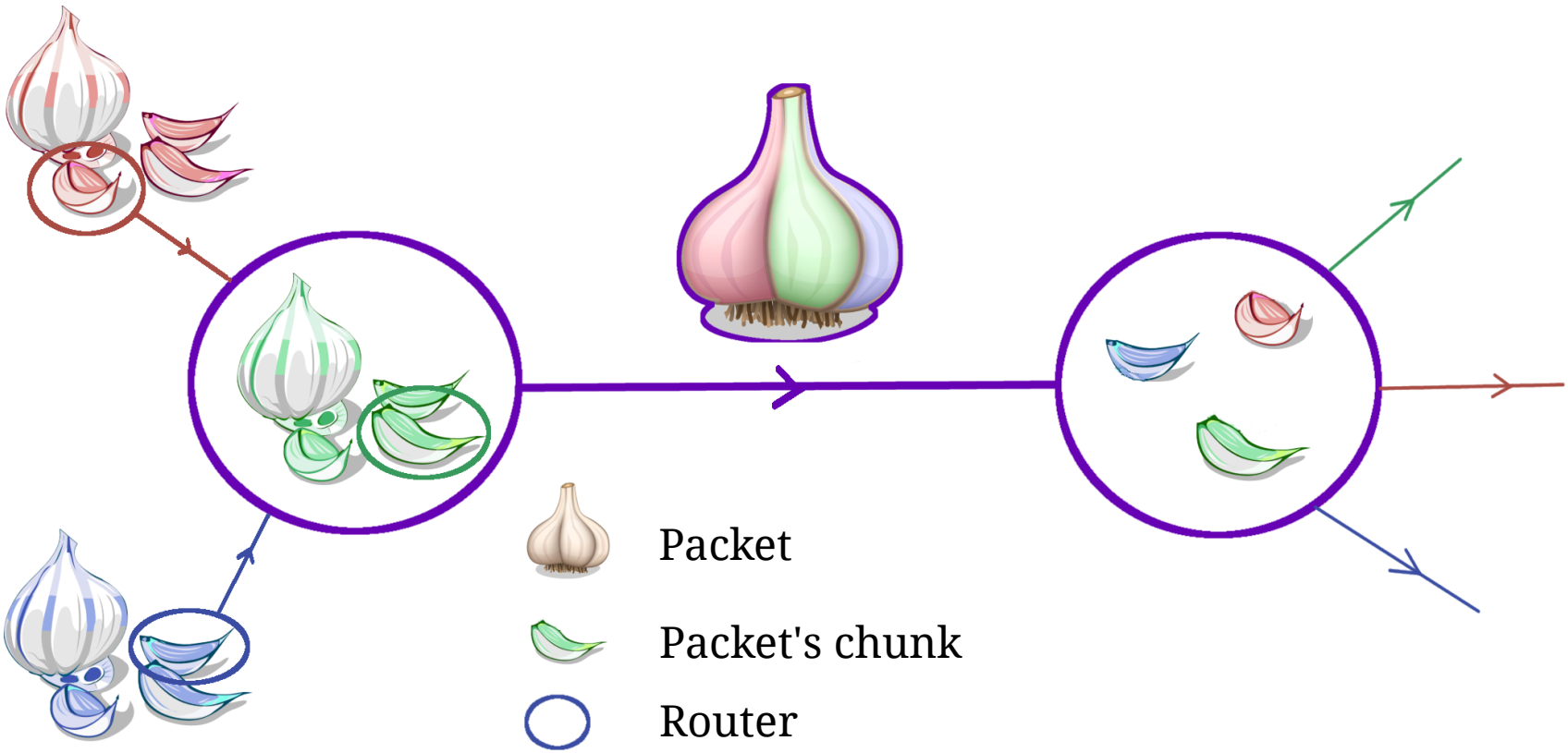
[7]

- Connect tunnel endpoints
- Different inbound and outbound tunnels
- Outbound endpoints are hidden
- Configurable tunnel length (usually 2-3)

