DIAS: Decentralized Internet Applications and Services

Midterm Presentation
3/13/14

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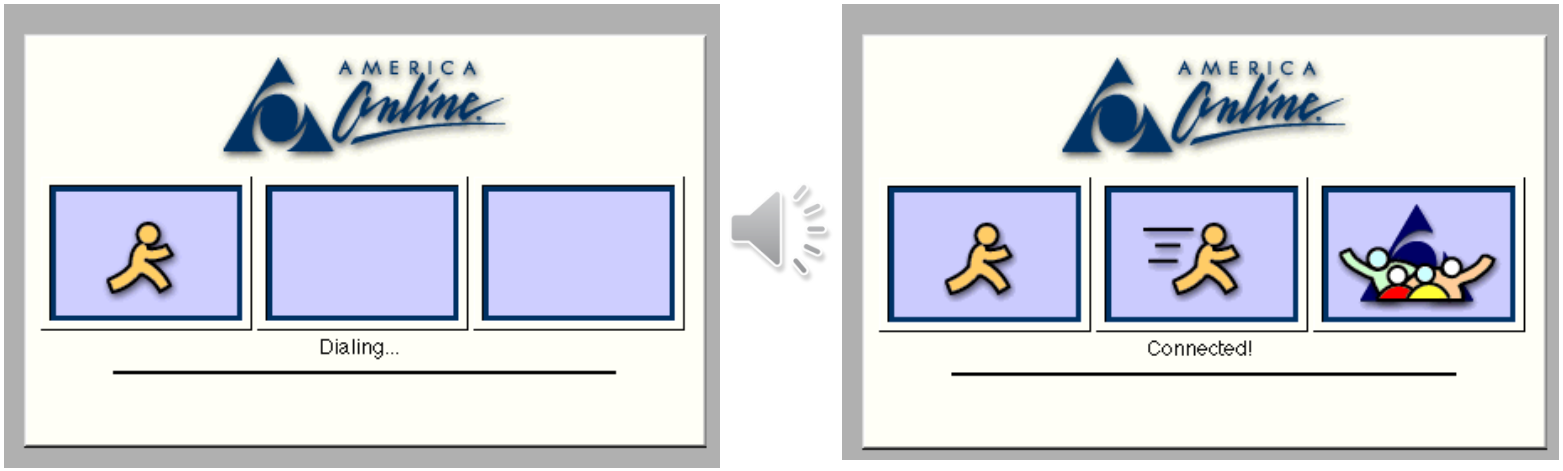
Agenda

- Background & Motivation
- DIAS Overview
- Related Work
- DIAS Framework
- Progress
- Remaining Work
- Demo

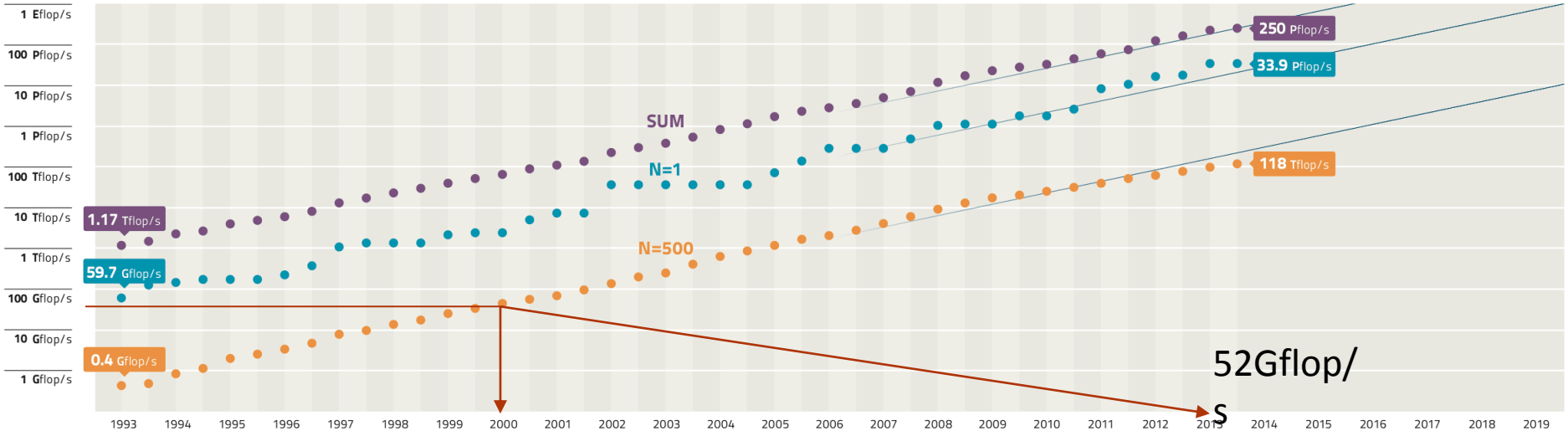
Motivation - Before

- Rare users have persistent always-on connections.



