On the Use of Social Networking Groups for Autonomic Configuration of Virtual Grid Environments

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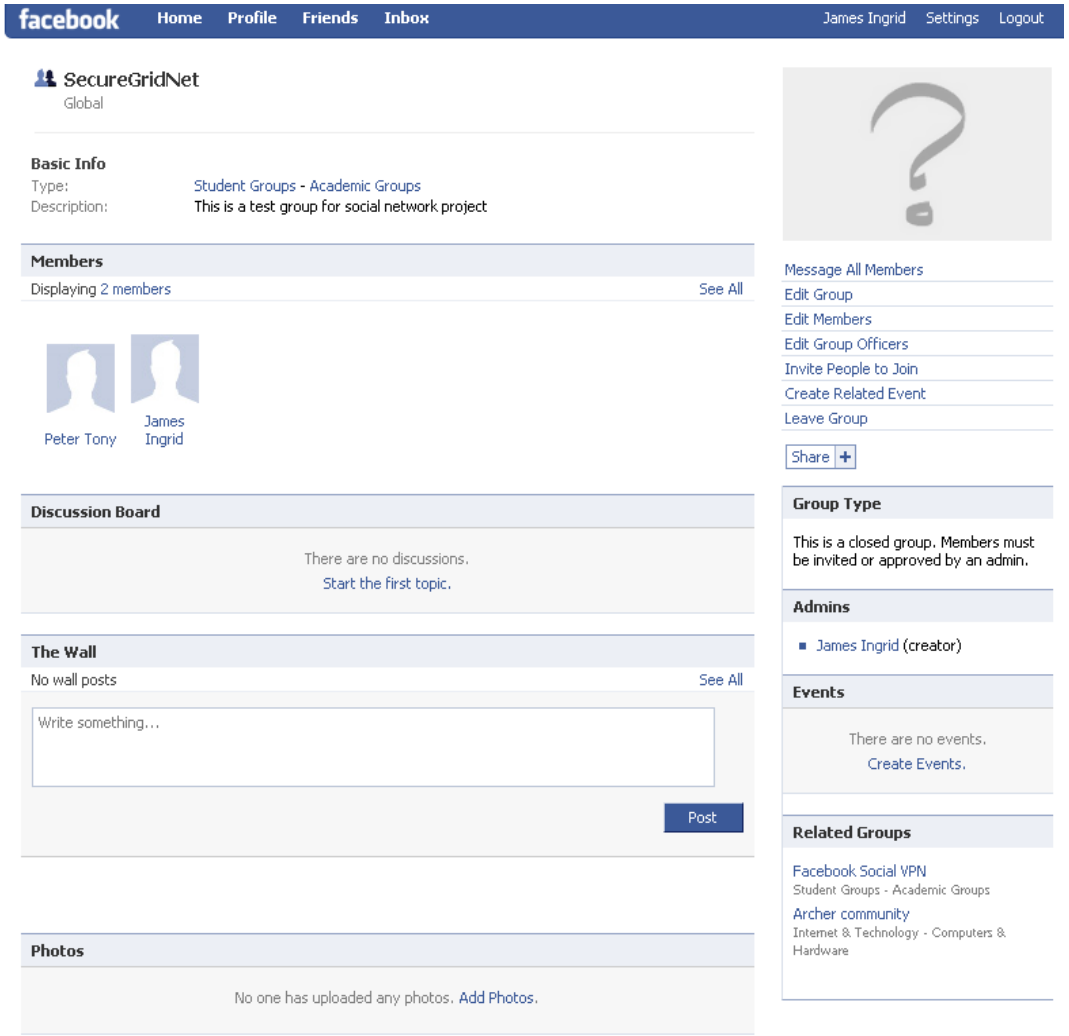
The Challenge

