WS 2012-2013 Advanced Internet Technology
WS 2012/ 2013 Prof. Wehrle
90 minutes - 80 points

Task 1 (Peer-to-Peer Networks) 1+2+2+2+4=13

a) Napster made use of centralised servers, but was nevertheless considered a P2P system. Why?

resources are shared between peers, resources can be accessed directly from other peers

b) Give two advantage and two disadvantages of using central components in P2P systems.

+ easy to manage, fast and complete -one single point of failure, bottleneck

c) When joining a pure or hybrid P2P system, a peer needs to find neighbouring peers. Assume that it can choose its neighbours from a large choice of peers in the systems. Name two metrics for preferring one neighbour over another. What is each metrics advantage over selection a random peer as a neighbour?

Numberically close node, close node based on proximity metric

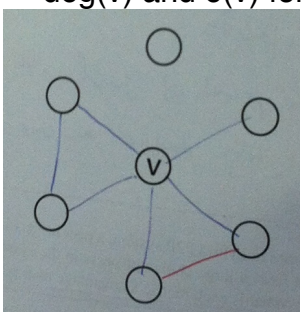
d) Consider Gnutella networks of the first generation in which every peer knows at least two other peers. In the worst passible case, what is the lowest number of independent peer failures sufficient to partition such a network.

two peers can fail,

e) Are Power-Law networks robust against random failures?

Yes, because with high probability a low connected node fail.

f) Given is the network. Add edges such that vertices v has clustering coefficient 0,2. Give deg(v) and e(v) for your solution.



Task 2 (Chord) 5+1+2=8

a) A node n participant in a typical Chord ring It has the following finger table:

Which IDs are possible (solution: 17-20)

finger	node ID
0	24
1	24
2	24
3	32
4	37
5	56

b) With the finger table from task a) which next hop does the chord routing algorithm choose a query from ID 42?

c) What is the memory complexity of a Chord routing table?

O(log N) per node

Task 3 (Pastry) 4+1+2+3=10

a) The following Pastry routing contains four errors:

ntifier. Identifiers consist of 5 digits to the

	0	1	2	3
0	03221	11230	–	31523
1	20332	–	12123	23001
2	21031	21120	21311	–
3	21302	21311	21320	21332
4	21300	–	21302	21303

i,j: 3,2 21330

3,0 -

1,2 22123

2,2 21211

b) What is the ID of the node owning the above Pastry routing table?

21301

c) Is the underlying geometrical structure of the Pastry network inflexible in term of neighbour selection?

Pastry = Hybrid(Tree + Ring) = good flexibility 2^(i-1)

d) Assume a Pastry network over an identifier space of 128bit. We want to guarantee that every node in the network can reach any other node within a max of 40 hops. What is the min number of columns of the routing table that fulfils this requirement?

l = 4

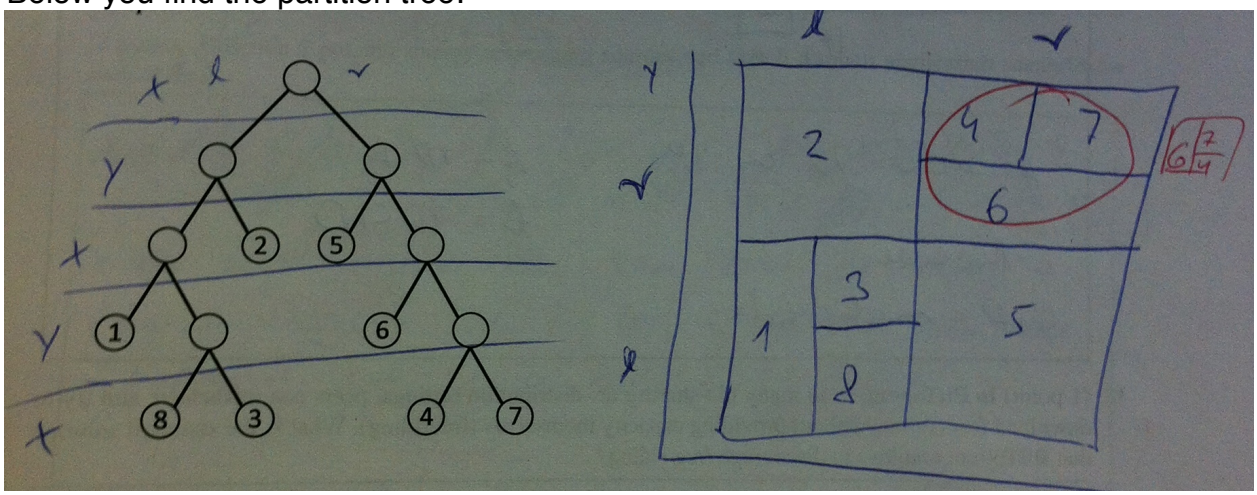
Task 4 (CAN) 2+4+2=8

a) Name two advantages and disadvantages of a very high-dimensional CAN DHT compared to having only few dimensions.