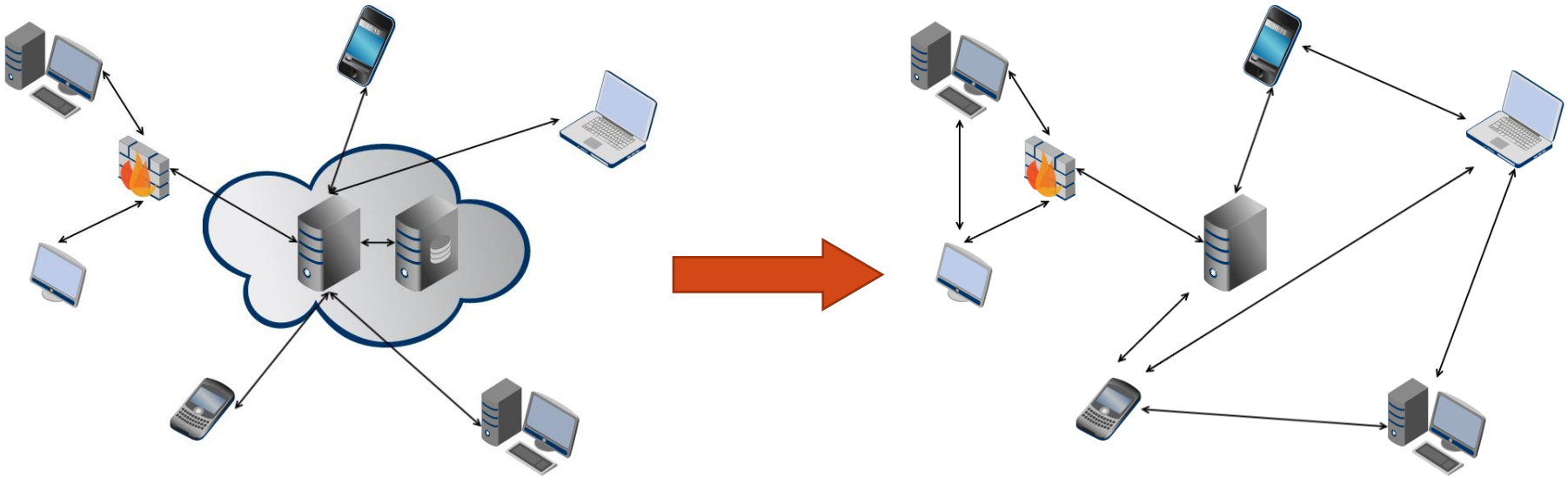
- Always connected servers used as intermediaries

Motivation - Today



- Mobile devices:
  - Widely adopted
  - Always-on
  - Always connected
- Powerful Mobile Devices
- Galaxy S4 - as powerful as a year 2000 super computer
- **Why do we still rely on servers?**

DIAS: Decentralized Internet Applications and Services



- Centralized Architecture
  - Single point of failure
  - ✗ Privacy
  - ✗ Security
  - ✗ Energy efficiency
- Decentralized Architecture
  - Robust to failure
  - Reclaim personal data
  - Power efficiency

DIAS Overview

Goal:

- Decentralize the current server-client model
- Replace servers with point to point communication for personal communication and services
  - Email, Web Pages, Social Networking, Chat, VoIP

Benefits:

- Security, Privacy, Resilience, Cost, and Power

Challenges:

- Redundancy, Uptime, Failover, Battery Management

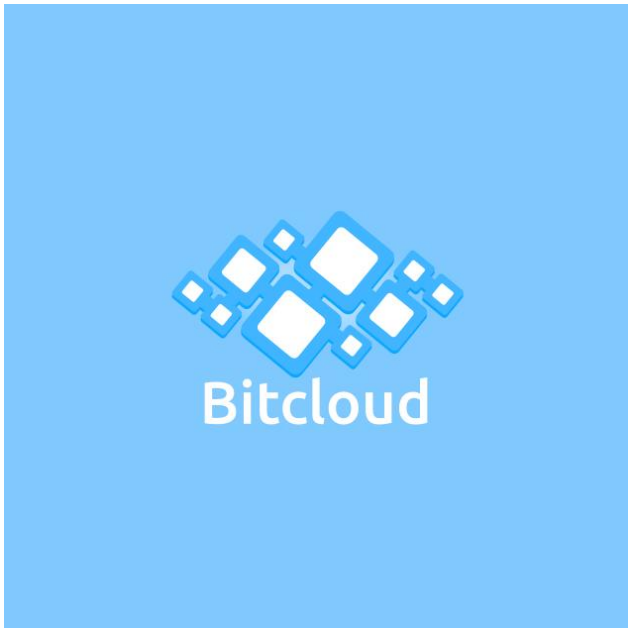
Related Work

Related Work

- Peer to Peer Networks (P2P)
- Connectivity and Reachability
- Data Replication

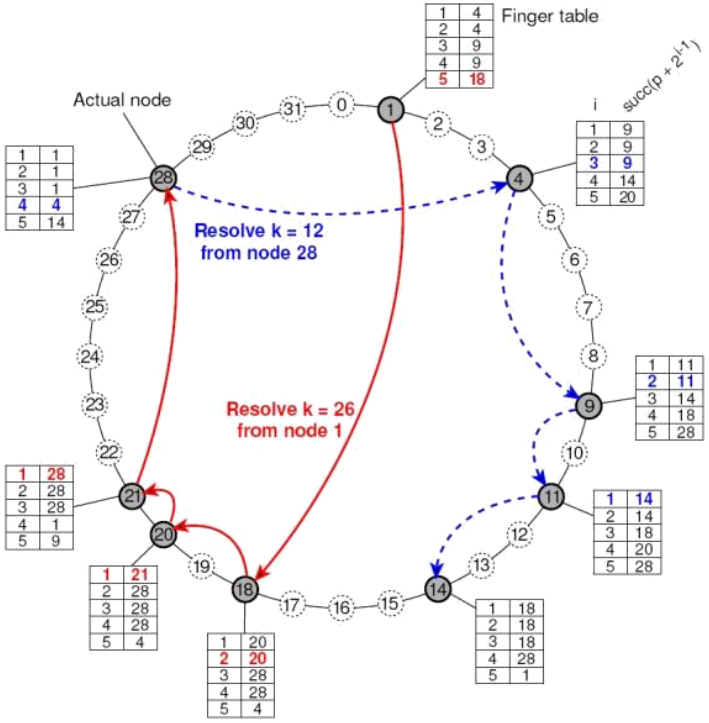
Related Work – P2P

- Bitcloud
  - Decentralizing the Internet, creating Distributed Applications, and developing a new mesh network to replace the Internet.
  - Improve privacy, security, and ending Internet censorship.