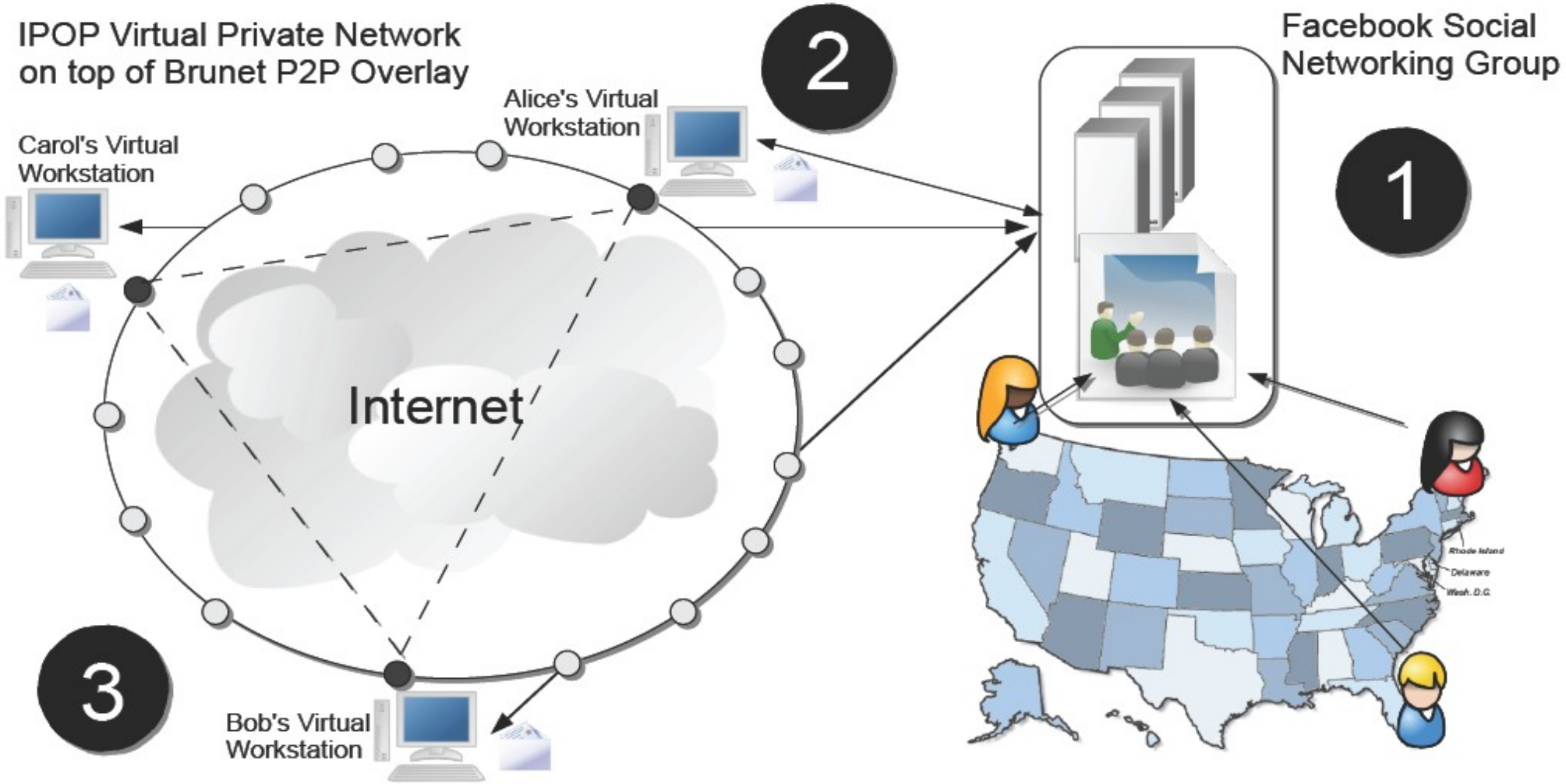
- Common Barrier to Grid Collaboration
  - Group of researchers wants to collaborate
  - Secure access to each other's systems (i.e. Grid resources)
  - Most security models depend on certificates (X.509 and PKI)
  - **End users are not often familiar with security concepts and configuration underlying PKI**
- Complexities of PKI-based systems
  - Certificate Authority (CA) regulates certificate signing
  - CA properly identifies certificate owner
  - Secure distribution of CA certificate
  - CA updates revocation list
  - **Tools for managing groups and PKI over time are not user-friendly**

Our Approach

- Use Web 2.0 (social networks)
  - Integrate the management of certificates with social networking groups
- Why social networks?
  - User friendly, intuitive
  - Much easier to manage a social networking group
  - Access through REST API
- **We use Facebook groups to automate certificate signing for IPSec to enable a virtual private network**



