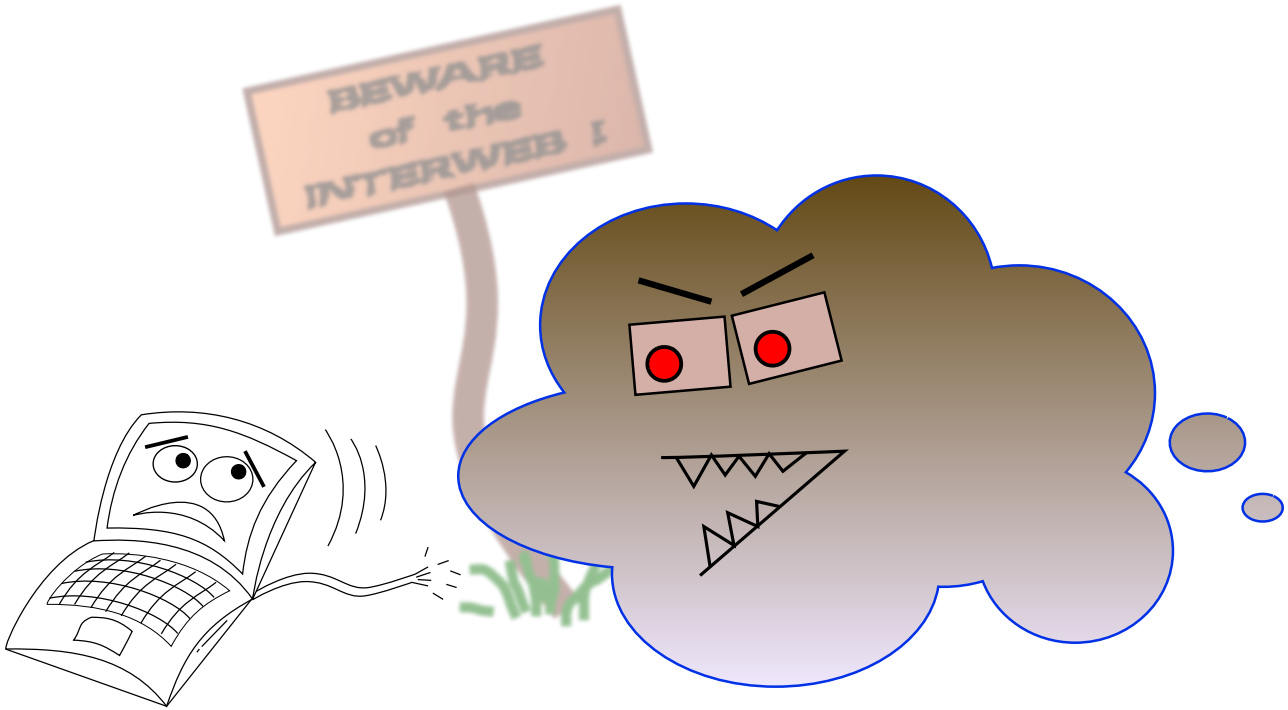
An introduction to tinc

Hamburg, July 28, 2014



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The problem of NAT

The problem of MTU

Other problems

Future plans for tinc

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The end

Before September 1997:

- Bad support for network virtualization
- No IPsec
- PPP module:
  - You have to speak the PPP protocol
  - Or run pppd through something else (like SSH)
  - Very poor performance
- CIPE module
  - out-of-tree
  - Does everything inside the kernel
  - Very inflexible, hard to maintain

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September 1997, Linux 2.1.53 is release.

- Introduces the Ethertap module
- ```
  modprobe ethertap
  ifconfig tap0 ...
  fd = open("/dev/tap0", O_RDWR);
  ```
- Several userspace projects start here.

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  ```

The very beginning of tinc: "tapencaps"

- Read packets from tap device, send them to TCP socket.
- Read packets from TCP socket, send them to tap device.
- Rest is left to the user.

That's nice but what can you do with that?

- Set up a private network to a friend!

This was started by me.

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The next stage: "vpnd"

- Turn tapencaps into a proper UNIX daemon.
- And make releases.
- And put source code into CVS.
- Slap the GPL license on it.

In short...

- Become an Open Source project.

This work was mostly done by Ivo Timmermans.

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We used it for our own friend network.

- Everyone wants to be able to connect to each other.
- Try a hub-and-spoke setup.
- One vpnd per spoke.
- Hub gets a lot of traffic.
- Falls apart everytime the hub goes down.
- Soon we reach the limit of 16 Ethertap devices.

