

Peer-to-Peer Systems – Exercise Winter Term 2014/2015

General Remarks

Welcome to the exercise for the lecture Peer-to-Peer Systems.

Please follow the general remarks regarding the organization of the exercise.

- The lecture's website is to be found here:
<http://tsn.hhu.de/teaching/lectures/2014ws/p2p.html>
- For further inquiries, please contact the lecturer under the following email address: graffi@cs.uni-duesseldorf.de

Problem 6.1 - Sampling Information in Networks

In this exercise we test the effect of sampling in random network. Consider for this the following network with 21 nodes:

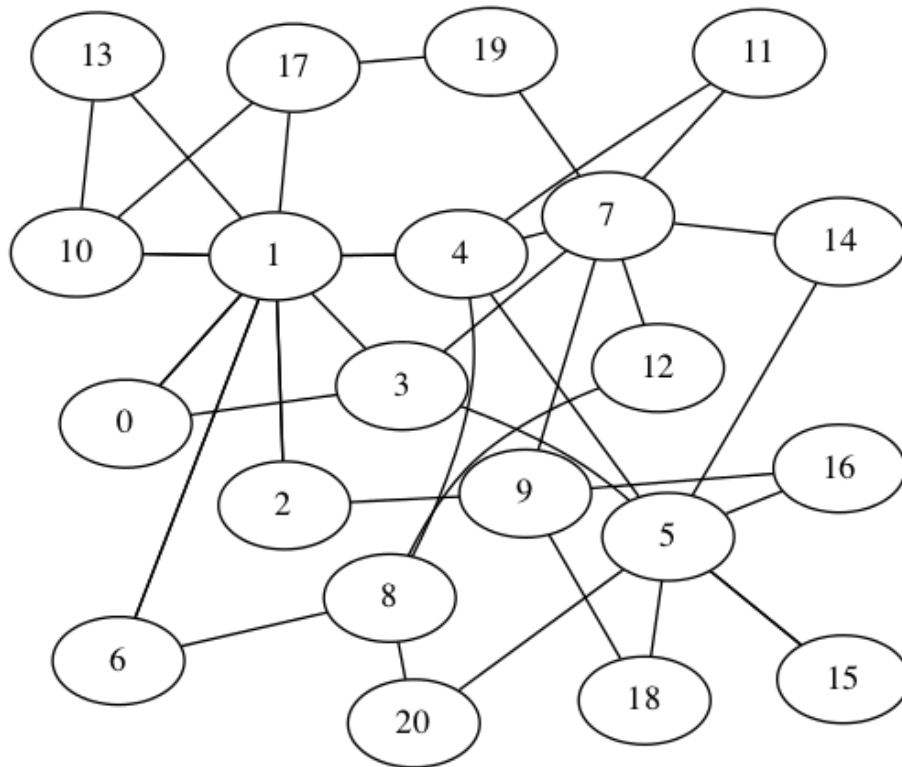


Abbildung 1: Random network with 21 nodes

a) Sample Sampling Run

Consider that node 20 and node 0 start a random walk with hop limit 10 trying to calculate the average node ID and degree in the network. The random walk passes 10 links and is replied by the node nr. 11 in the path to the querying node. Calculate the path of both random walks separately, the values gathered (11 samples) and the average node ID and degree obtained in each walk.

In the case that a node might choose from k neighbors as next hops, use following formula:

- Sort the neighbor node IDs: $ID_0 \dots ID_{k-1}$
- Add the current node's ID and add (if possible) the previous node's ID, e.g. the sum is M
- Calculate the index: $j = M \bmod k$
- Pick as next hop: ID_j

Please note, that loops are allowed.

What are the obtained values? How close is the average node ID obtained by sampling to the actual average node ID? There are in total 34 links and 21 nodes. The average node ID is 10.5 and the average degree 3.4. Use following tables and discuss the obtained results. What weaknesses do you see?

Random walk from node 20:

Current node	List of k neighbors	Sum M	k	M mod k	Next hop

Random walk from node 0:

Current node	List of k neighbors	Sum M	k	M mod k	Next hop

Problem 6.2 - Gossip based Monitoring

Consider in this exercise the small graph with 6 nodes. In this exercise we apply PushSum on this network.

