Overview on Modeling and Simulation in DOSN & DOSN Current trends and Platforms

University of Cyprus
Introduction: Why DOSNs?

- **Privacy**: There is no central server holding the data.
  - The users can truly keep their privacy hosted on their own computers or on the nodes that they trust.
  - Users participate in a Social Network without being censored by a central authority.

- **Scalability**: DOSN scale easily as more nodes join the network either in a P2P network or in a federation of servers.
Roadmap

• Overview on Modeling and Simulation in DOSNs
  – Modeling in DOSNs ↔
  – Simulation in DOSNs
  – Research

• DOSN Platforms: Current Status and Trends
  – Current Platforms
  – Protocols
  – Protocol Architecture
  – Limitations
  – Challenges
  – Research
Modeling and Simulation

Why modeling and simulation is important?

• After designing or developing a new approach
  – Evaluation:
    • Real-life environment and situations
    • Simulated real-life environments

• Modeling and simulation provides:
  – Simulation in real-life environment and results in a short period of time
  – The ability of investigating values that are difficult or impossible to use in real-life situations (Large-scale scenarios, Extreme values scenarios, etc.)
Modeling and Simulation in DOSNs

- Test new findings for robustness, speed, reliability, maintainability, etc.
- Provide evaluation based on different scenarios:
  - **User Actions**: Register, Connect, Publish, Search
  - **Resources**: Bandwidth limitations, Nodes hardware limitations
  - **Network topologies**: Different number of nodes, different types of nodes
  - **Combination of different scenarios**
Modeling in DOSNs

**Goal:** Provide the simulator with real-life scenarios in order to achieve real-environment simulation.

Diagram showing the components of the Decentralized Social Network Simulator:
- User Action Model
- Resource Allocation Model
- Network Topology Model

- OSN User Actions
- Decentralized Application Agents
- Protocols (Chord, CAN, ...)
- Physical Networks (Nodes, Links, ...)

Logos and badges indicating funding or collaboration with projects or organizations.
Modeling in DOSNs

• **User Action Model:**
  – Models the actions of the user that will be simulated
  – A DOSN should be able to execute OSN user actions
  – Basic OSN user actions:
    • Account registration – Profile creation
    • Connection creation – Friendship
    • Messaging – Posting – Publishing
    • Search – Data retrieval
Modeling in DOSNs

- **Resource Allocation Model**: Provides configurations for the simulation
- Such as:
  - Bandwidth
  - Response speed
  - Data exchange limitations
  - Priorities
  - Resources limitations
Modeling in DOSNs

• **Network Topology Model:** Provides network related information
  
  • Such as
    – Nodes topology
    – Type of nodes
    – Links between nodes
    – Network restrictions
Centralized VS DOSNs modeling

• Differences in Resource Allocation and Network Topology models

  • Resource Allocation model
    – Based on the approach that data flows between the central service and the nodes
    – Based on more complex approaches, such as data flows via several and different types of hops before arrives at the destination

  • Network Topology Model
    – Network nodes are connected with each other through a central service
    – The connection between nodes is based on different decentralization approaches like peer-to-peer, decentralized servers and hybrid

• User Action Model
  – A DOSN social network should support OSN users’ actions
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Simulators in DOSN

<table>
<thead>
<tr>
<th>Simulator</th>
<th>Language</th>
<th>Status</th>
<th>Usability</th>
<th>Scalability</th>
</tr>
</thead>
<tbody>
<tr>
<td>P2PSim</td>
<td>C++</td>
<td>Active</td>
<td>Poor documentation</td>
<td>3000 nodes</td>
</tr>
<tr>
<td>PeerSim</td>
<td>Java</td>
<td>Active</td>
<td>Poor documentation</td>
<td>1 million nodes</td>
</tr>
<tr>
<td>Narses</td>
<td>Java</td>
<td>Inactive</td>
<td>No documentation</td>
<td>600 nodes</td>
</tr>
<tr>
<td>FreePastry</td>
<td>Java</td>
<td>Active</td>
<td>Well documented + API</td>
<td>1000 nodes – extendable</td>
</tr>
<tr>
<td>PlanetSim</td>
<td>Java</td>
<td>Active</td>
<td>Well documented + API + Tutorials</td>
<td>300,000</td>
</tr>
</tbody>
</table>

- **Language**: Programming language used for the implementation
- **Status**: Project current status
- **Usability**: How easy is the simulator to learn and use? Does it provide an API?
- **Scalability**: How does the simulator scales regarding the amount of nodes?
Simulation in DOSN: Dataset Collection

- **Data from existing networks (DBLP co-authorship graph, Facebook, Flickr)**
  - Crawl data from a public dataset
  - Store data based on proposed model – architecture