That's not good. What to do?

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December 1998, project renamed "tinc".

January 1999, support for multiple connections:

- One daemon can connect to multiple other daemons
- One daemon still uses only one Ethertap device
- Tinc reads the IP header, routes packets.

This set tinc apart from other VPN projects.

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Fast-forward - Current features:

- Connects multiple sites together
- Can act as router (layer 3) or switch (layer 2)
- Full support for IPv6
- No central server
- You configure some endpoints, tinc will do the rest

Modus operandi:

- Metadata exchanges via TCP
- VPN packets directly via UDP
- Fall back to TCP if UDP is not possible

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The competition:

- CIPE†
- VTun†
- IPsec
- OpenVPN
- Hamachi

But also:

- GVPE
- CloudVPN
- SocialVPN
- n2n
- VDE

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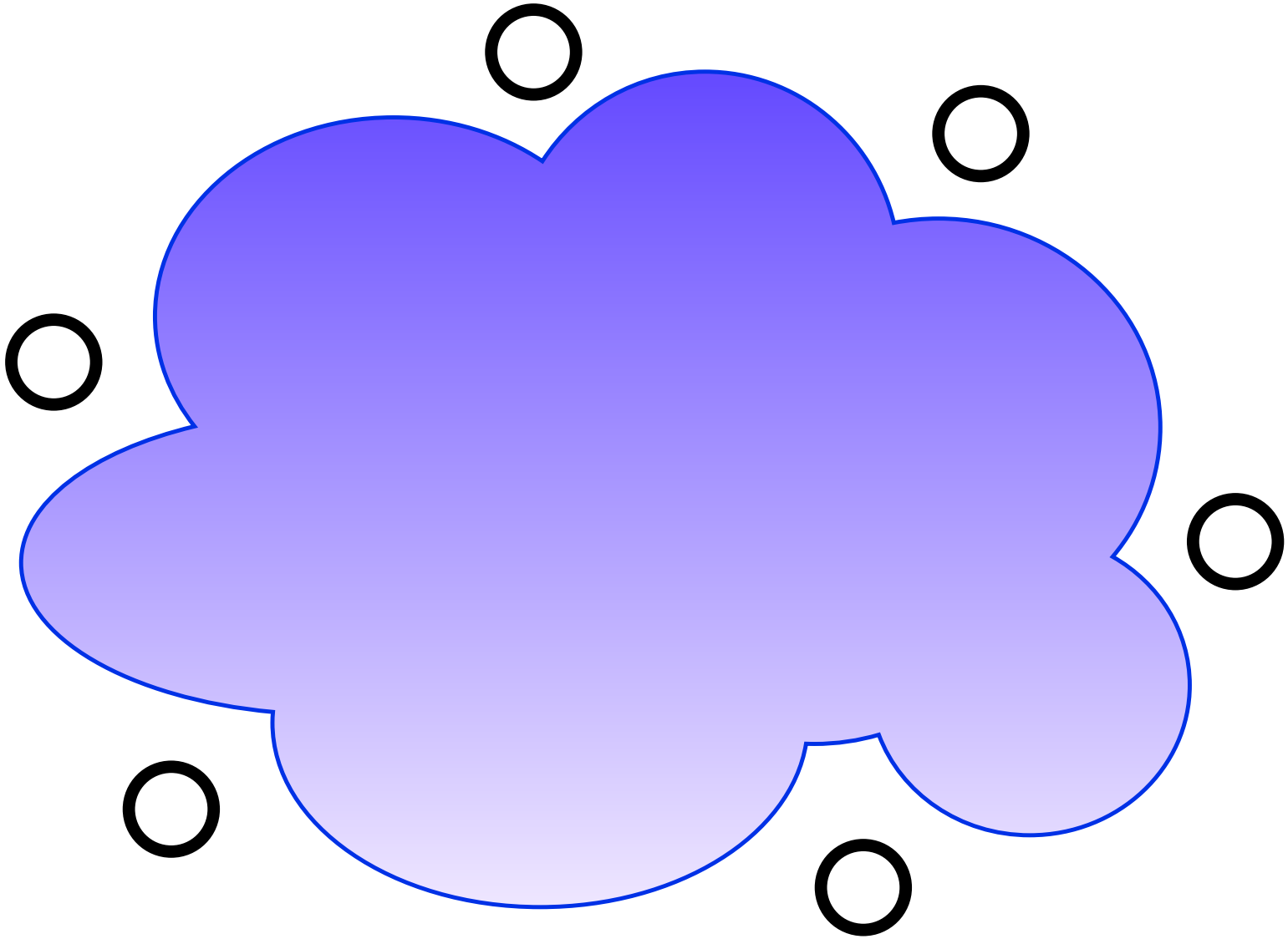
Network before VPN is configured:



Blue cloud: the Internet
Black circles: VPN nodes

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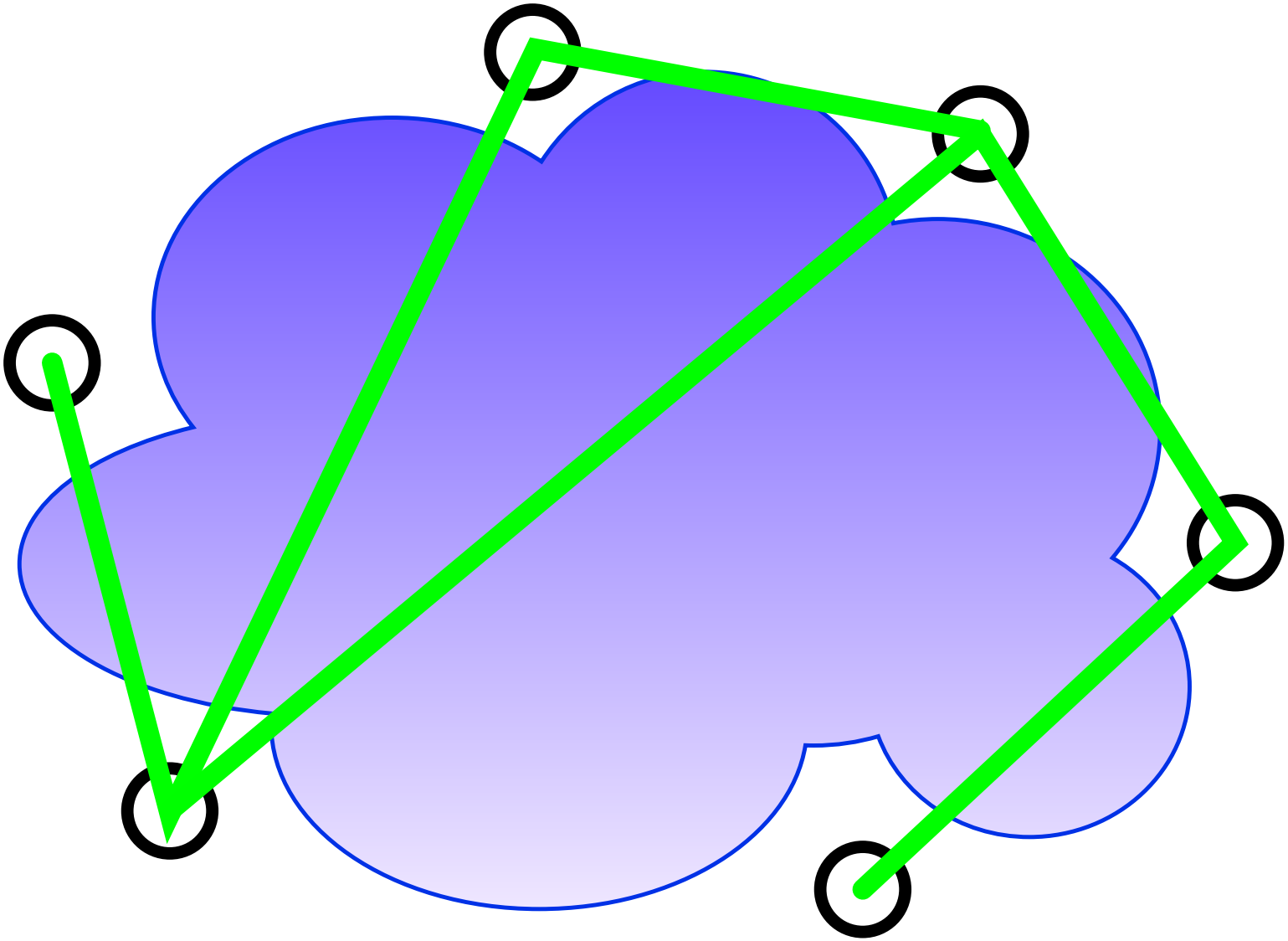
Initial connections configured by user:



Green lines: initial connections

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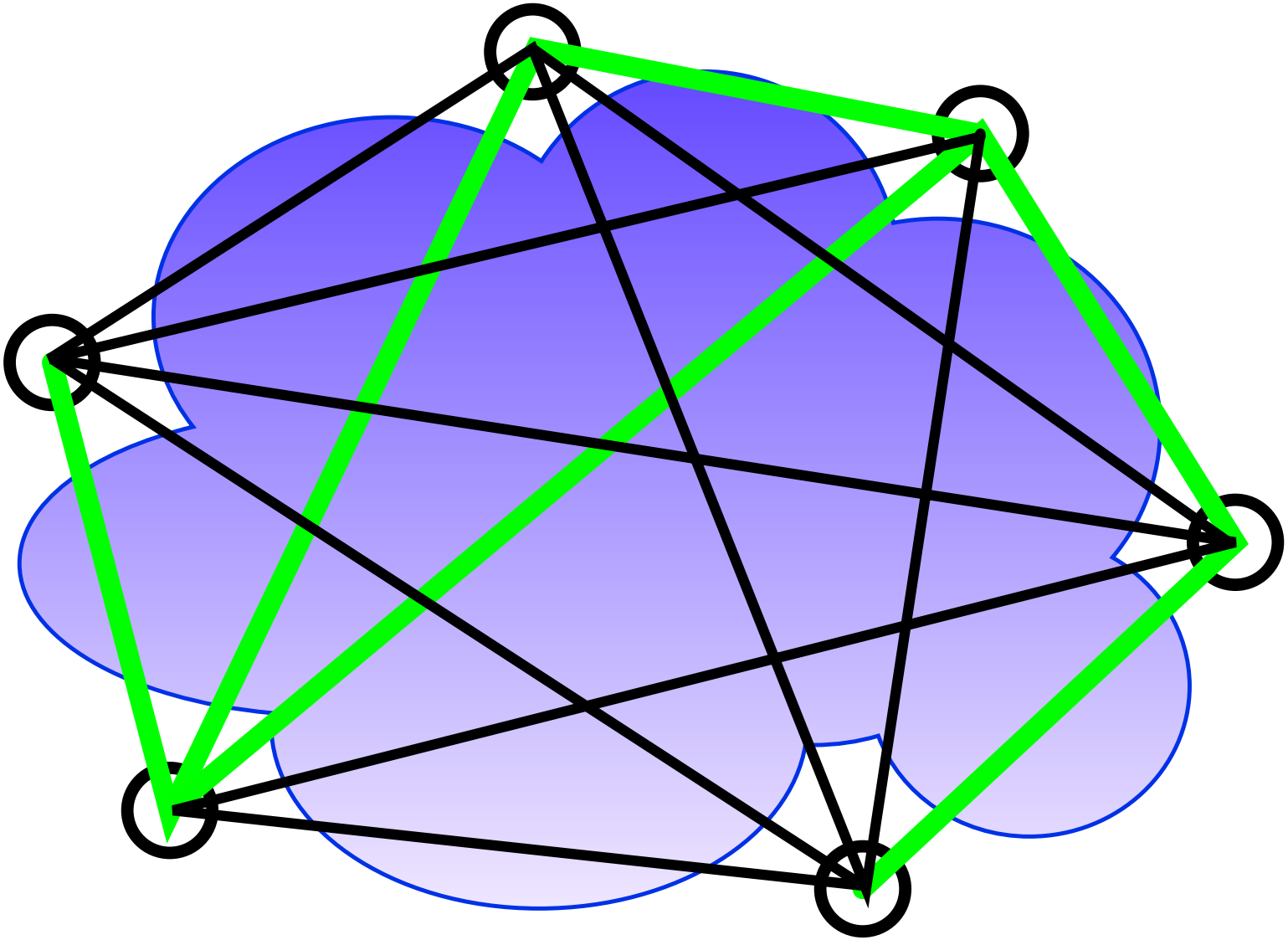
Full mesh created by tinc:



Black lines: UDP tunnels

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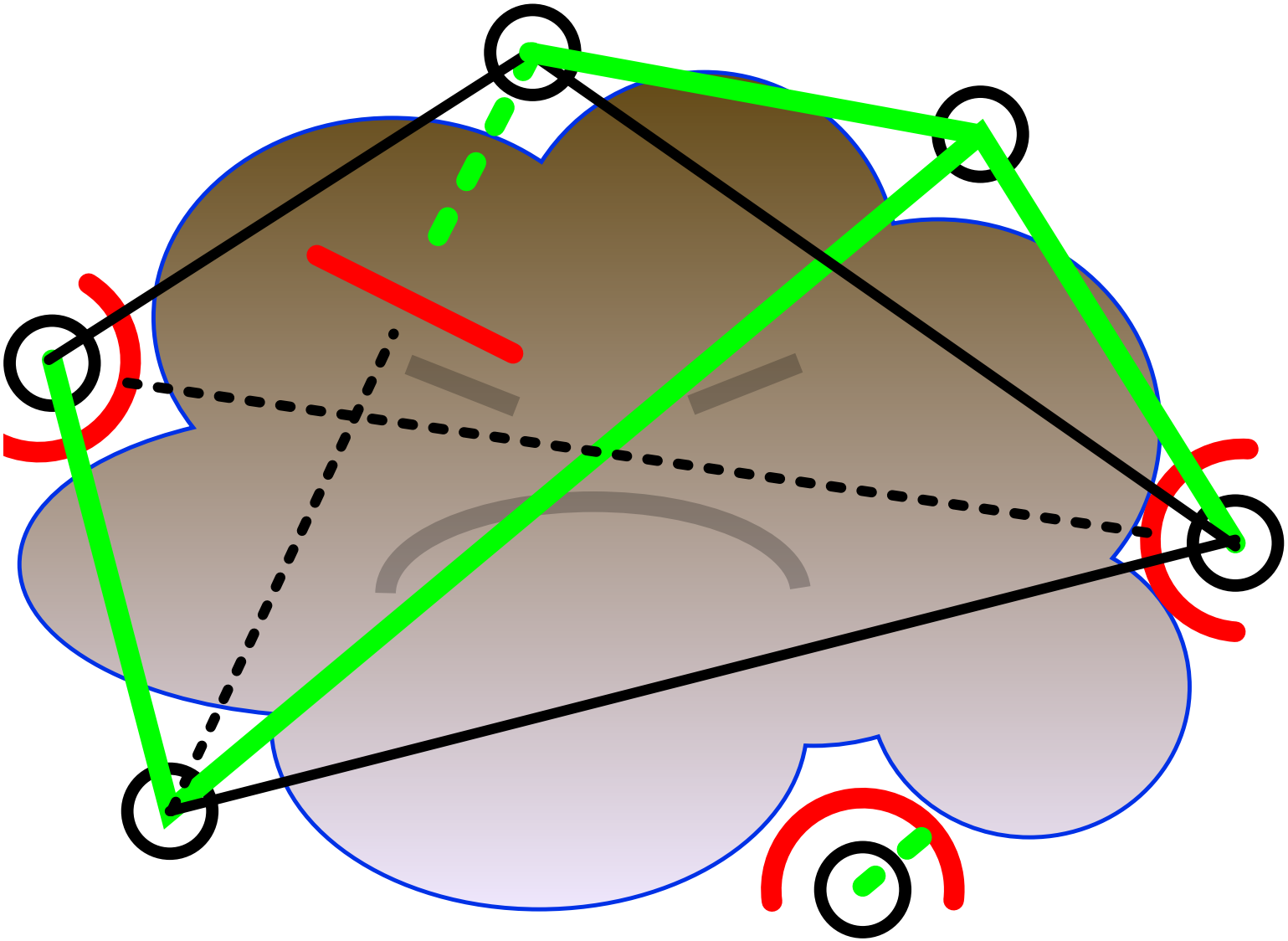
Reality is not so nice:



Red arcs: NAT
Red line: ISP blocking traffic
Dotted lines: failed connections

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The problem of NAT:

- Source address and port change
- Incoming connections blocked

Solutions:

- Routing via non-NAT node (not efficient)
- Port forwarding (not always possible, manual work)
- UPnP (needs router support, complex)
- STUN/ICE (not always possible, complex)