Related Work – P2P

- Chord and Pastry
  - Peer-to-peer lookup service for Internet applications
  - Peers can join and leave



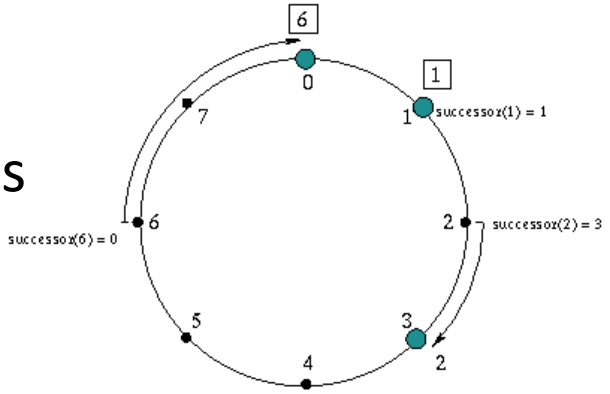
Related Work – Connectivity and Reachability

- Most networks block reachability
- Solutions
  - IPv6 with Mobile IP
  - Unmanaged Internet Architecture (UIA)
- Largely solved issue
  - Caused by business policy, not technical challenge

Related Work – Data Replication

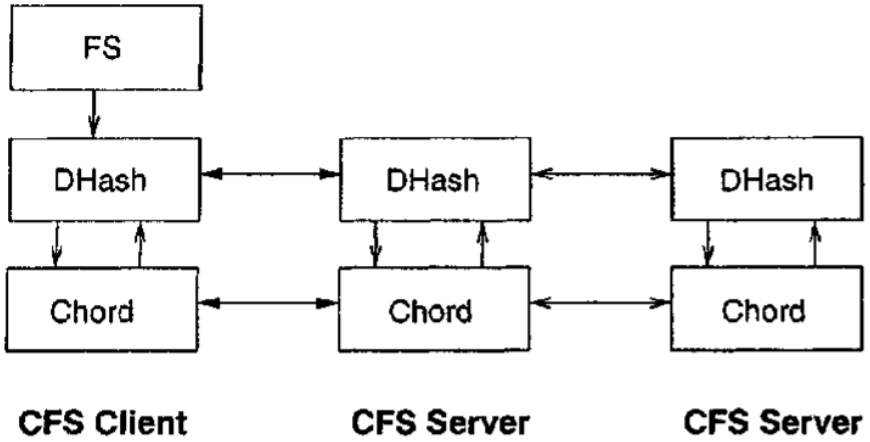
- Decentralized P2P file sharing programs - replicate file data on end nodes, which may become corrupt or suffer from loss of availability
  - Limewire
  - Bittorrent
  - Kazaa

- PAST
  - Built on Pastry
  - Replicates files close to owner's nodes
  - Replicates entire files



Related Work – Data Replication

- Cooperative File System (CFS)
  - Peer-to-peer read-only storage system that provides provable guarantees for the efficiency, robustness, and load-balance of file storage and retrieval.
  - Built on Chord – Coordinated File System
  - Replicates files close to owner's nodes
  - Replicates at block level to distribute the load and storage space among servers in the network.



Related Work – Data Replication

- Content Delivery Networks
  - Replicate data near consumers.
  - Akamai
  - Amazon S3