- **Data from participants**
  - Attract a number of participants
  - Monitor the behavior of the model according to participants’ interaction
## Simulation in DOSN projects

<table>
<thead>
<tr>
<th>DOSN</th>
<th>Dataset</th>
<th>Scope</th>
<th>Metrics</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuperNova</td>
<td>DBLP co-authorship Graph</td>
<td>Relation of online/offline time behavior to data availability</td>
<td>Data Availability + Reliability</td>
</tr>
<tr>
<td>eXO</td>
<td>Facebook + Flickr</td>
<td>Search and Data retrieval</td>
<td>Data Availability + Performance</td>
</tr>
<tr>
<td>PrPI</td>
<td>Own (Auto-generated users)</td>
<td>Queries performance (common-friends, friends’ friends, friend’s pictures, Top50 songs)</td>
<td>Response Time/Performance + Data Availability</td>
</tr>
<tr>
<td>Vis-a-Vis</td>
<td>Own (Auto-generated users)</td>
<td>Join, Update, Search operations according to nodes distribution</td>
<td>Response Time/Performance + Data Availability + Reliability</td>
</tr>
</tbody>
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Research

• **Our Vision:**
  – How to design and develop a simulator that takes as input DOSN model(s) and provides insights and results about all possible metrics?

• **Research Questions:**
  – How to design and develop a modeling tool that takes as input the requirements for a DOSN and produces the corresponding models?
  – How to identify patterns between the values of different metrics and DOSNs functionalities?
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The Trendiest DOSNs!

Diaspora* + 400 k users

Tent

*Partial connection to other OSN (e.g. Facebook)

STATUS·net

*Project Fork

node.js

pump.io (e.g. identi.ca)

There are already DOSN platforms currently in production.

- Diaspora is currently leading in terms of users.
- Tent is a protocol and a service that aims to unify Social Networking services with Cloud Storage.
- Friendica is one of the few DOSNs that offers “some” support to connect to other OSNs.
- The StatusNet project was divided in a LAMP Stack as GNUSocial and as a new implementation in node.js under the name of pump.io.
Other Trendy DOSNs...

- **Kune** focuses on document collaboration.
- **Jappix** is a French project that has seen some progress in microblogging.
- **Retroshare** is on the leading front regarding desktop applications, it also emphasizes privacy.
- **Lorea** has become the DOSN of choice for movements that were censored in other services.
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The Building Blocks of DOSNs: Protocols

A lot of emphasis!
Platforms by Protocols and Maturity

- XMPP
- XMPP + Others
- All
- XMPP + OStatus
- OStatus + Others
- Partial OStatus + Others
- OStatus
- Others

Platforms:
- Diaspora*
- StatusNet
- Duuit!
- Kune
- Lipsync.it
- Retroshare
- Jappix
- Lorea
- Thimbl
- OpenLink Data Spaces
- Friendica
- buddycloud
- DSNP
- newebe
- Cunity
- pump.io
- tent

Status:
- alpha
- beta
- stable
What is XMPP?

- The Extensible Messaging and Presence Protocol (XMPP) is an open technology for real-time communication, which powers a wide range of applications including instant messaging, presence, multi-party chat, voice and video calls, collaboration, lightweight middleware, content syndication, and generalized routing of XML data.

xmpp.org
What is Ostatus?

- **OStatus** is an open standard for distributed status updates that references a suite of open protocols including **Atom**, **Activity Streams**, **PubSubHubbub**, **Salmon**, **Webfinger**, that allows different messaging hubs to route status updates between users in **near real-time**.

Wikipedia
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How do these protocols collaborate?
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Limitations of Current DOSN Platforms

- Current federated DOSN (e.g., Diaspora*, Tent and Friendica) platforms have **not** been widely adopted mostly because the users require **technical skills** to install their own server. Otherwise they have to “trust” an administrator to host their profiles.
Limitations of Current DOSN Platforms

• Peer to Peer applications (e.g. RetroShare) have not been widely adopted because the user interface is different from widely used OSNs (mostly Facebook and Twitter) and also because an installation process is required.
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Challenges

• DOSN platforms must provide their services via a web browser and through well-defined APIs (for mobile applications).
Challenges

• Users should not be required to set up their own server nor “trust” system administrators to host their profiles.
Challenges

• There should be mechanisms in place so that the users can host their profiles in any server without running the risk of having their data compromised.
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After taking a look at the existing DOSN platforms and protocols, we spotted their limitations and elaborated on what challenges need to be addressed.

**How to provide a user-friendly DOSN service that overcomes the limitations of the current platforms?**
Conclusions

• There are modeling and simulation tools but none of them specializes on DOSNs.

• Currently there are DOSN platforms and protocols but they have considerable limitations.
Questions?