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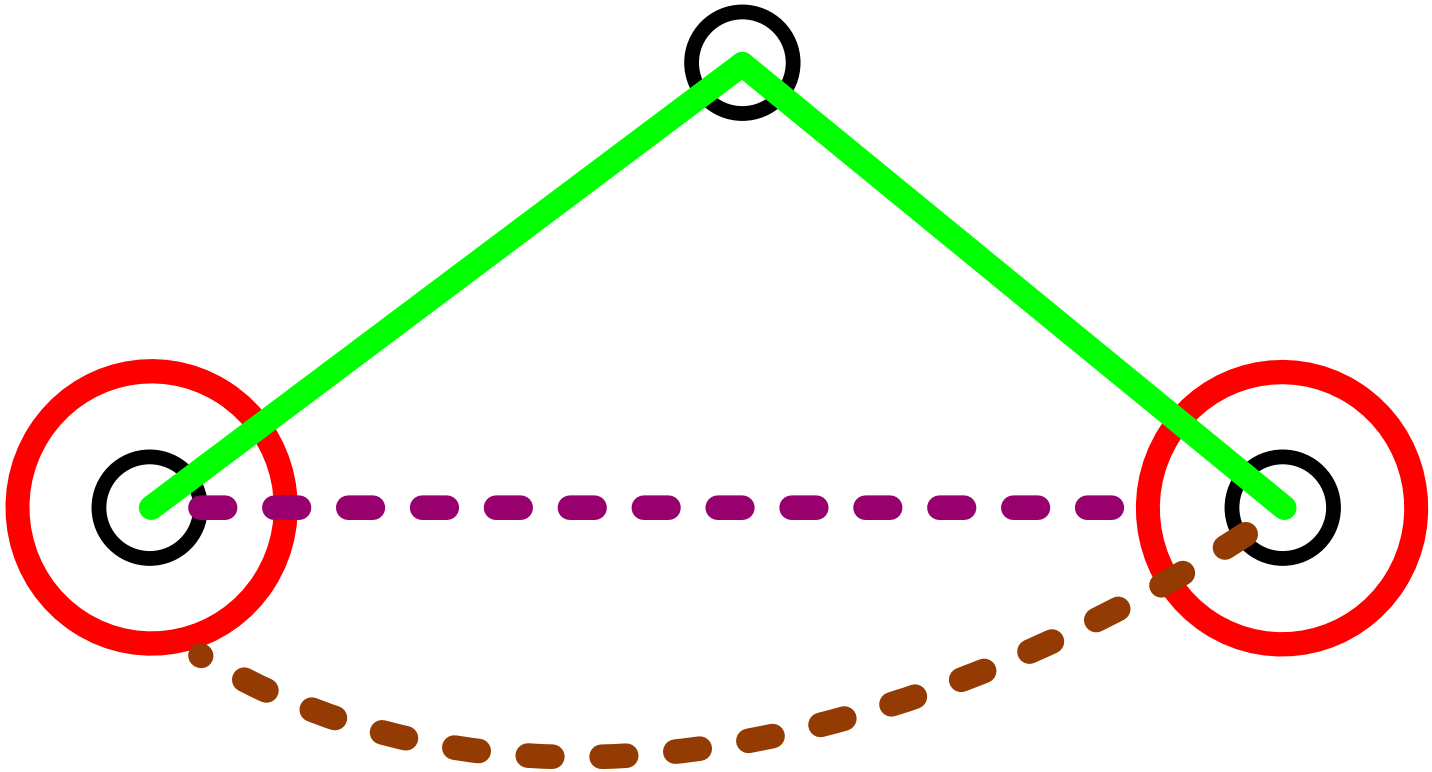
Two nodes behind NAT:



Both nodes can talk to a third node.
NAT changes ports, nodes cannot talk to each other.