Overview

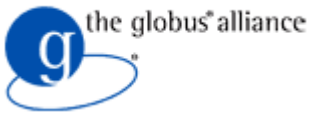

IPOP Virtual Private Network
on top of Brunet P2P Overlay
Alice's Virtual
Workstation
Carol's Virtual
Workstation
Internet
Bob's Virtual
Workstation
2
1
3
Facebook Social
Networking Group

Presentation Outline

- Background
  - Web-based social networking (WBSN)
  - Grid infrastructure: Grid appliance, IPOP virtual private network
- Design Overview
  - Certificate management
- Implementation Details
- Experiments and analysis
  - Ease of deployment, network performance
  - Social Network API Limitations
- Related Work
- Conclusion

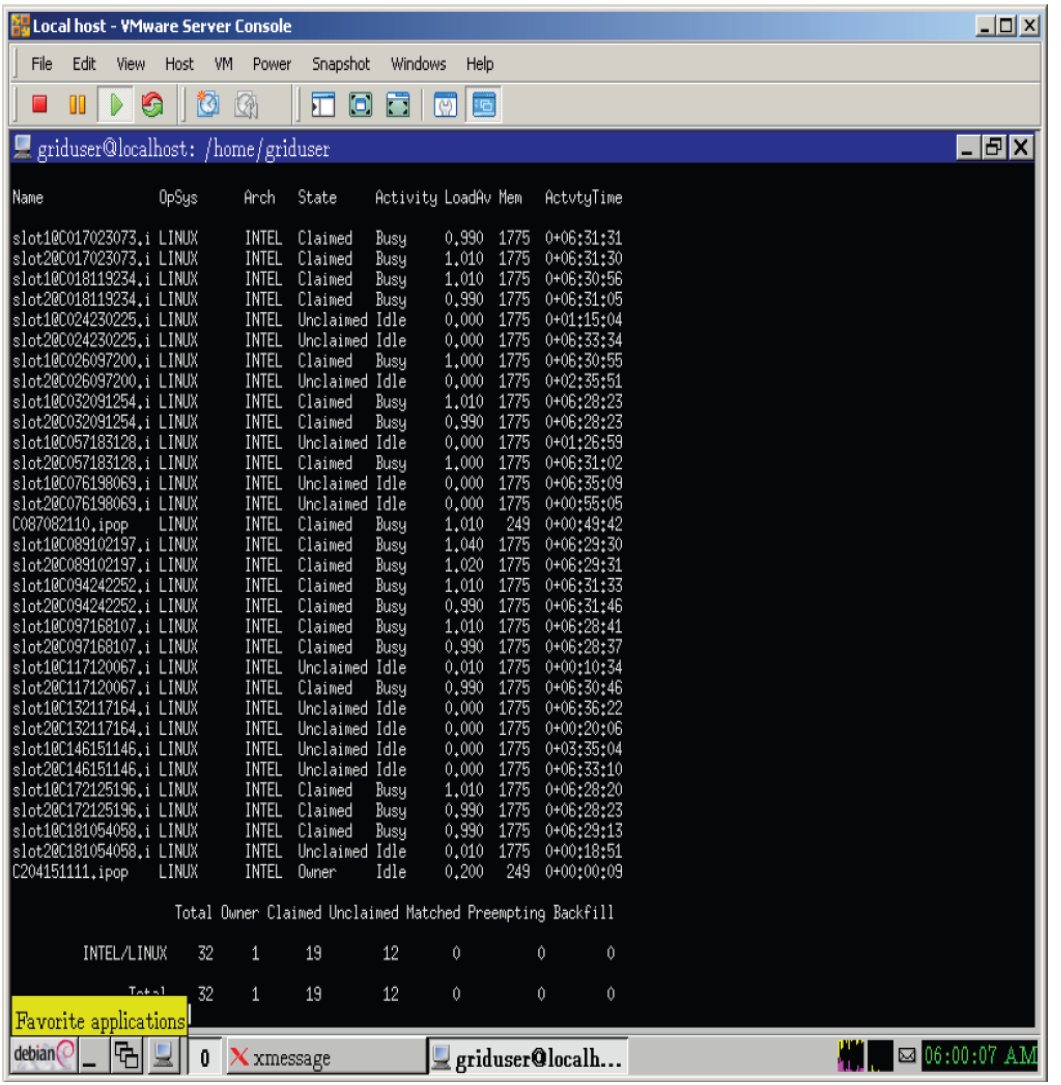
Web-based Social Networking

- Popularity and API