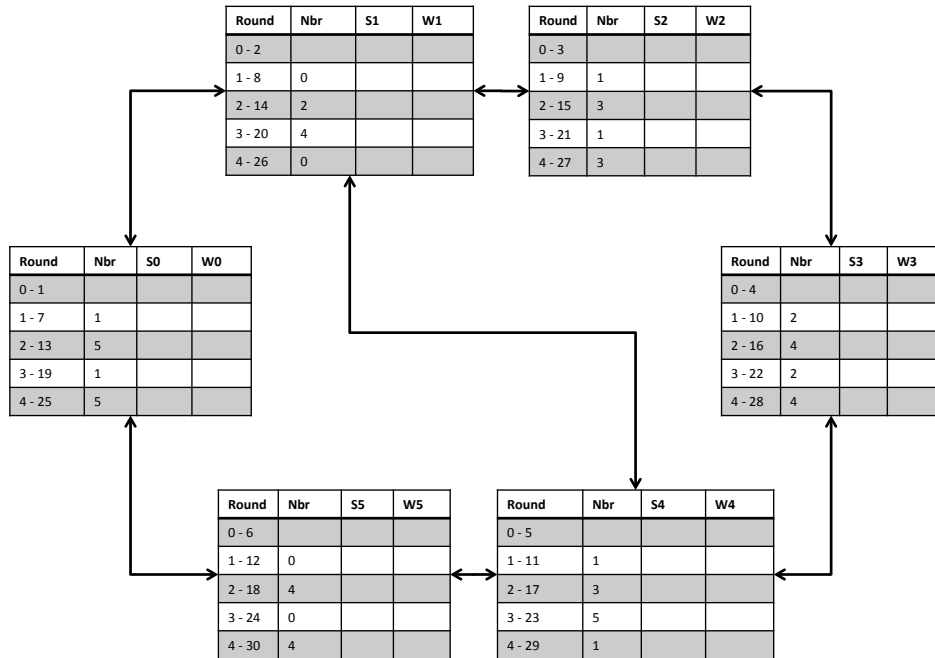


Abbildung 2: Network with 6 nodes

a) Sample Gossiping

Assume that the nodes in the small network want to obtain the number of nodes in the network. Therefore node 0 initiates a gossip epoch in round 0, all other nodes are prepared as well in round 0 and set their values s_i and w_i correctly. In each round the nodes act clockwise, i.e. starting with node 0 (action 0 - 1), then nodes 1,2,3,4 and finally node 5 is allowed to act. The round number also lists as a second parameter the action number. For example the value (2 - 15) displays that in the second round, node 2 performs his gossip action, which is the 15th in the row. After him, node 3 performs his gossip action numbered (2 - 16). The gossip partner is listed in the column (*nbr*), a full gossip transaction is performed. This means, that the process of sending 1/2 of the own values, receiving the 1/2 of the other node values and aggregating it is fully completed. Thus, a single node might be involved in several gossip transactions per round. Note in the corresponding fields in the figure the final values s_i and w_i after the end of each round at each node. After round 4, what are the obtained values? What is the calculated node count in each node after round 4? Discuss the obtained results. What weaknesses do you see?

Problem 6.3 - Monitoring P2P Systems - Joining the Tree

SkyEye.KOM is a monitoring approach that helps to gather and disseminate statistics on a p2p network.

a) Tree node positioning and parent node calculations

Consider Chord with an ID space ranging from 0 to $2^{160} - 1$. Node **AEE9 6FC9 9741 FE3C EFD6 174A 014B 0556 07D4 5795** wants to participate in monitoring and has first to identify its position in the tree. The tree consists of approx. 100 nodes, thus the predecessor node's ID is approx. 1/100 th of the ID space away (i.e. 0.01 in the unified ID space). Please calculate the position of the node in the monitoring tree SkyEye.KOM with a branching factor **2 and 4**. Calculate also the IDs of the corresponding (father) contact nodes in the tree. Hint: Calculate the nodeID in the unified ID space, and the first i DomainIDs which might be relevant. Find through the DomainIDs the place of the node and also a way how its father node can be contacted.

b) Issues in creating the tree

Having identified the position for one single node, we might identify some issues.

- Is the tree construction always deterministic?
- Can a parent node have more than β child nodes?
- What happens if nodes fail in the tree?
- Are there problems if the responsibility range of a node is increased / decreased (e.g. by a joining / leaving neighbor)
- Are there issues if the initial overlay is multi-dimensional?
- Which further issues do you see in creating the tree?

