

Quality Adaptation and Security in Peer-to-Peer Systems

Towards Future Internet P2P Video Streaming

P2P Video Streaming with Social Incentives

- Use a social network as a P2P network
- Natural incentives
 - Free riders allowed but only friends
 - Multi-level friendships can be harnessed

Advantages:

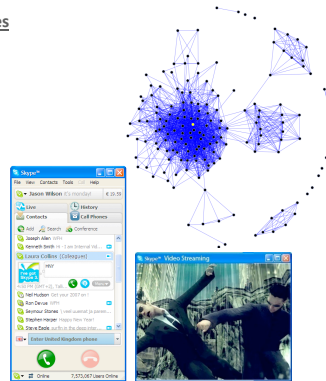
- Underlay aware by nature
- Self-organizing
- More efficient: friends have similar taste

Proof of concept

- SkypeBee: P2P streaming over Skype

Next steps:

- Framework for social incentives
- Use a unified social network infrastructure



Quality Adaptive P2P Streaming using SVC

- Quality adaptation
- Match quality to resources
 - Adapt to heterogeneity in the Internet

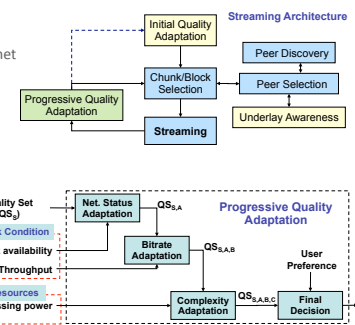
Stages of adaptation

- Initial quality adaptation
- to static resources
- Progressive quality adaptation
- to changing network conditions

- Performance enhancements
- Underlay awareness
 - Complexity matching

Next steps:

- Prototyping (with UniWue)
- Performance evaluation



Multi-level Analysis of Attacks in Peer-to-Peer Systems

Attacks in Peer-to-Peer Systems

- Peer-to-Peer evolved from filesharing to commercial applications
- E.g. video streaming, telephony and messaging

Distributed hash tables are basis for future evolution

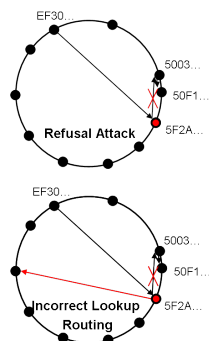
- Enable service lookup without central instances
- Fully decentralized, self-organizing, highly scalable

But: Various new possibilities for misbehavior

- Attacks target at the lookup process
- E.g. refusal attack, incorrect lookup routing
- Low effort but high impact
- Contemporary peer-to-peer systems lack self-protection

Goal: Systematic classification and analysis of attack vectors

- As foundation for developing appropriate security measures
- With G-Lab and PlanetLab as real-world environments
- To improve mathematical models and simulation tools



G-Lab Work: Analyzing Effects of Attacks on System Performance

Mathematical models

- Cover large range from few to millions of peers
- E.g. possibility for successful lookup (α) depending on
- Number of peers (N), fraction of malicious peers (f), bit size of one ID digit (b)

Simulations

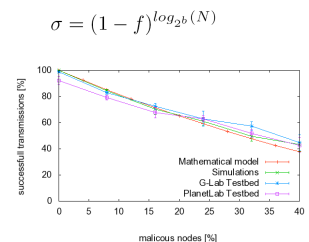
- Cover 10^4 to 10^6 nodes
- Depending on hardware and abstraction
- E.g. simulated overlay, modeled network

G-Lab testbed

- German national testbed
- Currently about 175 homogeneous nodes

PlanetLab testbed

- Worldwide testbed
- Currently about 1000 inhomogeneous nodes



Decentralized Preventive Security Measures for Peer-to-Peer Systems

Attack Prevention

- Attack prevention is based on means such as authentication and admission control
- Restricts access to sensitive resources and closed user groups
 - Usually requires central trusted instance and predefined security policies

But: Trusted instance and security policies not available in peer-to-peer environment

- Compensation possible by user-based cooperative decisions
- Mathematical fundament: Threshold cryptography

Goal: Develop and validate models describing user-based cooperative decisions

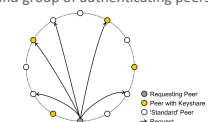
- As tools for governing the decision process
- E.g. optimize number of users involved to avoid unnecessary decision requests

$$p_{\text{succ}}(n_{\text{breq}}) = \sum_{n_{\text{req}}=n_{\text{breq}}}^{n_{\text{tot}}} \frac{\binom{n_{\text{auth}} \cdot p_{\text{req}}}{n_{\text{req}}} \binom{n_{\text{tot}} - (n_{\text{auth}} \cdot p_{\text{req}})}{n_{\text{req}} - n_{\text{breq}}}}{\binom{n_{\text{tot}}}{n_{\text{req}}}}$$

G-Lab Work: Model Validation

- E.g. interaction between a peer requesting authentication and group of authenticating peers

- Considered here: Random requests
- No knowledge on distribution of keyshares at requesting peer
- Requests are sent to randomly selected peers
- Authentication successful if at least a certain number (threshold) of peers approved identity



First results show differences between individual testbeds

- Match of model predictions and results from PlanetLab
- No exact match of model predictions and G-Lab
- Why?

Next steps: Identify reasons for divergence of results

- Adapt/generalize models appropriately
- Fundamental comparison of PlanetLab and G-Lab