DIAS Framework & Progress

DIAS Architecture

Building Blocks

Connectivity & Reachability

- Devices publically accessible

Naming and Domain Management

- DNS
- Failover

Basic Services

- Full Communication
- Web and Email services

Integration

Android Application

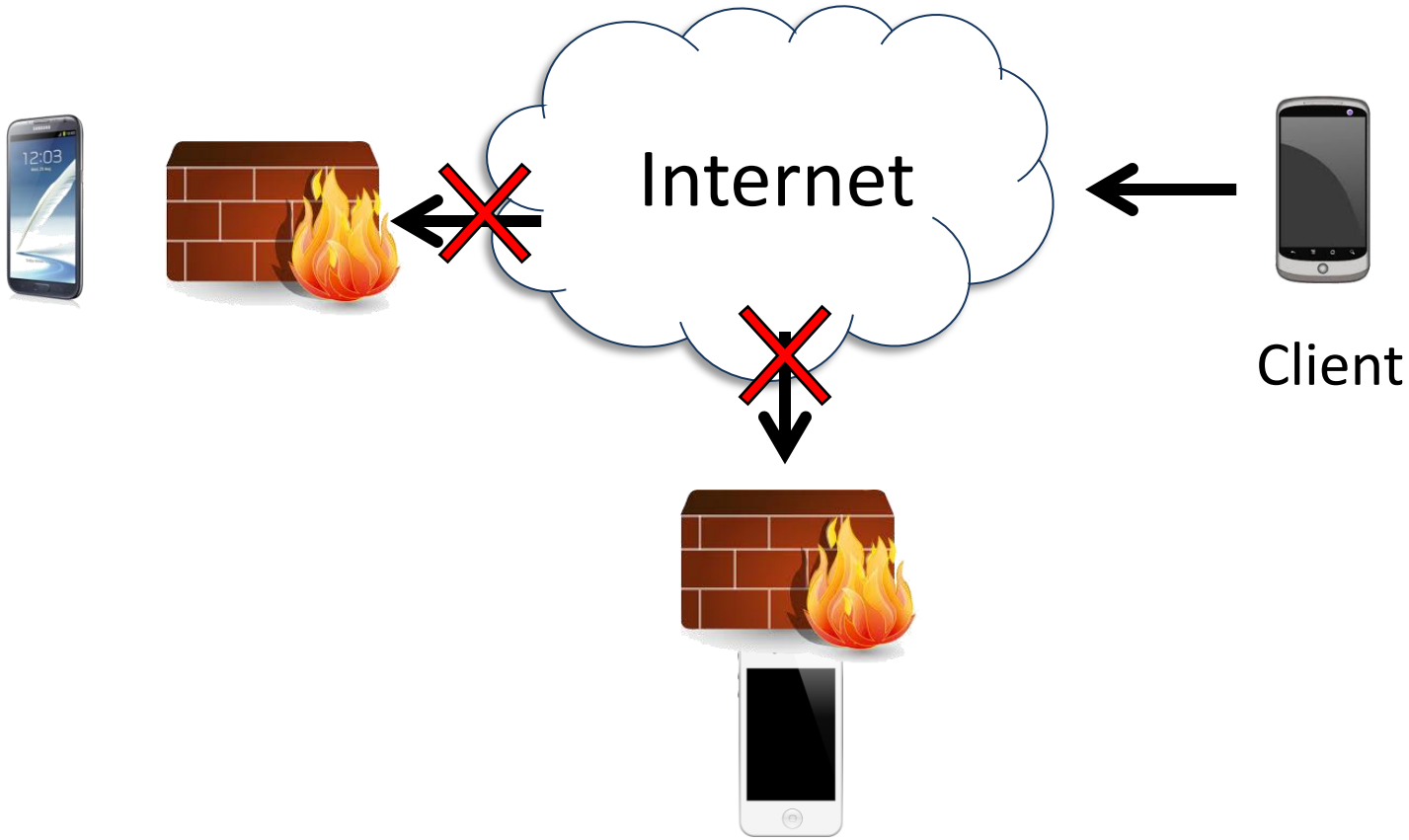
- Server Manager
- Battery Power Monitoring

Key Functionalities

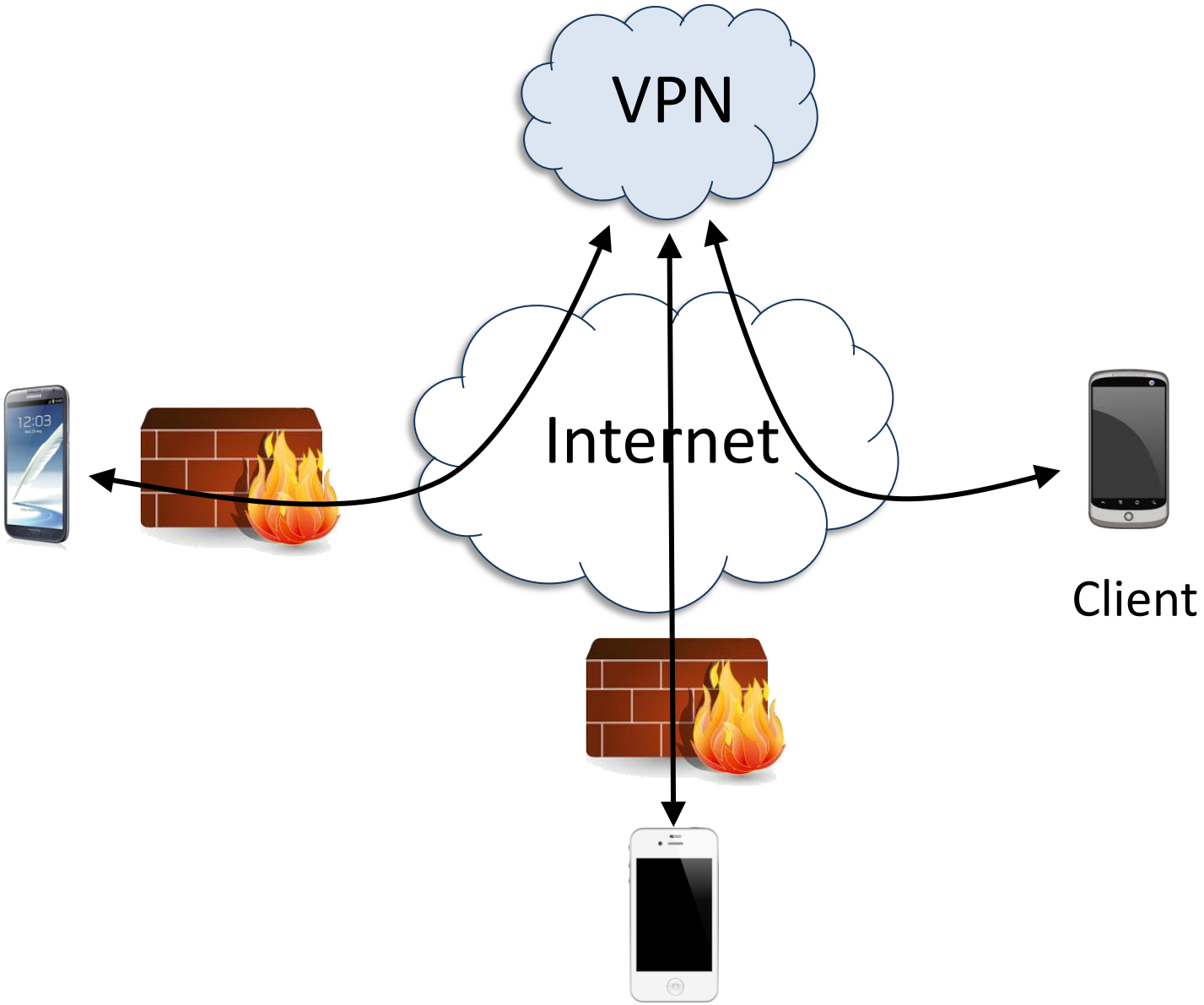
- Power Management
- Data Replication
- Smart Failover

