

Quality Adaptation and Security in Peer-to-Peer Systems

Towards Future Internet P2P Video Streaming

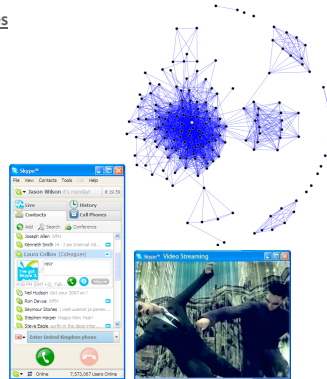
P2P Video Streaming with Social Incentives

- 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



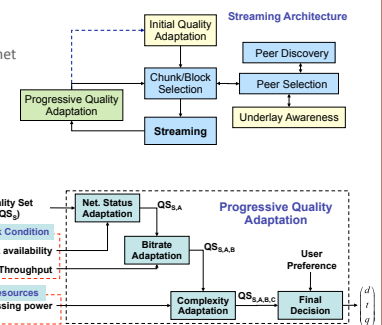
Quality Adaptive P2P Streaming using SVC

- 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

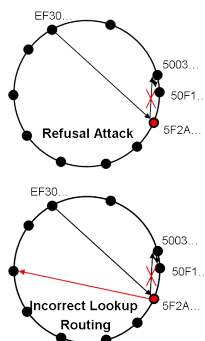
Attacks in Peer-to-Peer Systems

- 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 (σ) 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

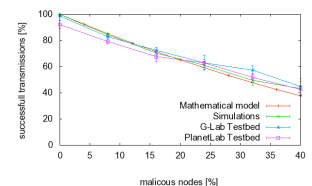
G-Lab testbed

- German national testbed
- Currently about 175 homogeneous nodes

PlanetLab testbed

- Worldwide testbed
- Currently about 1000 inhomogeneous nodes

$$\sigma = (1 - f) \log_2 b(N)$$



Decentralized Preventive Security Measures for Peer-to-Peer Systems

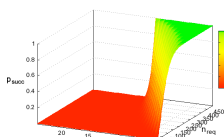
Attack Prevention

- 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

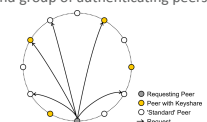
- Goal: Develop and validate models describing user-based cooperative decisions
- As tools for governing the decision process
 - E.g. optimize number of users involved to avoid unnecessary decision requests

$$p_{\text{succ}}(n_{\text{req}}) = \sum_{n_{\text{req}}=n_{\text{thr}}}^{n_{\text{tot}}} \binom{n_{\text{tot}} - n_{\text{req}}}{n_{\text{req}}} \binom{n_{\text{tot}}}{n_{\text{req}}}^{-1}$$



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