++ more neighbours - shorter path, more realties - more robustness

-- higher node states (more information needs to be saved in the nodes)

b) Below you find the partition tree:



c) Consider the two routes given in the table below:

from 7-8: 7-5-8 and 3-6: 3-2-6

Task 5 (Peer-to-Peer application) 7+1+2=10

a) Assume that you want to realise the following scheme with i3: First from host A to host B; then either to C or D, depending in the latency; finally from there to E which delivers the data to all hosts in its IP-subnetwork. Assume for this that the subnetwork has four hosts IP1 to IP4. Depict the correct triggers for hosts B, C, D and E, and describe their type with one word or in one sentence. In addition, depict the initial data packet as sent by host A including the correct i3 header which would follow the realised routing path.

b) In BitTorrent, as in many file-sharing of distributions settings, peers can misbehave and try to download from others without providing capacity themselves (free-riding). What is the standard solution that BitTorrent employs to discourage free-riding?

- choking - temporary reject upload, downloading occurs as normal

c) Denote in the table the behaviour of peer A in reaction to peer Bs behaviour. t0 denotes the initial behaviour in subsequent rounds at time t(i+1) A can take into account Bs behaviour up to time t1.

time	Peer A	Peer B
t0		cooperate
t1		defect
t2		cooperate
t3		defect

Task 6: (Sensor networks) 3+2+1+3=9

a) List the main hardware components of a sensor node. For only one component, indicate a possible policy to save energy in its usage.

Controller, sensor, batteries, radio modem (do not sent whole time), memory

b) Describe 2 possible energy scavenging sources and sketch a rough application scenario for each of them.

solar cells, temperature gradients

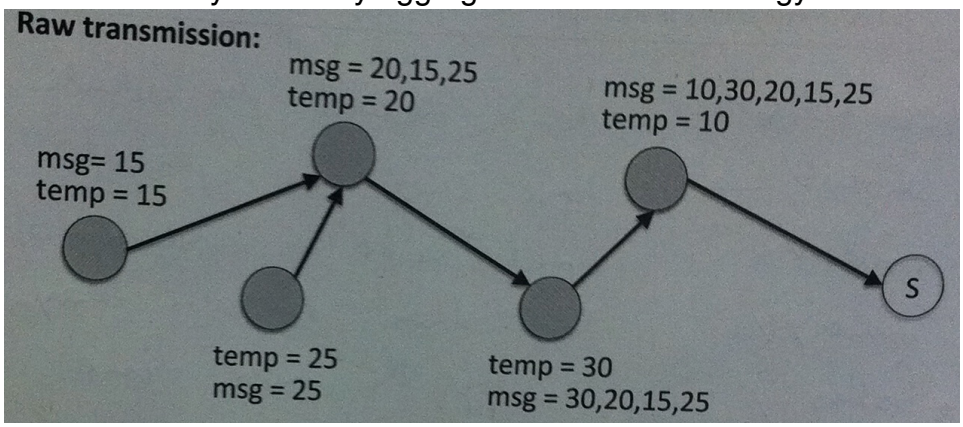
c) What is the requirement for aggregation to be preferable to transmitting the raw data?

don‘t sent it all, only min, max, average, sum

take tree network so get data - hop to hop

d) In the given network, the average temperature shall be calculated at the sink S. We provide an example which each node forwards its measurement to the sink. Your task is to fill in the message content on each hop when aggregation is performed in the

network. Briefly state why aggregation does save energy in this case.



sum the temp with counter for dividing

Task 7: (Routing in Sensor Networks) 3+2+1,5+4,5+0,5=13

a) Imagine a scenario in which a very large network is expected to report rare events with minimum latency. For this specific scenario, provide one advantage and one disadvantage in employing each of the following routing schemes, reactive and proactive routing.

