New Applications for P2P

A Research Agenda
Forschungsseminar, KIT, 09.11.2010
Benjamin Schiller, Thorsten Strufe
Peer-to-Peer

![Chord](chord.png)

![Gnutella](gnutella.png)

![Kazaa](kazaa.png)

![The Pirate Bay](pirate-bay.png)

![BitTorrent](bit-torrent.png)
The Peer-to-Peer Problem

Now where was that resource that I need?
P2P in a Nutshell

Properties of (pure) P2P: "All peers are equal"
- no dedicated service, no central entity
- no a-priori knowledge / structure / hierarchy
- highly dynamic behavior of nodes
  → Flat system architecture, flat namespace, unreliable service providers

Main primary problems of P2P:
- Staying connected
- Resource lookup (name resolution, location of replica, especially selecting a good next hop for the delegation → routing)

Standard Solutions (p2p – the executive summary)
- Connectivity: select enough fall-back "servers"
- Name resolution: unstructured P2P (flooding) or external search engine
- Resource location: registry and lookup in structured P2P (DHT!)
Peer-to-Peer (a Definition)

Communication model: asynchronous (request-response)

Role model: a single role (?)
- symmetric behavior, all peers in general (can) do the same
- **BUT**: considering an interaction there is one requesting and \( n \) responding peers.

Organisational model: completely unstructured („it’s a mess!”)
- Other than bootstrapping no knowledge whatsoever about the context, no knowledge about the structure

No Identifiers, only names

...all this in order to do:

*File sharing, content distribution (BitTorrent), session initiation/chat/voip (skype, jabber), malware distribution/spam (botnets),...*
Our first claim:

Peer-to-Peer is well understood and there’s nothing fundamentally new to learn

But then:

aren’t there more interesting things to do, with all the resources!?

Can we leverage properties of this paradigm for other applications?
Some New Challenges

- **Live** multimedia streaming
- Anonymous communications
- Resistant communication infrastructures
- Distributing services
- Social networking services

- „P2P-based Social IPTV“
Social IPTV?

**Social TV Concept**

Advanced TV service efficiently integrating the legacy IPTV service and web-based social service including personal/group broadcasting, game, advertisement, shopping, telemedicine, etc.

**Social Network Service**

Experience, History, Relationship, Behavior, Habit, ...

**Social Media**

Social Game
Social Ad
Social Shopping
Social Learning

Advanced TV Service to Create a New Business Model using SNS-based Participation, Relationship, and Personalization over IPTV Infrastructure

**IPTV**

**IPTV Contents & Services**

Social TV

Digital TV
PC
Set-top Box
Mobile Device
Game Console

Thorsten Strufe, P2P, TU Darmstadt
Peer-to-Peer Networking Group
Collaborative IPTV with OSN Integration

Live Streaming of Users, Discussions

Friends watching this channel:
- Thorsten Strufe
- Jussi Kangasharju
- Kalman Graffi
- Osama Abboud

Integration with Online Social Networks

How much money would you spend?

Support of ad-hoc collaborative applications
“Social IPTV” – Content Providers

Collab. viewing overlays, Service overlays

media streams

meta information mashups uploading content

meta information additional services

Users

Service Provider

Third Parties

ISP

TV Stations
Social IPTV Testbed in Darmstadt
Social IPTV Testbed in Darmstadt
Summarizing P2P Social IPTV

Leverage the P2P paradigm for multiple „new“ applications
- ALM / live streaming (decrease load of infrastructure)
- Collaborative interaction (the teleconf scenario...)
- Creating, deploying, running „apps“ (P2P service distribution)

A case for
- Resistant / resilient networking (commercialization)
- Privacy protection (direct identification of participants)
Decentralized Social Networking Services

Simplified, walled-garden version of „the Web“:

- Easy to set-up pages („profiles“) of *individuals* (... and companies...)
- Links reflecting *real-world relations* between individuals
- Possibility to share user generated content

...including messaging

- “Guest book” / “Wall” (asynchronous broadcast)
- Email (asynchronous unicast)
- Chat (~ synchronous unicast)

Collaborative applications / games
Target Audience / Application Domain

- Publish-Subscribe Posting ("Micro blogging"): Twitter
- Planning Business Trips: Dopplr, TripIT
- Location based achievement systems: foursquare, gowalla
### Why Bother?

