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Wroclaw Information Technology Initiative Seminar

Aufgabe 1

In this exercise, you will study peer-to-peer systems.

1. Name and explain two attacks used by the BitThief client to exploit BitTorrent!

   BiThief performs a so-called large-view exploit: It connects to many other clients by contacting the tracker repeatedly. Thus, it can benefit from many peers' optimistic unchoking slots.

   In addition, BitThief fakes tracker announcements in sharing communities, pretending to be a big uploader.

2. Name two vulnerabilities of today's Kad network!

   Node insertion attack (peer assumes arbitrary overlay positions) and publish attack (peer poisons caches of publishing peers).

3. Some of the Kad attacks can be circumvented by binding overlay IDs to IP addresses. Do you see reasons why this solutions may be problematic in practice?

   Binding IP addresses to IDs can be problematic if the nodes have dynamic IP addresses and if multiple peers behind a NAT share the same IP.

Aufgabe 2

Consider a set of n nodes distributed arbitrarily in a metric space. Assume that – as presented in the seminar – nodes are selfish and seek to minimize their individual costs which is given by the sum of the stretches to all other nodes plus α times the node's out-degree.

1. First assume that the nodes are distributed in a 1-dimensional Euclidean space. Show that if the nodes are connected as a doubly linked list, this situation constitutes a Nash equilibrium.

   No node has an incentive to change its neighbors. To see this, observe that in the described network, all nodes have an optimal stretch of 1 to all other nodes. So it can only be better to connect to less nodes, in which case, however, the graph gets disconnected!

2. Now consider again arbitrary metric spaces. Show that in any Nash equilibrium, $O(\alpha n^2)$ is an upper bound on the social costs.

   The connection costs cannot exceed the bound trivially, as there are at most $O(n^2)$ edges in a graph. Moreover, observe that a selfish node will always connect to another node if the stretch is larger than $\alpha + 1$: The cost of an additional link is only α.

Aufgabe 3

Prove that the linearization algorithms LIN_{max} and LIN_{all} presented in the seminar require $\Omega(n)$ rounds even in the best case!

Let $v_1, v_2, ..., v_n \in V$ denote the nodes in sorted order, i.e., $v_1 < v_2 < ... < v_n$. Consider the following initial topology $G_0 = (V, E)$ where for all i such that $0 < i < n - 1$: $\{v_i, v_{i+1}\} \in E$. Additionally, E contains a long edge $e := \{v_1, v_n\}$. In the beginning, edge e has length of $len(e) = n - 1$. Observe that in each round, both for LIN_{all} and LIN_{max}, the length of e is reduced by at most one. Thus, by induction, it takes at least a linear number of rounds to sort G_0, as the execution is inherently sequential.