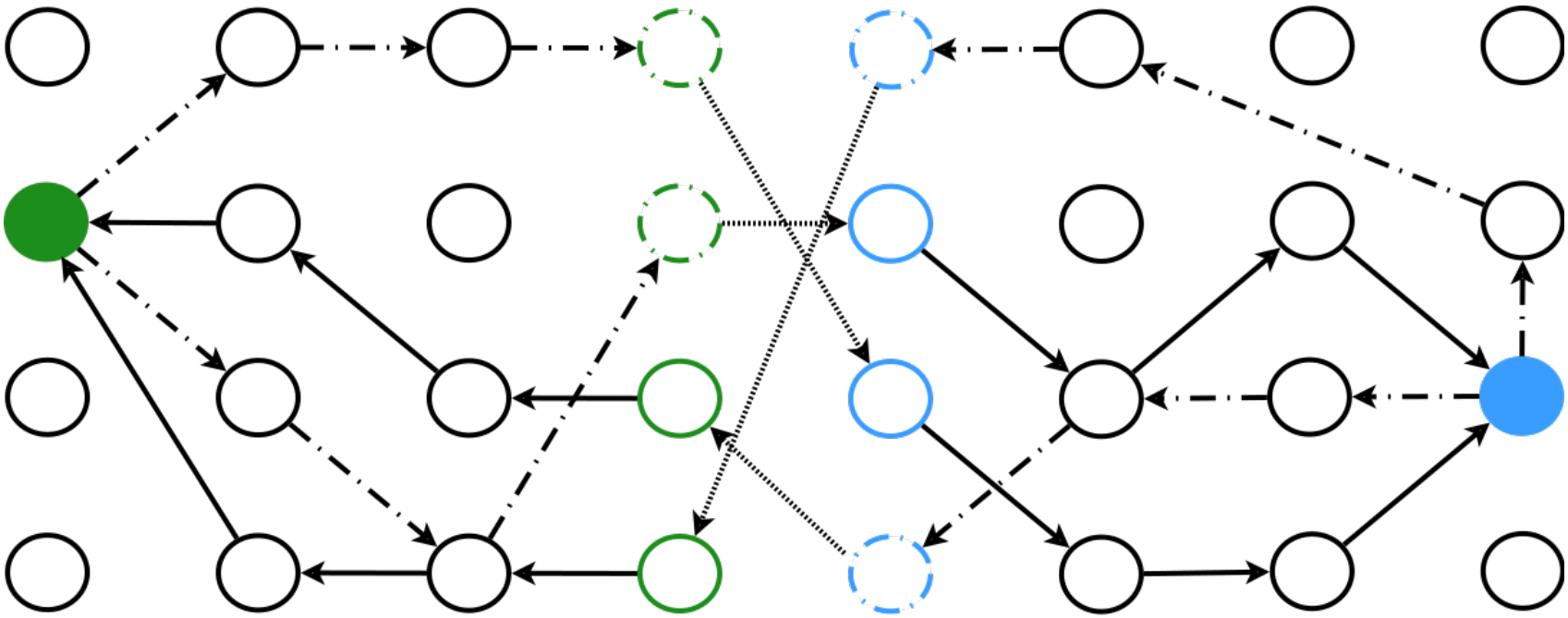
Three I2P Layers



The Garlic Routing



Ping-Pong: 2 chunks, 3 hops



Inbound
Outbound
Intertunnel

Outbound endpoints are hidden

Tunnels regen in ~10 min or at request

The Network Database

- No DNS-like centralized services
- Distributed (DHT-like) netDB is used:
  - RouterInfo (router contacts)
  - LeaseSets (destination endpoints)
- Public key based identification and connections

RouterInfo:

- ID (encryption and signing pub keys)
- contact (proto, IP, port)
- aux data
- all above is signed

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The Network database

Each node generates:

- encryption key
- garlic end-to-end encryption key
- signing key
- everything is signed into 516+ byte cert

Management:

- distributed netDB
- by *floodfill* routers
- $\sim$ $20'000 \div 30'000$ ($\sim 600 \div 1000$ at once)
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The Addressing Scheme

b32:

- SHA256 (cert(pub keys))
- equivalent of the IP in clearnet
- each node may have many b32's
- base64-encoding:

  nrbnshsndzb6homcipymkkngngw4s6twediqottzqdfyvrvjw3pq.b32.i2p

.i2p:

- covenient name, e.g.: *i2pwiki.i2p*
- addressbook based mapping
- persistent storage
- multiple sources:
  - inr.i2p
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- address helpers available

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b32:

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- or fresh netDB part
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Cryptography

Symmetric:

- AES-256

Asymmetric encryption:

- Elgamal-2048

Hash:

- SHA-256

All the above possible to change, but problems with backward compatibility.

Cryptography: signatures

1. DSA-SHA1 *[obsolete]*
2. ECDSA-SHA256-P256
3. ECDSA-SHA384-P384
4. ECDSA-SHA512-P521
5. RSA-SHA256-2048
6. RSA-SHA384-3072
7. RSA-SHA512-4096
8. EdDSA-SHA512-Ed25519 *[popular]*
9. EdDSA-SHA512-Ed25519ph *[popular]*

10. GOSTR3410-GOSTR3411-256-CRYPTO-PRO-A
11. GOSTR3410-GOSTR3411-512-TC26-A

} i2pd

Implementations

i2p [11]:

- original implementation
- in java
- up to 2 – 5 GB RAM

i2pd [12]:

- full implementation in C++ (w/o https proxy)
- 150 – 350 MB RAM
- $\sim 20 - 50\%$ less CPU usage
- works on Raspberry PI [13]

other forks: kovri [14], etc...