Building Blocks

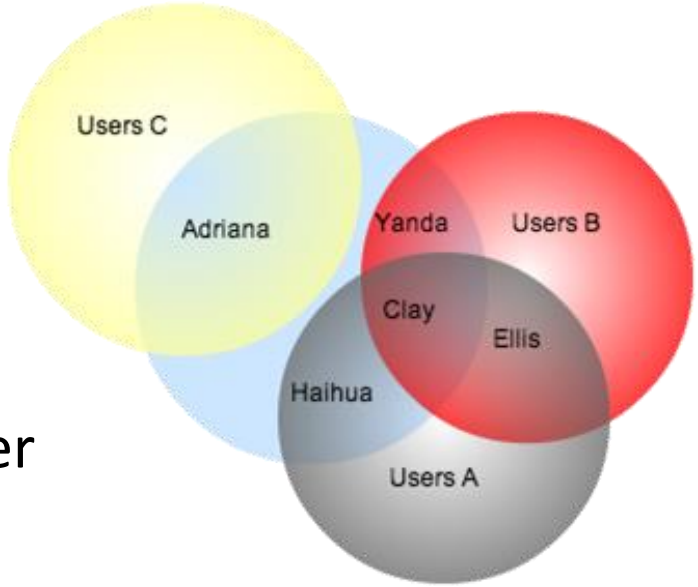
Reachability Problem



Reachability Solution



Naming and Management



- DNS
  - Backwards Compatible
  - Human friendly names
  - Help with load balancing and failover
- Identify our personal clusters
  - Self-own laptop, smartphone, desktop, tablet, etc.
  - Clever self failover technique
    - Establish a failover order self-own devices

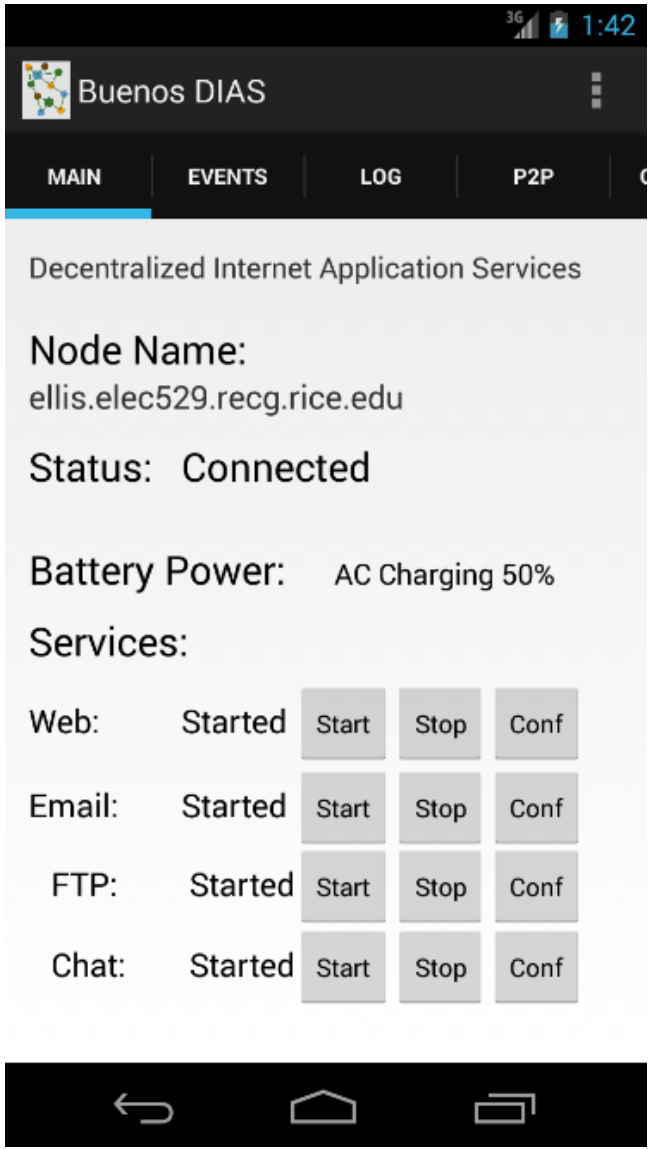
Communication Services

- Utilize open-source server software, provide basis for our communication services
  - Email Server
  - Web server
  - Other services

- Guarantee:
  - 99% uptime
  - Backwards compatibility

Integration

Android Application



Event and Debug Logs and Configuration Tabs

Configurable Node Name

Connection and Overall Status Monitoring Thread/Event Receiver

Battery Power Monitoring Thread and Event Broadcast Receiver
Can act on power changes.