  - Hundreds of millions of users
  - Emergence of social networking applications
  - Facebook Platform API and OpenSocial
- Long-term focus
  - Leverage social networks to build more intuitive systems
  - Design systems with social aspects of users in mind
- **We leverage WBSN technologies to configure Grid environments**



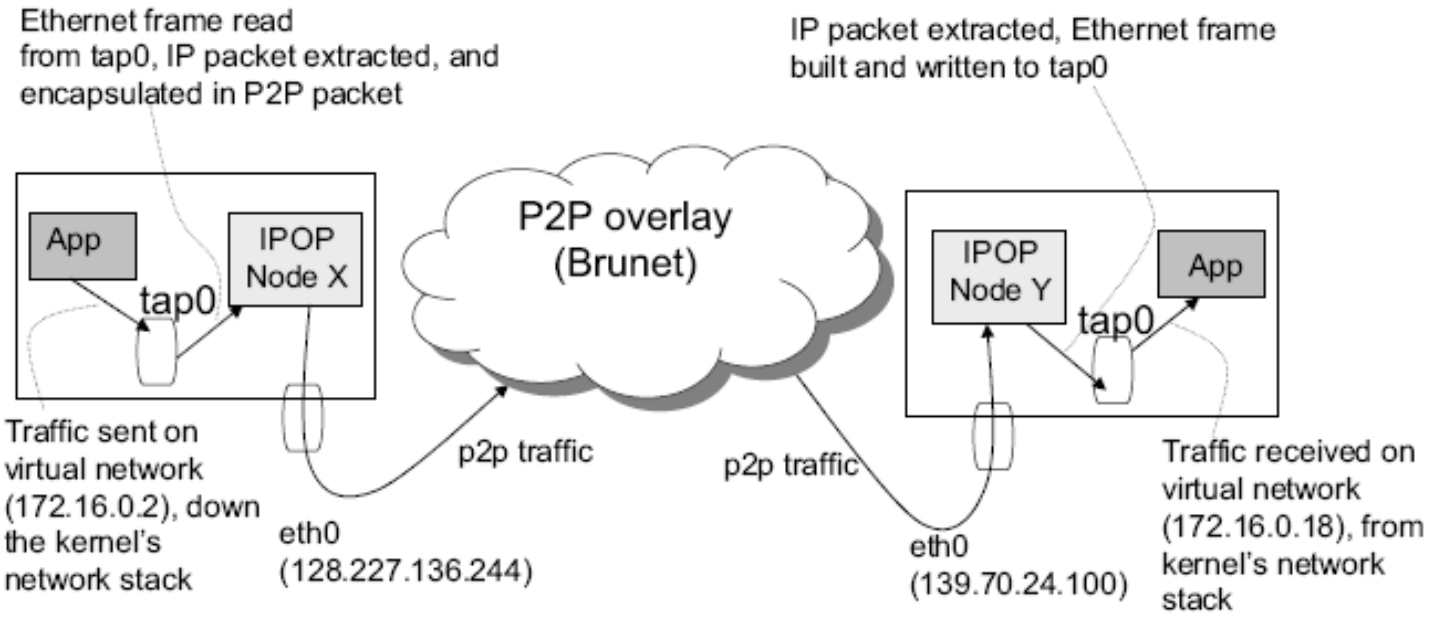
The Grid Appliance Project

- Ease of deployment
  - Prepackaged virtual machine
  - Condor job scheduler
  - Homogeneous software stack
- Desktop Grid
  - End users contribute their desktop to pool of resources
  - **Virtual LAN connects virtual machines**
  - Unmodified applications can communicate (NFS, SSH)
- **www.grid-appliance.org**

