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IPOP: Self-configuring IP-over-P2P Overlay-based Virtual Private Networking

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Abstract

We present IPOP (IP-over-P2P, http://www.ipop-project.org), an easy to deploy user-level system which uses a **self-configuring peer-to-peer overlay to ensure private IP connections between virtual machines** that can be physically distributed across multiple sites, but are logically interconnected by a virtual network. Our goal is to **demonstrate that this overlay VPN technology can complement or supplant emerging cloud networking solutions** such as Amazon VPC or Microsoft Azure's upcoming software-defined-networking services, in a manner that allows user-defined inter-cloud virtual networks.

Key Features

=> Chord-like structured P2P overlay

=> Decentralized DHCP service through DHT

=> Builtin packet encryption and support for IPSec

=> Decentralized NAT traversal

=> Fully decentralized with no single point of failure

IPOP in the Cloud

=> Deployments in EC2, GoGrid, FutureGrid

=> Delivers up to 98 Mbps on Amazon EC2

=> Enables condor deployments across cloud providers

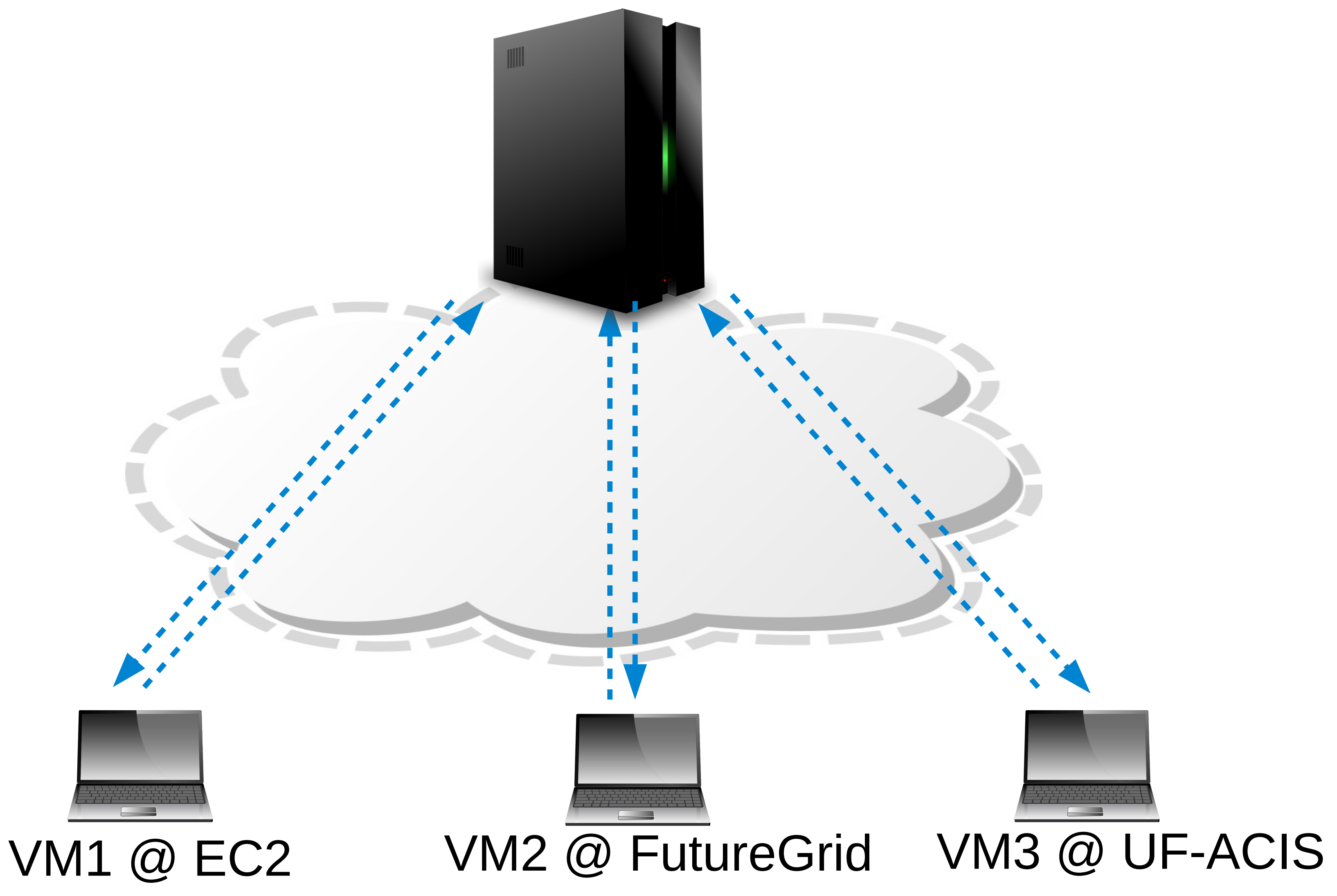
Future Work

=> Exploring support for Openflow

=> Autoconfiguration support for StrongSwan

=> Builtin packet encryption and supports IPSec

Architecture

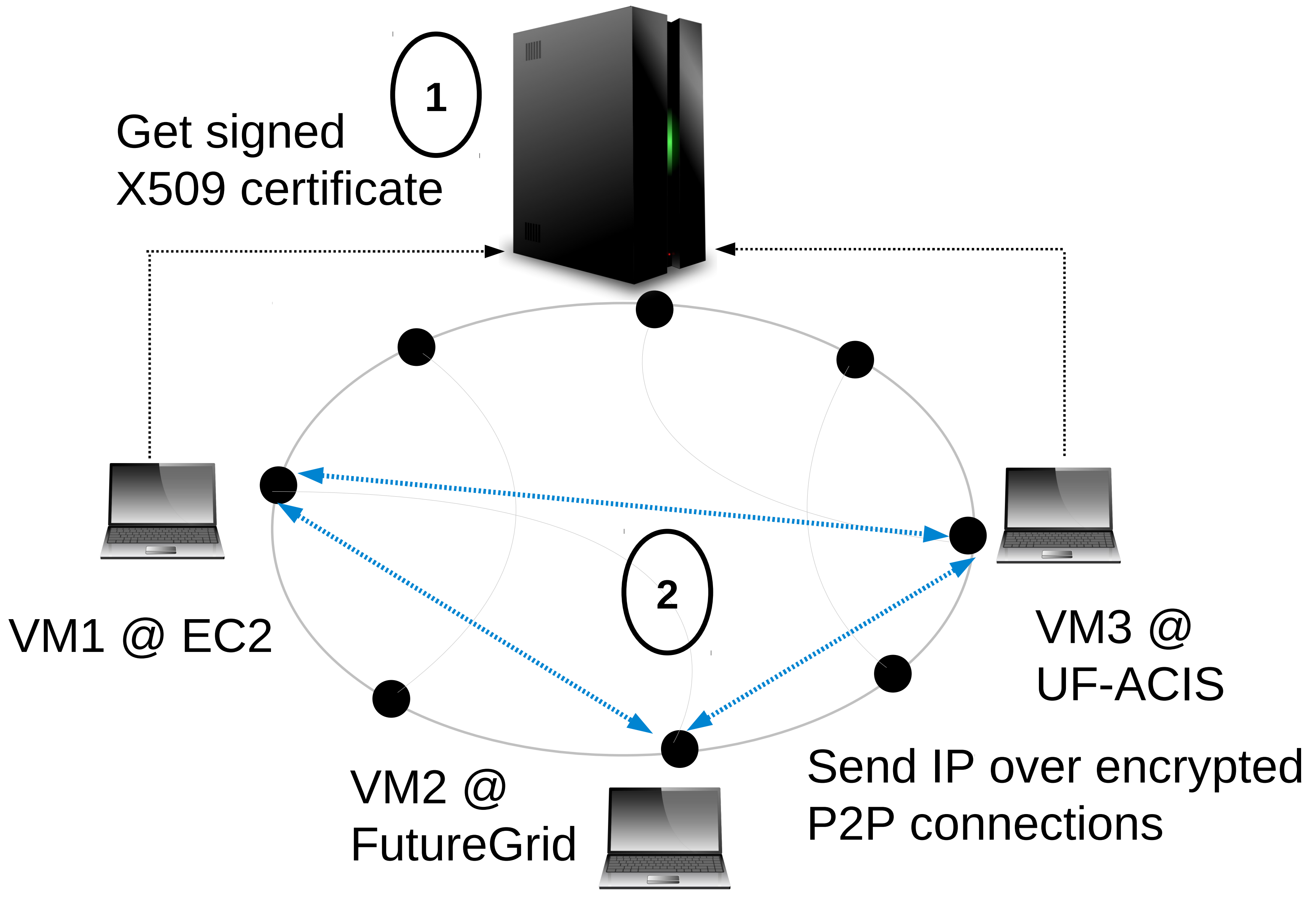


Centralized VPN Approach (OpenVPN)