Pluggable Services List

Services can provide Start, Stop, and Configuration methods.
Web, Email, FTP, etc.

```java
package rice.comp529.dias;

import java.util.Vector;

public interface ServicesManager {
    public ServicesManager getServicesManager();
    public void registerService(ServicesInterface service);
    public Vector<ServicesInterface> listServices();
    public void logMessage(String message);
    public void logEvent(String event);
}
```

```java
package rice.comp529.dias;

public interface ServicesInterface {
    public String getDescription();
    public String getConfigUrl();
    public void start();
    public void stop();
}
```

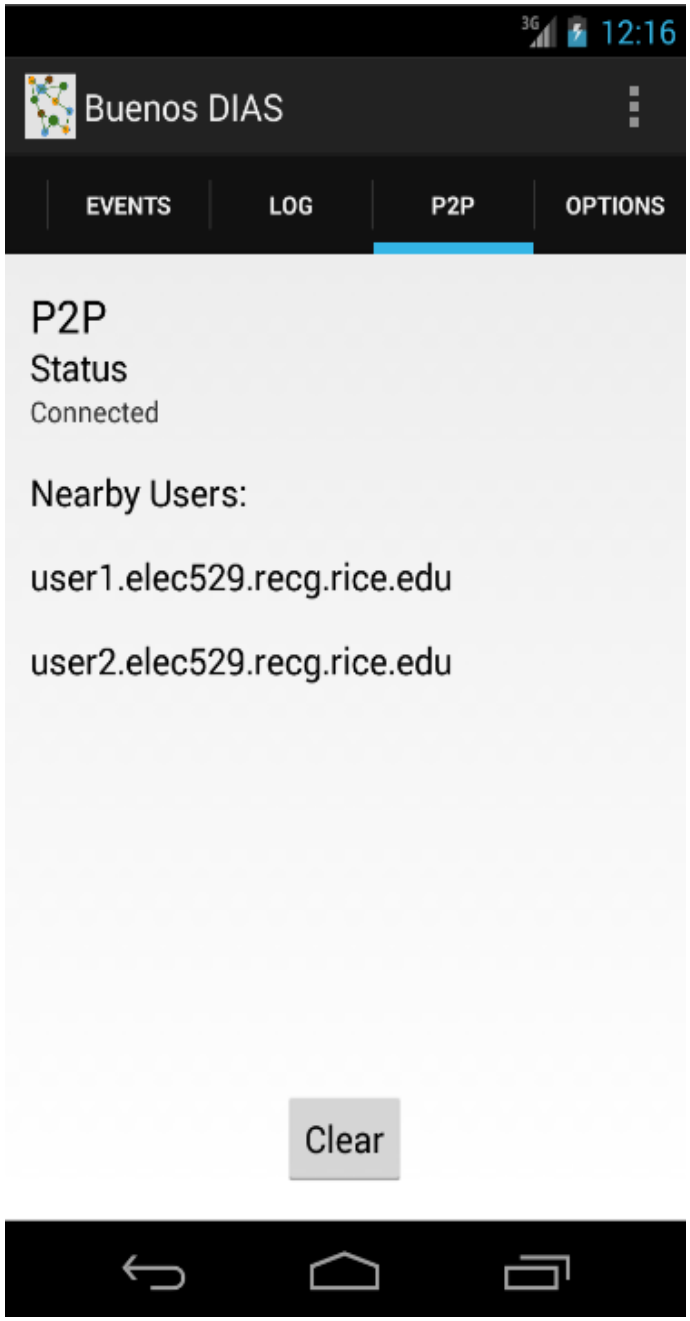
Web

Email

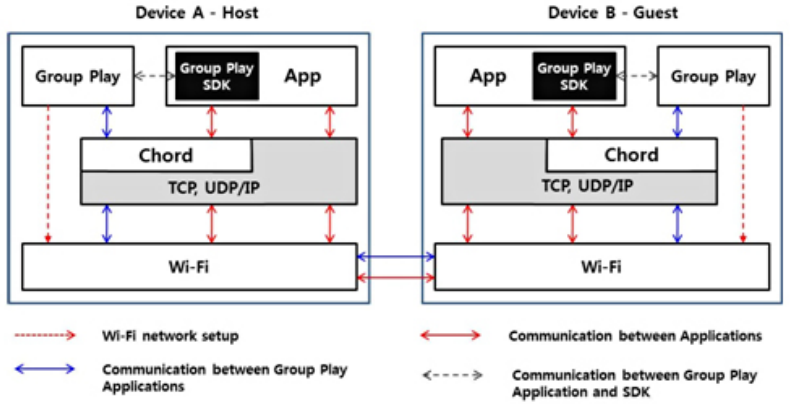
Other Services

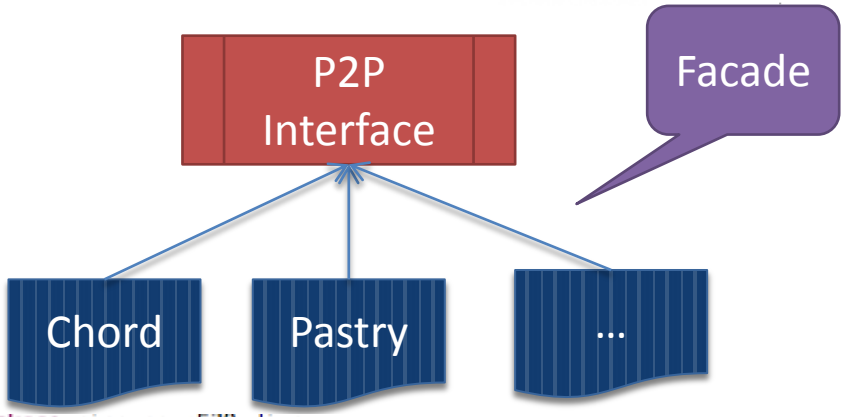
Kirium

i-jetty://



Samsung Group Play SDK Utilizes Chord
However, it is closed source and doesn't execute outside of Android SDK. Chord SDK Discontinued






```
package rice.comp529.dias;

public interface P2P {
    public String getDescription();
    public void start();
    public void stop();
    public void onConnected();
    public void onDisconnected();