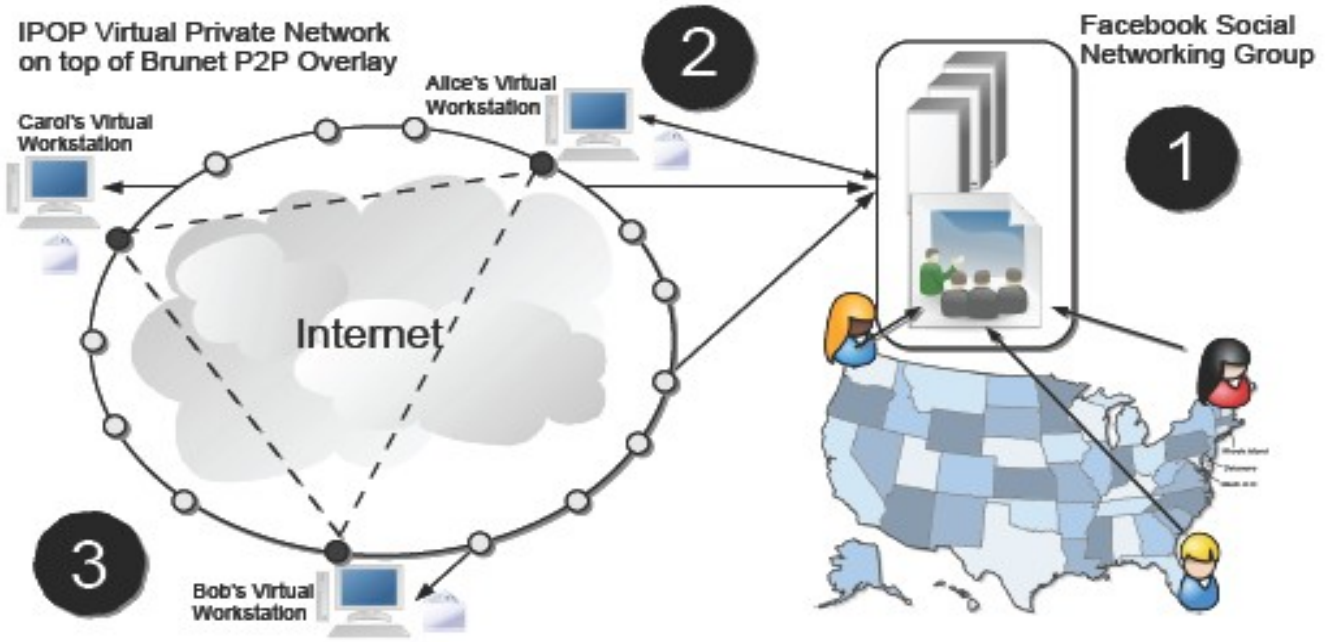


IPOP Virtual Private Network

- Virtual LAN
  - **Self-configuring, decentralized virtual network**
  - P2P VPN routes IP packets over P2P overlay
  - IPSec provides security
- P2P Overlay
  - Structured P2P overlay
  - NAT/firewall traversal
  - **Robust, scalable, and self-organizing system**