<table>
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<th>Brand</th>
<th>Unique Audience (000)</th>
<th>Time Per Person (hh:mm:ss)</th>
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<th>MOM Time % Change</th>
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Source: The Nielsen Company

**Note:**
- CNNMoney.com mentions Google-owned sites like Gmail.com.
Generalized Architectural Model of SNS

Distributed Environment

Main SNS centralized
Additional 3rd party application servers
Quest to Decentralize

Issues of centralized architectures

- Centralized control
- Centralized data storage
- Full, centralized access to data...

- Single Point of failure

“Taking back the web”

- Breaking out of the walled gardens (again, cf. AOL)
- Re-democratizing the web
- Distribute the services!
Quest to Decentralize

Issues of centralized architectures

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“Taking back the web”

Breaking out of the walled gardens (again, cf. AOL)

Re-democratizing the web

Distribute the services!
Plethora P2P / Decentralized Social Services

FOSS
- BuddyPress, CrabGrass, Cobs, DaisyChain, Diki, Elgg, FETHR, GNUNet, Gossple, Jappix, Lorea, Mycella, Movim, PeerScape, Pinax, StatusNet

Commercial Approaches
- diaspora, wuala, LifeSocial

Academia
- Friend-of-a-Friend, FriendStore, HelloWorld, LifeSocial, LotusNet (Likir), PeerSon, Safebook, SocialCircle, Tribler, Vis-a-Vis

Focus on systems that
- implement social networking and publication functions
- Provide running software or a comprehensive protocol / system description
- Actually are decentralized
Selected Systems and Proposals

diaspora

Friend-of-a-Friend

LifeSocial

LotusNet / Likir

PeerSon

Safebook

Vis-A-Vis
Classifying Decentralized OSN

Type of storage / service provision
- Infrastructure-based
  - Dedicated Web-Servers
  - Deployed in the cloud
- Peer-to-Peer-based
- Hybrid

Granularity of service provision
- Replicating whole service
- Distributed storage of attributes

Level of integration
- Stand alone system
- Extension of existing systems

Resource sharing incentives
- None
- Social cooperation
- Payed premium services
<table>
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</table>
Our current approach...

Safebook: Privacy-Preserving Online Social Networking

http://www.safebook.us

L. A. Cutillo, R. Molva, T. Strufe

...and plenty of students :-)
Architecture

- Matryoshka
  - Data storage
  - Cooperation
  - Communication with privacy

- Trusted ID System
  - ID Management

- Peer-to-peer substrate
  - Lookup
Network view

Social network overlay

Peer to peer overlay

Internet

Trusted ID System

@ user id

@ node id

@ ip address
User i’s Matryoshka

End to end privacy based on hop by hop trust

Outer shell

Inner shell

Trust relationship for c's friend

Trust relationship for i

Trust relationship for c's friend

Entry nodes

i’s node

User i’s Matryoshka

Thorsten Strufe, P2P, TU Darmstadt
Peer-to-Peer Networking Group
Finding it, using P2P: \( a \) looks for \( b \)

- \( a \) sends profile data request to \( b \)’s entry node
- Data reply
  - One of \( b \)’s inner shell nodes answers
Summary

P2P itself is boring
Using P2P for new applications is not ;-)  
Some of our current activities include
- Live multimedia streaming
- Anonymous communications
- Resistant communication infrastructures
- Distributing services
- Social networking services

Which we integrate in our „P2P-based Social IPTV platform“