=> IP packets routed through gateway (latency and bandwith)

=> Gateway handles encryption/decryption (trust)

=> IP routing information stored at gateway (stateful)

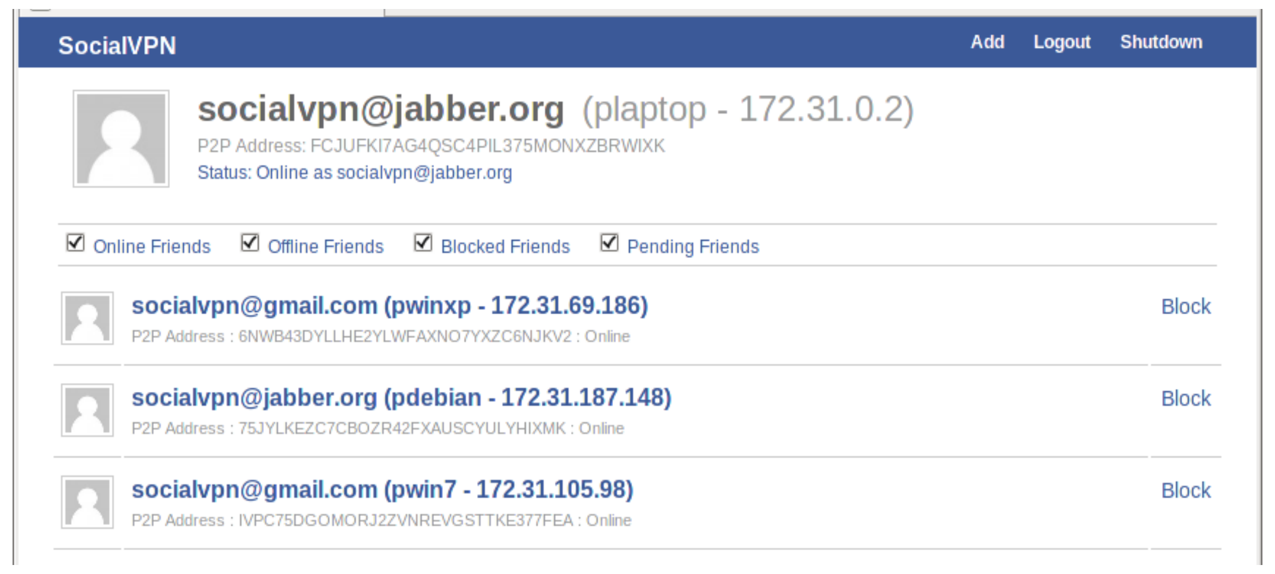


P2P VPN DHT-based Approach (IPOP)

=> IP packets routed directly over P2P connections

=> Authentication and encryption is end-to-end

=> Routing information is distributed



SocialVPN Add Logout Shutdown

socialvpn@jabber.org (plaptop - 172.31.0.2)
P2P Address: FCJUFKI7AG4QSC4PIL375MONXZBRWIXK
Status: Online as socialvpn@jabber.org

☑ Online Friends ☑ Offline Friends ☑ Blocked Friends ☑ Pending Friends

socialvpn@gmail.com (pwinxp - 172.31.69.186) Block
P2P Address : 6NWB43DYLLHE2YLWFAXNO7YXZC6NJKV2 : Online

socialvpn@jabber.org (pdebian - 172.31.187.148) Block
P2P Address : 75JYLKEZC7CBOZR42FXAUSCYULYHIXMK : Online