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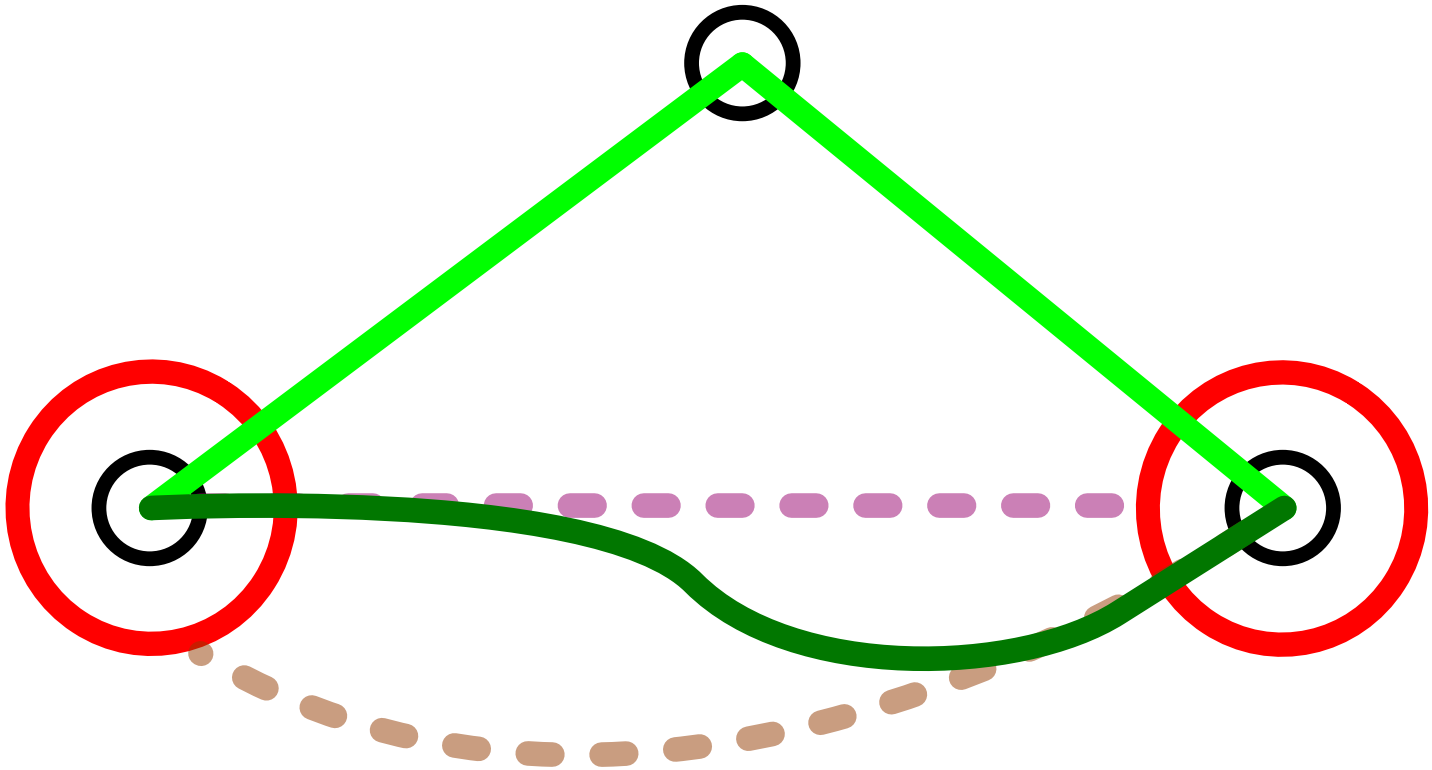
STUN in action:



Third node tells other nodes about their addresses and ports.
Nodes connect to each other using this information.

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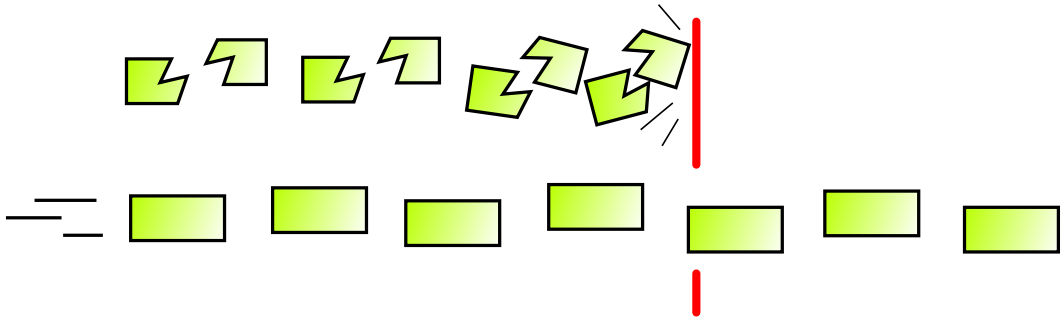
The problem of packet fragmentation:

- MTU inside tunnel smaller than outside
- Outer layer fragments bad for performance
- Some firewalls/ISPs block fragments



Solution:

- Determine path MTU between nodes
- Generate ICMP Fragmentation Needed packets
- Should work for all IPv4/IPv6 traffic
- Fall back to TCP for other traffic

