Exercise 2

Exercises Peer-to-Peer-Systems and Security (SS2010)

Monday 10.5 2010
Hand-in: Thursday 27.5. 2010 in lecture or per mail
Exercise: to be announced

Dipl.-Inform. Heiko Niedermayer
Lehrstuhl für Netzarchitekturen und Netzdienste
Technische Universität München

Rules: There will be five exercise sheets with each 10 points. You have to achieve 50 % of the points and present a solution in the exercise course to get the 0.3 bonus.

Task 1 (2 Points) CoolSpots Munich II

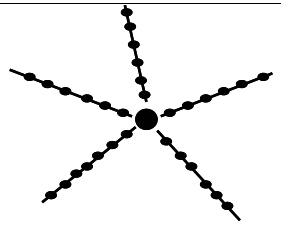
This time you should solve the task to organize the CoolSpots Munich network with a Distributed Hash Table. Use spot_ID = h(GPS coordinate of spot) to store the items. As item descriptions are rather short, the data is stored on the DHT nodes and not only on the node that contributed the item.

a) Briefly describe the operation of the CoolSpots Munich DHT.
b) How can you find an item that is directly at your GPS coordinate?
c) Items at my exact GPS coordinates are not too useful, what do I have to do to look up items close to my GPS coordinate? Propose a measure to limit the number of lookups necessary for this task.

Task 2 (2 Points) An unusual topology

The image on the right shows a solar-like topology. Peers are positioned on 5 rays that are connected via a central peer. The topology further imposes the constraint that the largest ray should not be more than twice as large (with respect to number of nodes) as the smallest ray.

a) Describe a topology-preserving join procedure.
b) What is the largest distance in the topology (let s be the number of nodes on the smallest ray without the central node)?
c) Describe an addressing and routing scheme for the topology.
d) What happens when a node fails? What can you do to make the topology resistant to a failure of a single node?



Task 3 (2 Points) Key-based-Routing-API

Please, briefly describe your idea first, before you write pseudocode. Use a pseudocode that avoids unnecessary details. Assume that you have a structure Peer-to-Peer system that implements the Key-based Routing-API. All messages are processed recursively (e.g. no iterative lookup):

a) *Ping and Pong:* a node A pings (sends "Ping") a node B via the KBR network by sending message to its ID. Node B replies to the ID of node A with a "Pong". Give the code for the send and receive operation.
b) *Counter:* implement a counter that counts the number of messages that the node forwards.

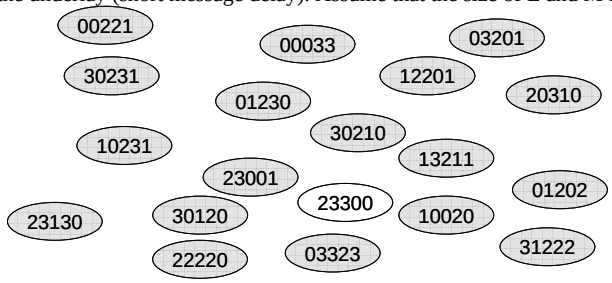
Task 4 (2 Points) Distribution of Interval sizes

In this task we want to compute the distribution of the interval size in systems on the basis of Consistent Hashing like Chord. Let us assume the ID space to be real-valued in the interval [0,1). Without loss of generality we can put our node on the position 0 in the ID spacce.

a) Nodes are positioned randomly on the basis of uniform random numbers. What the cumulative distribution function (CDF) L of the corresponding uniform distribution.
b) Now calculate the CDF for the minimum of n-1 independent experiments with the distribution from a). Hint: The CDF for the minimum von random variables with CDFs L_1, L_2, L_3, … is given by the forumla $L\_\min = 1 - \prod_i (1 - L_i)$.
c) Now differentiate L_min to get the probability density function l_min.
d) Plot the probability density function l_min.

Task 5 (2 Points) Pastry

This task is about Pastry. The figure is a snapshot with the current nodes (dark) and the new node (white) and how they are positioned in the underlay. If they are close in the figure they are close in the underlay (short message delay). Assume that the size of L and M is 2.



a) The white node 23300 wants to join the network via the node 10020. Describe the join process step-by-step and state the corresponding routing information seen and stored by the white node. What is the routing table of 23300 at the end? (Hint: There is no need to calculate each routing table, but simply make reasonable assumptions.)
b) Now, send a message from 23300 to ID 03023. For the first step use the routing table from a) and then make reasonable assumptions.