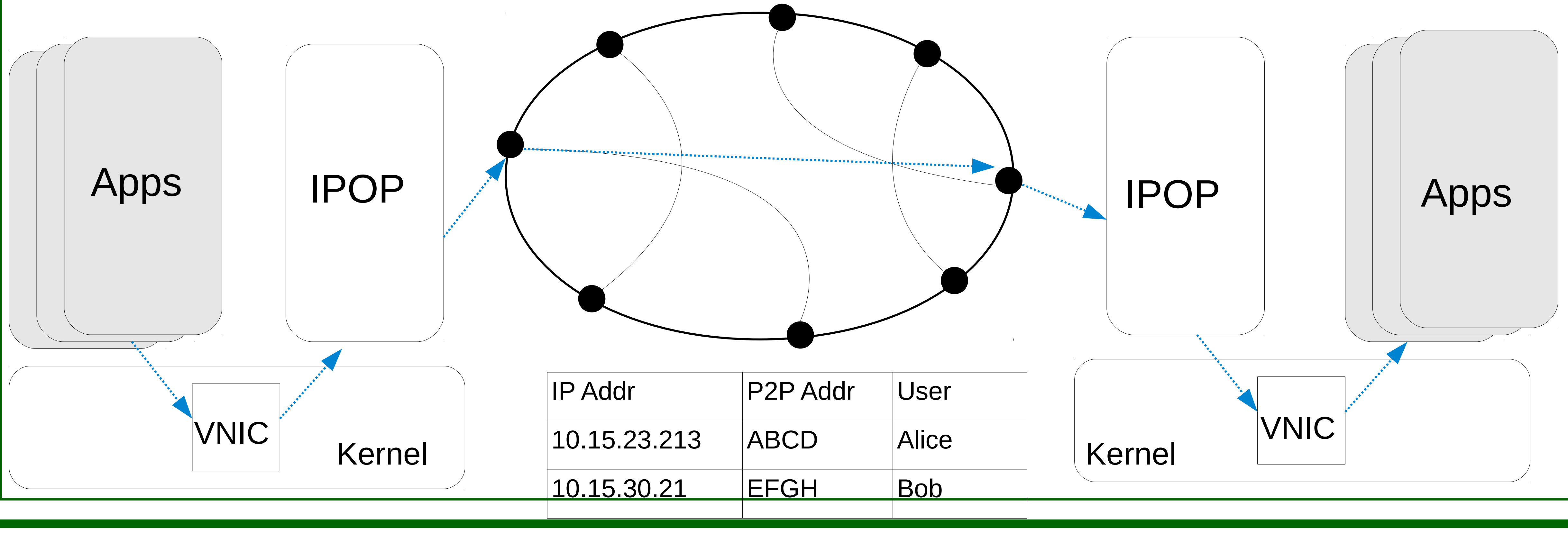
socialvpn@gmail.com (pwin7 - 172.31.105.98) Block
P2P Address : IVPC75DGOMORJ2ZVNREVGSTTKE377FEA : Online

IPOP Technical Details

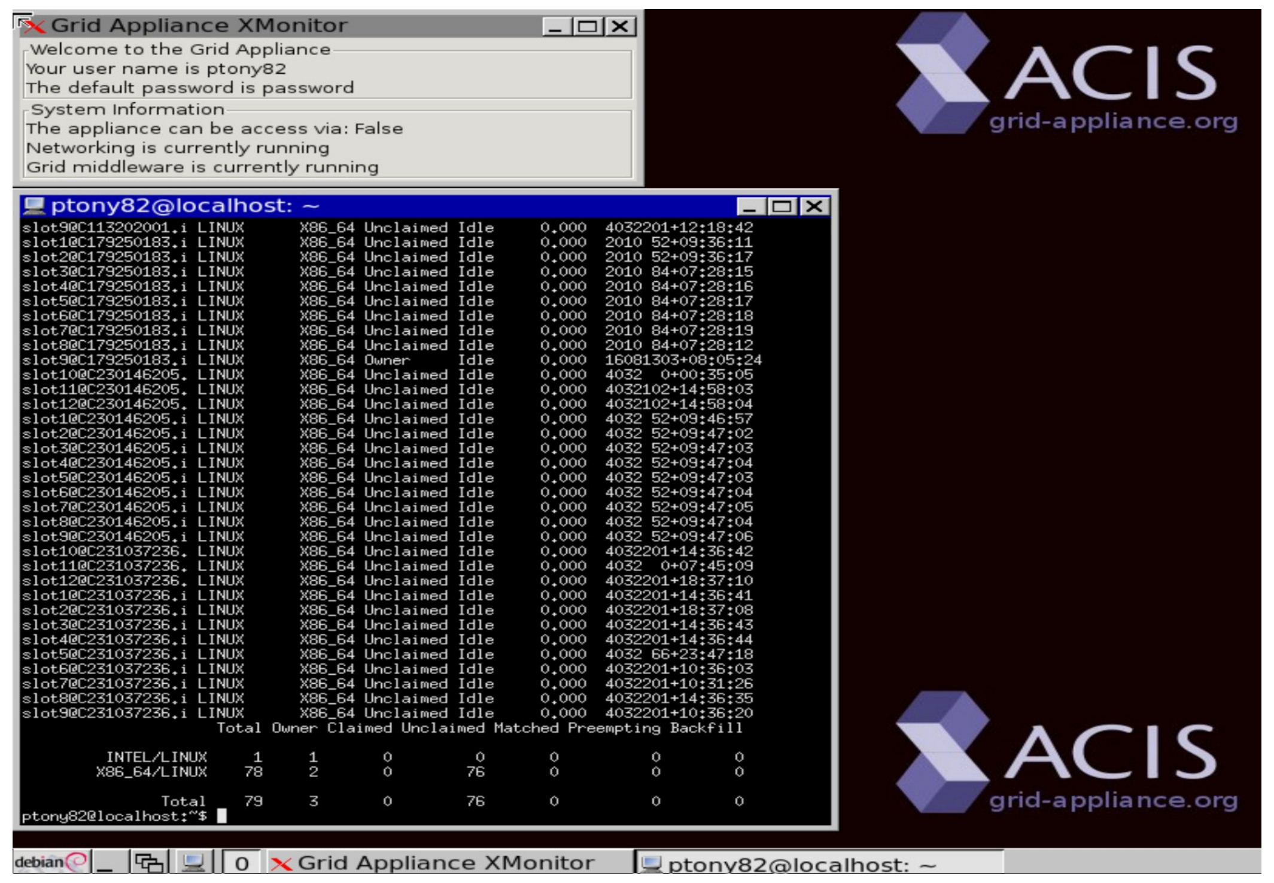
=> IP packets captured through virtual TAP network interface provided by the kernel