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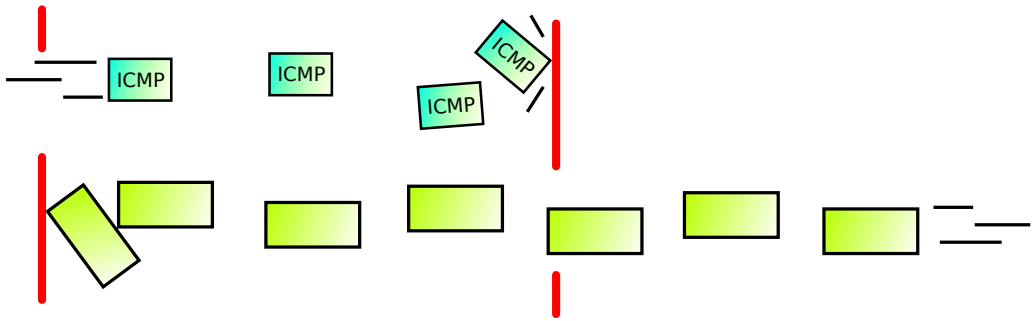
The problem of firewalls/ISPs blocking ICMP:

- ICMP Fragmentation Needed does not work!
- Happens when network traffic leaves the VPN (for example, when having default gateway on VPN)



Solution:

- Clamp MSS field in TCP packets to path MTU
- Works only for TCP

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Other problems:

- Frequently changing IP addresses
  - use dyndns
  - cache & forward known addresses between nodes
- Only allowing certain ports, like HTTP
  - tunnel over ICMP/DNS/HTTPS
- ISPs dropping/delaying small UDP packets
  - because they think it's VoIP!
  - severely slows down TCP streams inside tunnel

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Version 1.1:

- Control a running tinc daemon (CLI, GUI)
- Greatly simplify setting up tinc
- Improve security (SPTPS)

Version 2.0:

- Get rid of the legacy protocol
- Decentralized authorization framework (next slides)

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Authentication and authorization

- Authentication = proving who you are
- Authorization = proving you are allowed to do something

Two well known (mostly authentication) methods:

- X.509 certificates
  - centralized approach
  - focused on identities (LDAP like), and URLs
- OpenPGP keys
  - decentralized approach
  - focused on email addresses

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We need OpenPGP-like features:

- Completely decentralized
- Web of trust

We need more than OpenPGP can offer:

- Authorise anything, not just email
- Everyone can add/remove authorizations
- Negative authorization: forbid things
- Group decisions

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libfides: lightweight p2p authorization framework

- Create and maintain repository of many certificates
  "X said at time T that Y is allowed to do Z"
- Newer certificates overrule older ones
  "X said at time T+1 that Y is not allowed to do Z"
- Make it simple to query the repository
  "Is Y allowed to do Z?"

- Fast & easy synchronization of repositories
- Application does not need to know about crypto
- Libfides itself uses only ECDSA primitive

- Still in alpha stage.

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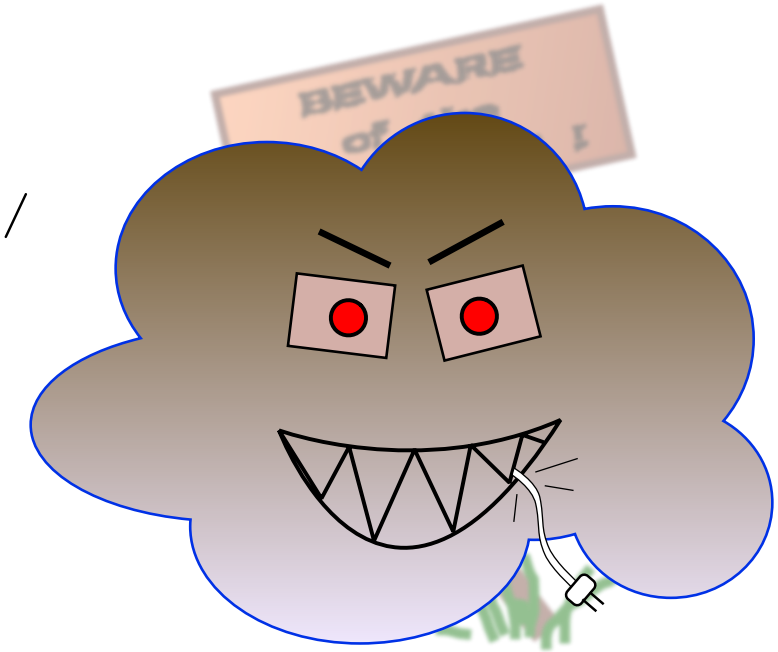
Conclusions:

- Tinc has come a long way since 1997.
- The Internet eats your packets.
- Lots of techniques necessary to work around it.
- Distributed authorization is a challenge.

That's it.

- Questions?

Visit the website:
`http://tinc-vpn.org/`



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