3 Easy Steps

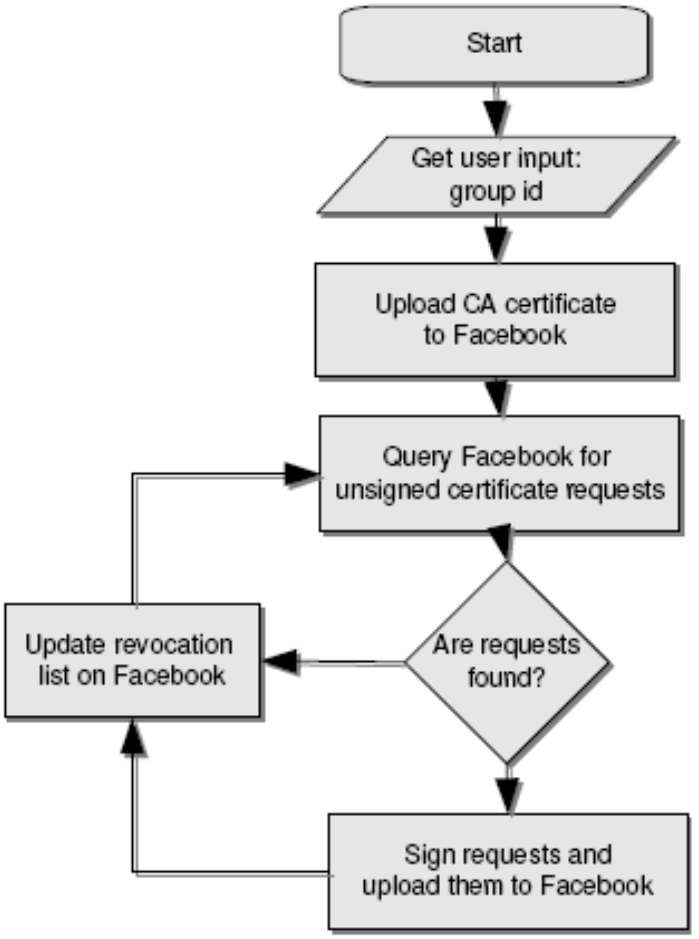


- Our Contribution
  - **Hide the complexity of PKI/certificate management**
  - Use social networking API to provide user with easy to use management
- The Process
  - Users join social networking group
  - Users run virtual machine and select group through Web interface
  - Virtual machines form VPN

Certificate Management

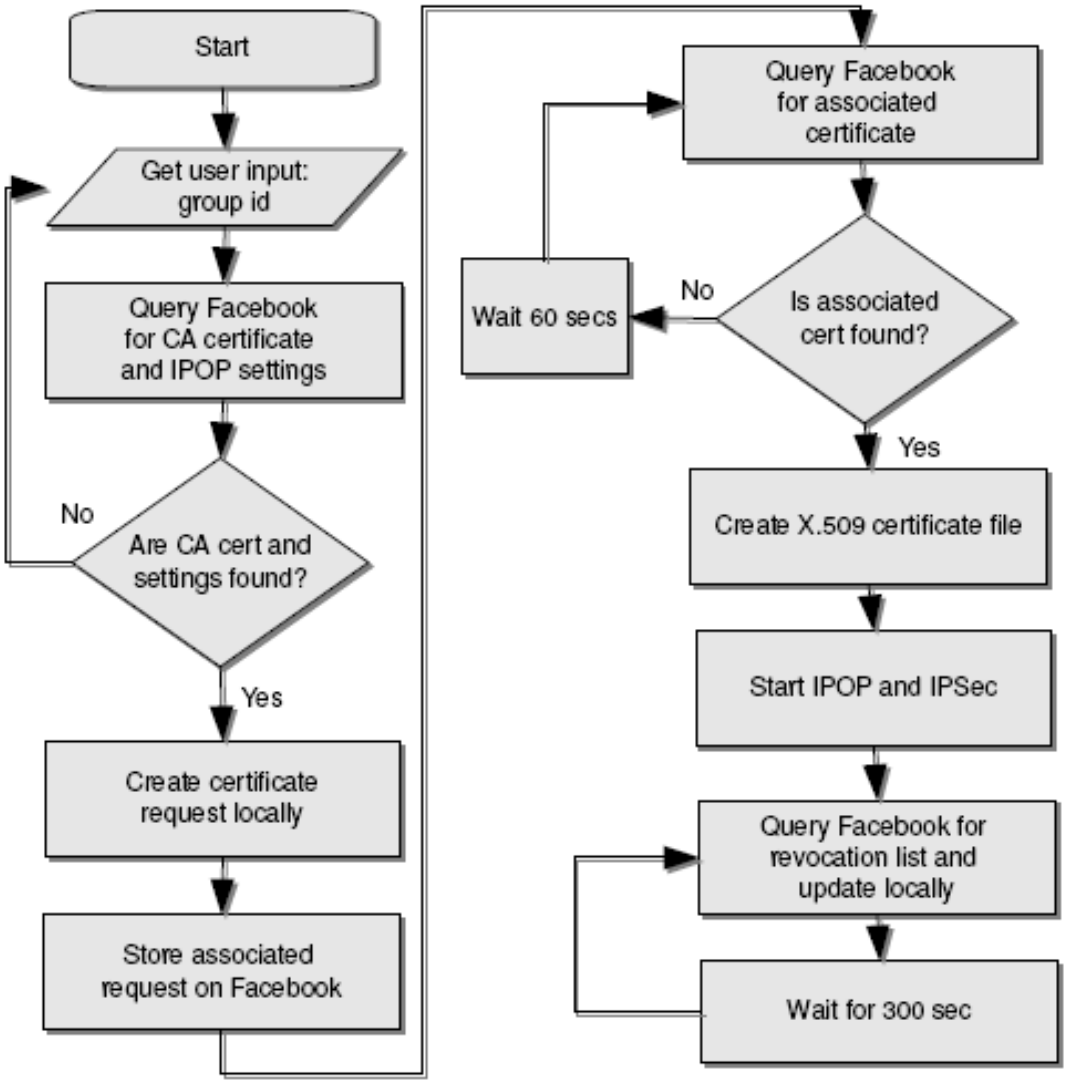
- CA certificate management process
  - CA uploads its certificate to the group's datastore
  - Checks group's datastore for unsigned certificate requests
  - If requests found, sign the request
  - Store the signed certificates back on group datastore
  - Update revocation list, if necessary
  - Wait for a specific interval
  - Loop back to query step