flooding: + reach every node, -high traffic
reactive: + smaller packets, -high delay, overhead
proactive: +if network change, avoid loops -high energy consumption

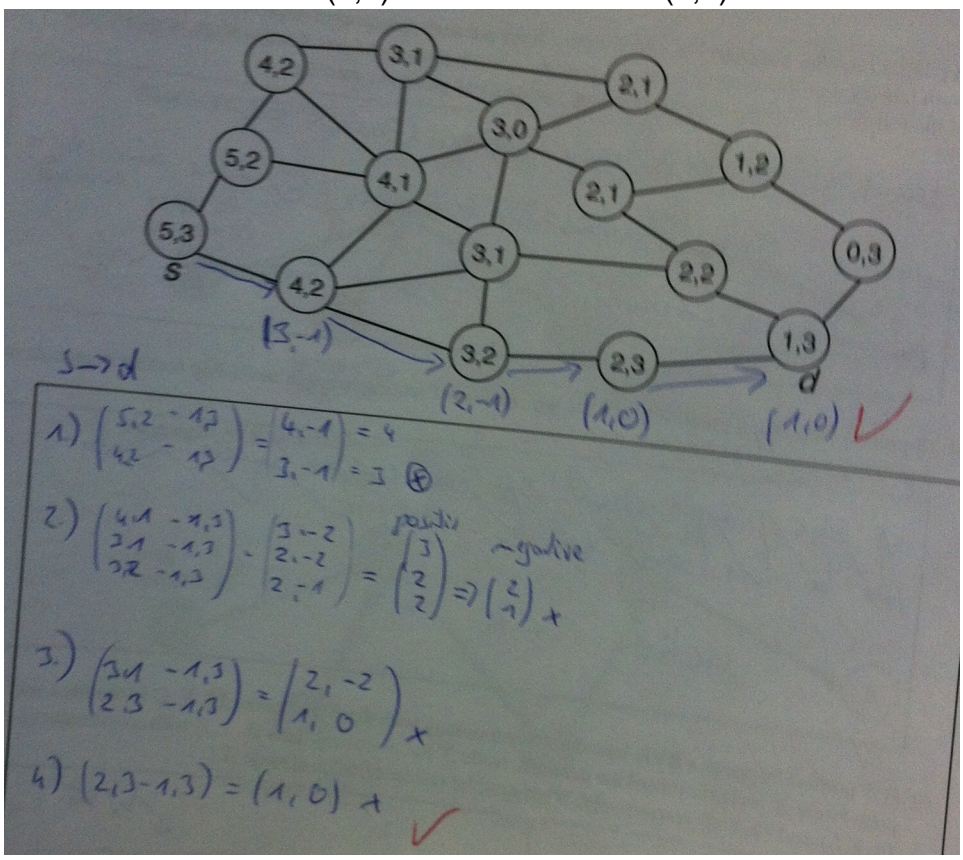
b) Describe a possible cause for the creation of routing loops in multi-hop routing protocols and a technique capable of detection them.

c) Suppose a BVR-based routing topology with three landmarks M,N,O, in the network. Suppose Node X recently joined the network. Node X has three neighbours W,Y,Z with coordinates (5,9,9), (2,8,5) and (3,7,6) respectively. What shall be coordinate of node X?

d) The BVR algorithm, as describe in the lecture, used three different kinds of routing decision to properly route to the target, even if one decision fails. Name those three kinds in decreasing order of priority.

1. Beacon-Vector Routing
2. Fallback-mode
3. scoped flooding

e) In the network below s(3,3) wants to route to d(1,3) via BVR:



f) Write down the coordinate or encircle in the above figure the beacons.
3,0 and 0,3

Task 8 (Localisation and Synchronisation) 2+3+2+2=9

a) Why do pure RSSI-based localisation techniques typically perform poorly? name different approaches and its main advantage.
   High error-prone process
   Time of arrival: faster
   Time Difference of Arrival: two signals

b) Assume 2 sensor networks, one deployed indoor and one deployed outdoor. Which should be expected to experience higher synchronisation errors?
   indoor higher errors, because of open/ closed doors and windows, walls and walking people

c) Consider a deployment monitoring volcano activities. Name 2 reasons why time sync is needed.
in network event detection, network aggregation (Zusammenschluss), one action the same?

d) Why is network-wide sync via LTS with one reference node problematic? What is the main problem that occurs, especially in large network?