    public void onPeerJoined(String nodeId);
    public void onMessageReceived(String fromNodeId, byte data[]);
    public int sendMessage(String toNodeId, byte data[]);
}
```

Battery Power Monitoring

- Event Log for asynchronous events received from the device such as, network and battery levels. It also logs events for pluggable services and building blocks.
- Debug Log contains debug messages from monitoring threads and services.
- Android application can react to changes in the battery level or network events.
- It has monitoring threads for battery and network connections, and depending on thresholds, the application will be able to react and shutdown services or send notification messages.

Progress

Building Blocks

✓ **Connectivity & Reachability**
- Devices publically accessible

✓ **Naming and Domain Management**
- DNS
- Failover

✓ **Basic Services**
- Full Communication
- Web and Email services

Integration

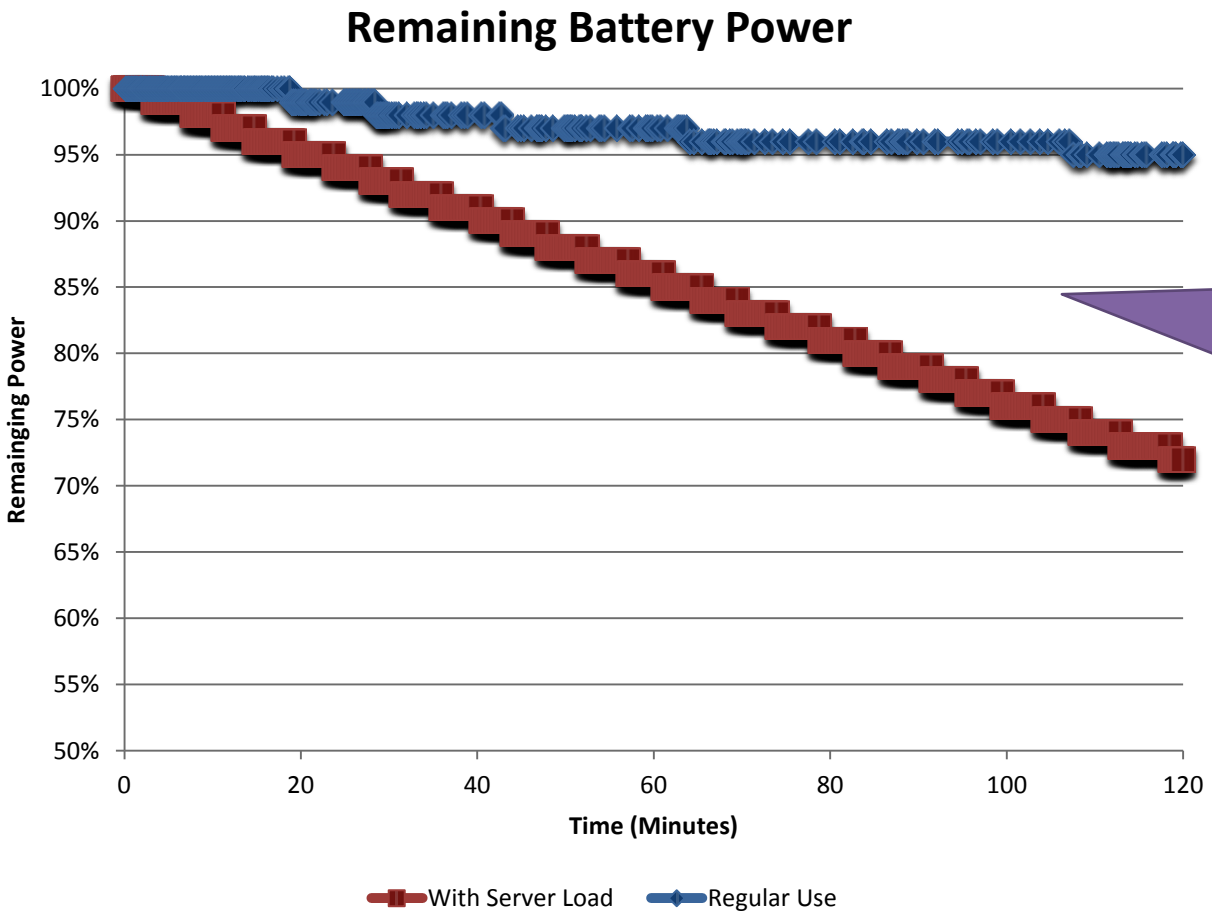
✓ **Android Application**
- Server Manager
- Battery Power Monitoring

Key Functionalities
- Power Management
- Data Replication
- Smart Failover

Early Results

- 99.7% uptime!