- **This process is automated, the group creator only has to manage the social networking group**



Certificate Management (2)

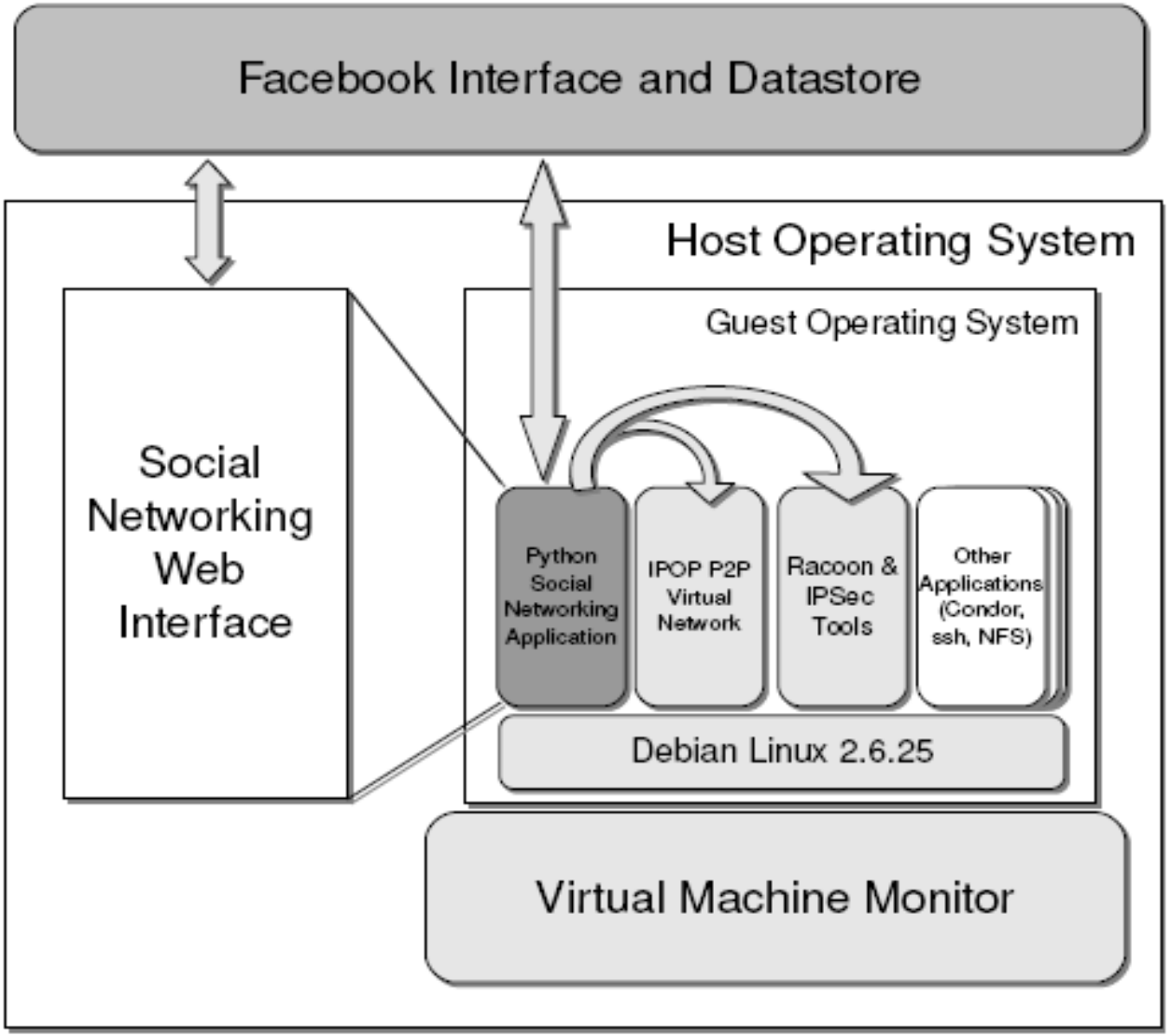
- Peer certificate acquisition
  - Query social networking group for CA certificate
  - Upload certificate request to group datastore
  - When signed certificate is available, configure and run VPN and IPSec
  - Retrieve revocation list from social networking datastore
- **Peer joins group and select group name through Web interface, social networking application handles the rest**