=> IP address is looked up in DHT for P2P address that maps to a direct connection

=> IP packet is encrypted (by IPSec) and sent over P2P overlay for delivery



IP Addr	P2P Addr	User
10.15.23.213	ABCD	Alice
10.15.30.21	EFGH	Bob



Welcome to the Grid Appliance
Your user name is ptony82
The default password is password
System Information
The appliance can be access via: False
Networking is currently running
Grid middleware is currently running

ptony82@localhost: ~

```
slot9@C113202001.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+12:18:42
slot1@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  52+09:36:11
slot2@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  52+09:36:17
slot3@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  84+07:28:15
slot4@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  84+07:28:16
slot5@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  84+07:28:17
slot6@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  84+07:28:18
slot7@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  84+07:28:19
slot8@C179250183.i LINUX      X86_64 Unclaimed Idle     0.000  2010  84+07:28:12
slot9@C179250183.i LINUX      X86_64 Owner     Idle     0.000  16081303+08:05:24
slot10@C230146205. LINUX      X86_64 Unclaimed Idle     0.000  4032   0+00:35:05
slot11@C230146205. LINUX      X86_64 Unclaimed Idle     0.000  4032102+14:58:03
slot12@C230146205. LINUX      X86_64 Unclaimed Idle     0.000  4032102+14:58:04
slot1@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:46:57
slot2@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:02
slot3@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:03
slot4@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:04
slot5@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:03
slot6@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:04
slot7@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:05
slot8@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:04
slot9@C230146205.i LINUX      X86_64 Unclaimed Idle     0.000  4032  52+09:47:06
slot10@C231037236. LINUX      X86_64 Unclaimed Idle     0.000  4032201+14:36:42
slot11@C231037236. LINUX      X86_64 Unclaimed Idle     0.000  4032   0+07:45:09
slot12@C231037236. LINUX      X86_64 Unclaimed Idle     0.000  4032201+18:37:10
slot1@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+14:36:41
slot2@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+18:37:08
slot3@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+14:36:43
slot4@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+14:36:44
slot5@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032  66+23:47:18
slot6@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+10:36:03
slot7@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+10:31:26
slot8@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+14:36:35
slot9@C231037236.i LINUX      X86_64 Unclaimed Idle     0.000  4032201+10:36:20
                   Total Owner Claimed Unclaimed Matched Preempting Backfill

      INTEL/LINUX     1     1      0         0       0          0        0
     X86_64/LINUX    78     2      0        76       0          0        0

            Total    79     3      0        76       0          0        0
ptony82@localhost:~$
```

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