Galaxy S4 Running DIAS
Dynamic DNS -> Local WiFi
ellis.route404.com
i-jetty, kirium, dyn-dns client
Web server sent over WiFi
2.35 GB Data / 2hrs



Can effectively monitor power levels with resource monitor threads. Can react to resource changes.

Remaining Work

Proposed Timeline

March Early

- Framework Setup

Get connectivity and reachability on phones

VPN server with public IPs and DNS

Servers installation (Web and Email)

March Mid

- Mid-term Presentation
- Basic experimental framework installed
- Start working on novel issues (replication, failover, and power).

March End

- Data Replication:

Basic replication scheme working

Proposed Timeline

April Early

- Failover:

Basic mechanism developed and implemented

April Mid

- Power:

Experiment with performance and power analysis

April End

- Final Presentation:

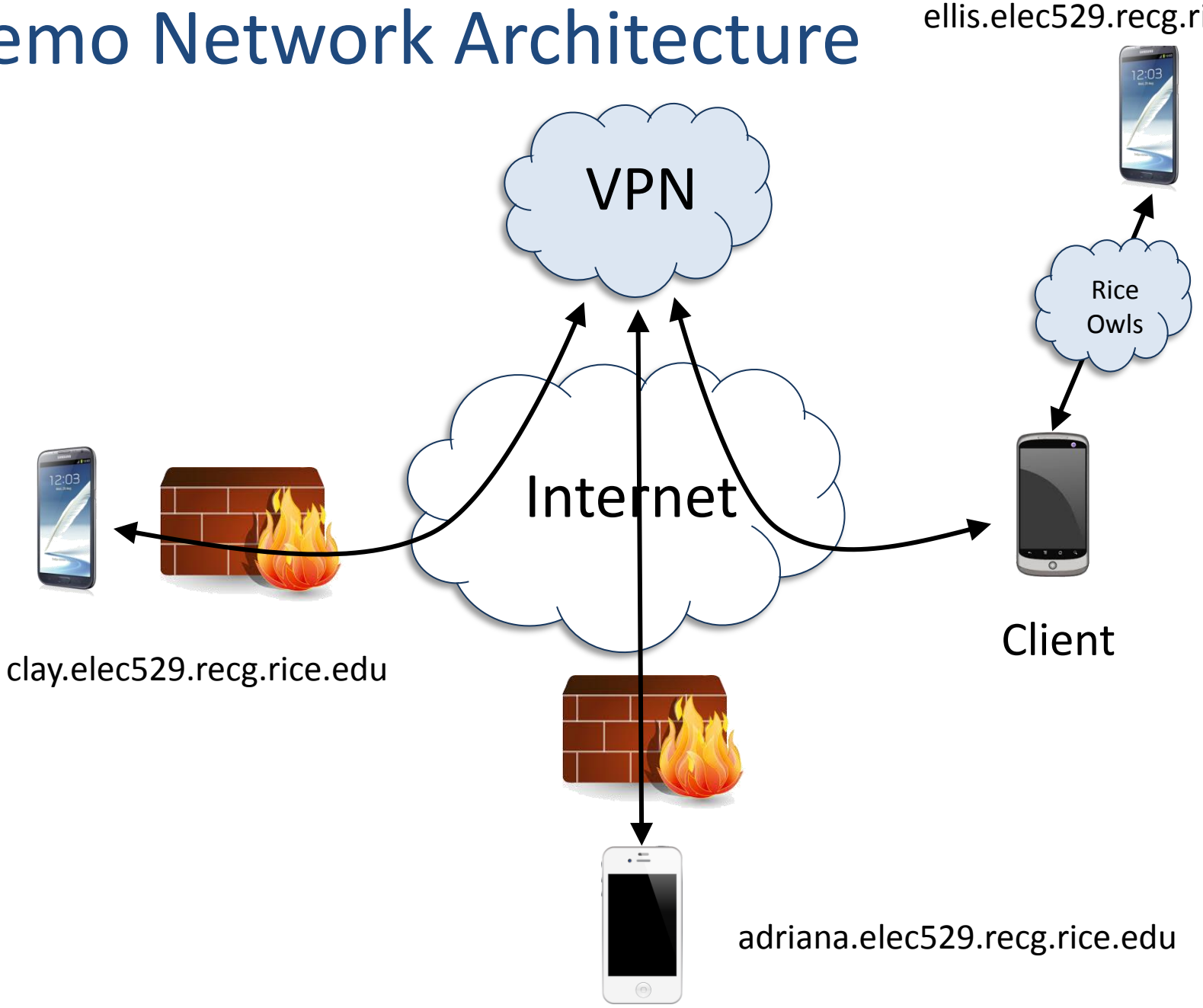
Polish and integrate results into final presentation

Remaining Work

- Investigate Uptime and Reliability
- Data Replication and Redundancy
- Failover Handling
- Disaster Recovery
- Impact on Power and Mitigation
- Polished Full-Featured App

Demo

Demo Network Architecture



Website hosted by our phones

- Go to: (quicklinks at http://clay.rice.edu/dias)
  - http://clay.elec529.recg.rice.edu:8080/
  - http://adriana.elec529.recg.rice.edu:8080/
  - Over Rice Owls WiFi Go To: http://dyn.ellis.elec529.recg.rice.edu:8080/
- Failover:
  - Clay
    - http://3.clay.elec529.recg.rice.edu:8080/
  - Adriana
    - http://1.adriana.elec529.recg.rice.edu:8080/