Problem 6.4 - Example of using the Monitoring Tree

Consider in this exercise the small graph with 15 nodes. In this exercise we apply the SUM aggregation of SkyEye.KOM on this network.

a) Sample usage of the monitoring tree

Assume that the nodes in the small network want to obtain the sum of all values in the network. The nodes submit their aggregated values periodically in rounds, the acknowledgements on the other side are replied immediately. Thus, the aggregation updates are performed roundwise, starting with the leaves of the tree then with the levels towards the root. Write in the table the aggregation obtained in the corresponding round. Through the round based communication, the aggregated value in a node in round i is based on the values of its child nodes in round $i-1$. *AckR* stands for „received ACK”. It denotes the global view obtained from the parent node in the ACK sent for the nodes aggregation update. Fill out the tables. How long does the information dissemination take to reach all nodes? Discuss the obtained results. What weaknesses do you see?

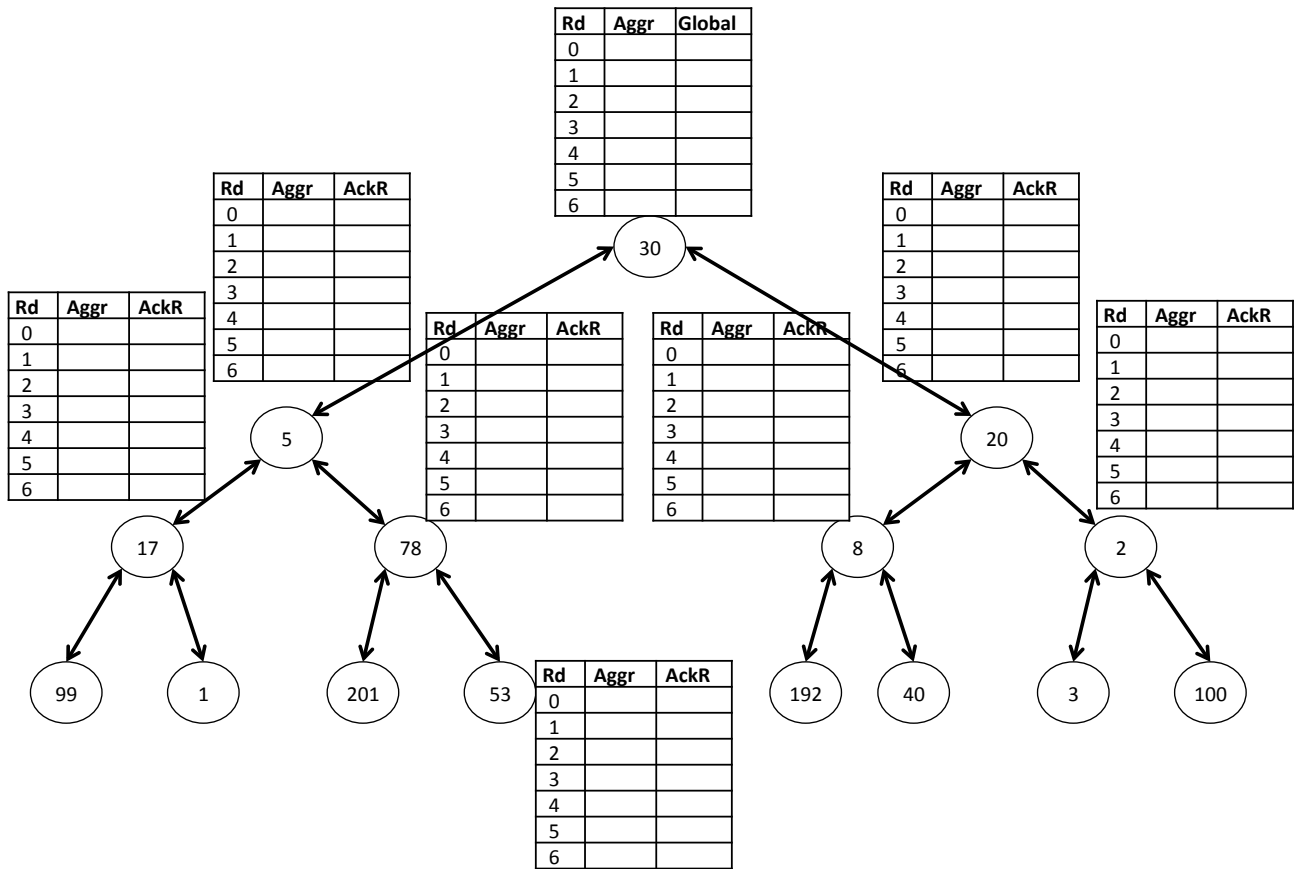


Abbildung 3: Network with 15 nodes