Implementation Details

- Grid Appliance
  - Debian Linux, kernel version 2.6.25
  - Condor job scheduler for cycle sharing
- Virtual Private Network
  - IPOP Router, open-source C# ,
  - Linux kernel tap device
  - IPSec and Racoon for security and IKE
  - OpenSSL tools for X.509 certificate management
- Social Networking Application
  - Written in Python 2.4
  - PyFacebook, Python libraries for Facebook API
  - Python-Django, web framework for user interface

Implementation Details (2)



Demo Video

Time for a video,
we will continue slides after video

Experiments and Analysis

- Ease of deployment
  - Peer joins Facebook group, downloads and runs virtual appliance
  - User navigates to http://apps.facebook.com/securegridnet/ and selects group and node type
  - **Virtual workstation joins VPN in less than 5 minutes (one-time overhead)**
- Network Performance
  - We ran IPSec between two nodes in the same LAN to measure throughput
  - 2GB Ethernet network, 2.33 GHz dual core host with 8GB RAM, 256MB RAM per VM

Protocol	Without IPSec	With IPSec
TCP	51.5 Mbps	33.0 Mbps
UDP	45.4 Mbps	32.0 Mbps

- Performing Grid Tasks
  - **We successfully performed a BLAST job on a Condor pool of 4 virtual workstations**

Social Networking API Limitations

- Assumptions of Trust in Social Networks
  - Secure communication channel with social network
  - Data integrity and protection in social networking datastore
  - **Trust in social networking identity binding**
- Social network as a trusted medium
  - Trust retrieved CA certificate
  - Identify owner of certificate request
- Limitations of Facebook
  - Only HTTP access is provided through REST API, HTTPS is not yet available
  - **Integrity check is provided for HTTP POST, no encryption is available**
  - Facebook is still working on user permissions, access control is not yet available

Related Works

- Curry et. Al (2008)
  - HP lab project that used Facebook and virtual machines to provide employees access to legacy software
- Authenticatr (2008)
  - Use social links for authenticated out-of-band channel to enable secure communication channels by exchanging cryptographic keys through social networks
- Social Networking Standards
  - OpenSocial - open standards that defines API exposed to developers across different social networks
  - OpenID – distributed framework for digital identity consisting of multiple providers such as Yahoo.com, WordPress.com, LiveJournal.com
  - Oauth – open standard that describes how one system can grant limited access to another system on behalf of a particular user

Conclusion

- The bottom line
  - Social networking groups management can be mapped directly to certificate management
  - Access to a social networking group means acquisition of CA certificate and signed certificate
  - Removal from a group means invalidations of your certificates
  - **Access control to resources through social networking group management**
- Future Work
  - Integrate with OpenSocial-based social networks (MySpace, Orkut, LinkedIn)
  - Study other aspects of social networking in collaborative environments
  - **SocialVPN – self-configuring P2P VPN consisting of your social networking peers**

Thank you and Questions?

- We hope that this presentation provided some insights on the benefits of integrating social networking/Web 2.0 in grid computing environments.

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- **We welcome criticism, comments, and suggestions, feel free to contact us**