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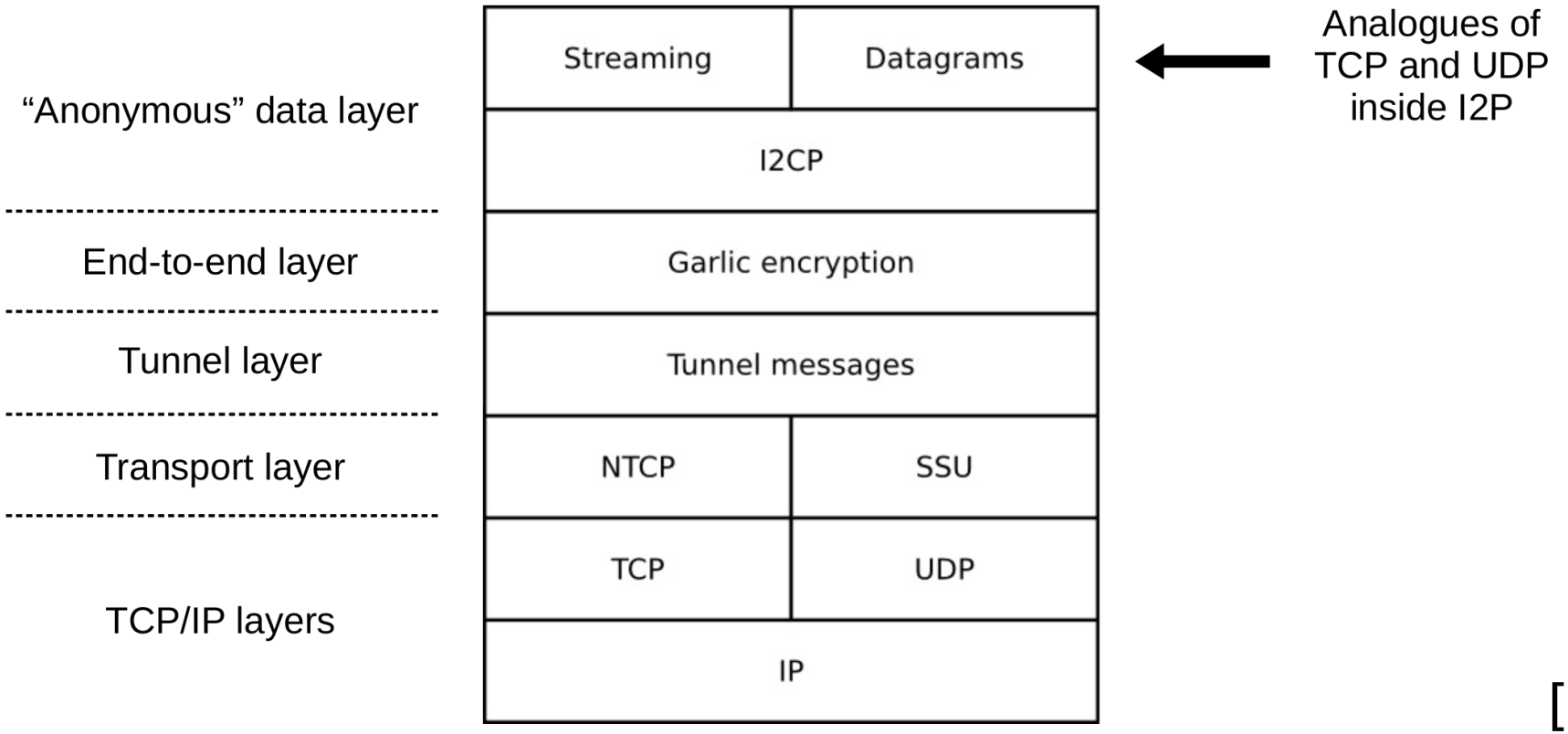
The I2P Protocols



[10]

- SOCKS and http(s) proxies for the I2P layer are provided
- Control protocols allow fine tunnel control

Usage

Some resources:

- official I2P page [15], wiki [16, 17], search [18]
- messengers: IRC [19], Jabber [20]
- social networks [21, 22]
- torrents [23, 24, 25]

Software:

- decentralized forums: Syndie [26]
- torrents: transmission-i2p [27]
- distributed network file system: Tahoe-LAFS [28]
- crypto currencies: anoncoin [29], monero [30, 14]

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Use case: SSH

- many inbound tunnels => no problems with NAT
- set `UseDNS = no` in sshd.conf
- in tunnels.conf:

```
[ssh]
type = server
host = 127.0.0.1
port = 2222
keys = ssh.dat
```

- connect:

```
torsocks -P 4447 ssh name.b32.i2p
```

Use case: VPN

- server, tunnels.conf:

```
[openvpn]
type = server
host = 127.0.0.1
port = 1194
keys = vpn.dat
accesslist = b32addr1, b32addr2
```

- client, openvpn.conf:

```
socks-proxy 127.0.0.1 4447
remote name.b32.i2p
```

Security

I2P Threat analysis:

- thourought analysis [31] and numerous publications are available [32]
- most threats are partially or fully minigated

The weakest part is **user**

- user *fingerprinting*:
  - browsers are terrible problem: too many complex and leaking technologies
  - check yourself at [33, 34]
- application level leaks

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Security: patterns

Insecure / deanonimyzing:

- using the same browser for clearnet, tor and i2p
- including QuickProxy, FoxyProxy, privoxy (with multiple upstreams)
- webrtc [35]
- javascript, flash, plugins,...

Secure:

- dedicated browser, container / vm
- security-oriented software (e.g torbrowser)
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Summary

- Use it, setup routers [11]
- Be *careful* and wise
- Contribute and develop

Thank you for your attention!

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