
1. Dual-Choice Questions on Overlay Systems and Networks (10 Points)

Choose for each statement either true or false. Please tick the box for the correct answer. (0.5 point each)

(Please note that for each incorrect answer within the questions a), b), c), and d) as many points will be deducted as you get for each correct answer. Negative points will result in zero points for the corresponding question.)

	TRUE	FALSE
a) Overlay Networks Applications and Mechanisms		
An overlay topology is independent of the physical layer.	☐	☐
Network Address Translation (NAT) improves peer-to-peer connectivity.	☐	☐
Sending a broadcast message is possible within an overlay network.	☐	☐
The Bitcoin mining process generates an arbitrarily large number of Bitcoins.	☐	☐
The difference between broadcast and multicast is that messages in case of broadcast are delivered synchronously and with multicast asynchronously.	☐	☐
b) Overlay Network Routing		
No information on neighbours is needed in a flooding search.	☐	☐
The use of redundant routing paths reduces problems caused by node failures.	☐	☐
Flooding scales well with many nodes in a network.	☐	☐
An unavailable node in the routing path causes the immediate failure of the routing operation.	☐	☐
Peer IDs in a P2P network with 128 peers should have a length of at least 5 bits.	☐	☐
c) Distributed Hash Tables		
Kademlia (and TomP2P) use an XOR-based distance metric, because of its properties, such as symmetry, low complexity, linearity, and unidirectionality.	☐	☐
In DHTs peers and content are addressed using identifiers in the same address space.	☐	☐
The use of a good hash function always guarantees load balancing (e.g., good distribution of a root node in a P2P file system).	☐	☐
In DHTs the equal distribution of the content among nodes is crucial for an efficient lookup of content.	☐	☐
DHTs offer strong consistency guarantees for updates.	☐	☐

	TRUE	FALSE
d) Overlay Networks Security		
Encrypting DHT keys makes the DHT more secure.	☐	☐
Adding a combination of honeypots and distributed probes is one complementary manner to monitor content access to DHTs.	☐	☐
In a Sybil attack an attacker needs to create many identities.	☐	☐
If you loose your Bitcoin wallet, you can always restore your keys from the blockchain.	☐	☐
In TomP2P the vDHT mechanism is used to mitigate poisoning attacks.	☐	☐

2. Multiple-Choice Questions on Overlay Networks and Systems (9 Points)

Choose for each statement either true or false. Please mark the correct answer with a cross. (1 point each)

(Please note that for each incorrect answer within the questions a)-e) as many points will be deducted as you get for each correct answer. Negative points will result in zero points for the corresponding question.)

	Question	True	False
a)	WebRTC is intended for...		
	... P2P-Filesharing.		
	... real-time P2P-Video-Chat.		
	... real-time P2P-Messaging.		
b)	A DHT ...		
	... stores key-value pairs.		
	... is faster than regular Hash Tables.		
	... replicates data to achieve robustness.		
	... is used in the Bitcoin system.		
c)	An overlay network is...		
	... a virtual network.		
	... a physical network.		
	... a static network.		
	... a network composed of other networks.		
d)	Structured P2P systems...		
	... consist of peers and super-peers.		
	... can use any node to perform bootstrap.		
	... are always based on distributed hash tables (DHTs).		
	... typically offers content search using the flooding approach.		
e)	Neighbor nodes in an overlay...		
	... are in the same autonomous system (AS).		
	... have shorter round-trip-times (RTT) than to other nodes.		
	... are close in the overlay address range.		

3. Explanation of Overlay Network Terms (18 Points)

Explain the following terms.

Please answer each subquestion with a single sentence only. ..

	Begriff	Erklärung in <i>einem</i> Satz
a)	Super-Peer	
c)	Tracker	
d)	Application-Layer-Multicast (ALM)	
e)	Network Coding	
f)	Fast Similarity Search	
h)	Bitcoin-Miner	

4. Peer-to-peer Networks (12 Points)

Answer each of the following questions in the maximum two sentences.

(Please note: correct answers with more than 2 sentences will have one point deducted)

- a) Define the bootstrapping in the context of P2P networks (in one sentence) and list the key requirements for a successful bootstrapping. (3 points)

- b) Cite two advantages and two drawbacks of *Bloom filters*. (3 points)

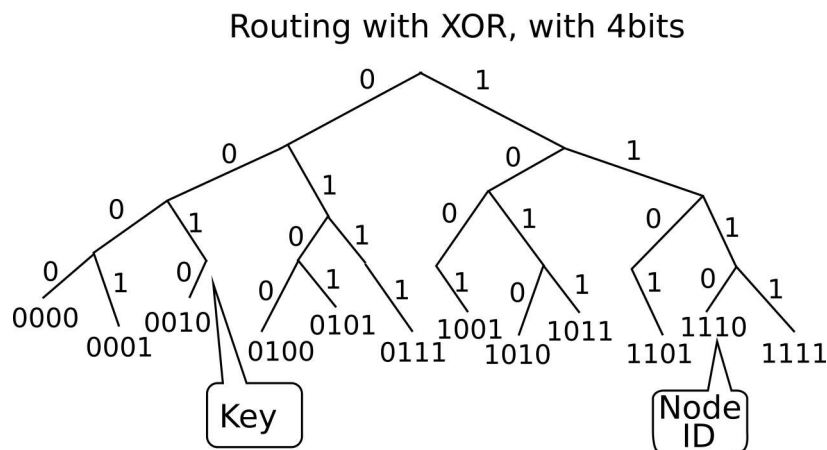
- c) Cite one advantages and one drawback of using a flat structure for an overlay network instead of using a hierarchical structure? (3 points)

- d) For three peers A, B, and C the peer A stores the data set D_A and the peer B stores data set D_B . What query (queries) would peer C use to find the intersection of D_A and D_B to create only a minimal amount of network traffic? (3 points)

5. Kademlia (11 Points)

The following Kademlia network with an addressing space of 4 bits is given as shown below. The routing table state of each node is provided below as well. Consider the following situation:

Node 14 (binary notation 1110) starts a lookup for key 3 (binary notation 0011). Please answer in this context the questions a), b), and c) as from the next page.



4-bit Kademlia network

Bucket Nr	1	2	3	4	node 15
Node	14	13	10	2	
Bucket Nr	1	2	3	4	node 14
Node	15	13	9	7	
Bucket Nr	1	2	3	4	node 13
Node	-	15	11	0	
Bucket Nr	1	2	3	4	node 11
Node	10	9	15	2	
Bucket Nr	1	2	3	4	node 10
Node	11	9	14	1	
Bucket Nr	1	2	3	4	node 9
Node	-	10	13	4	
Bucket Nr	1	2	3	4	node 7
Node	-	5	1	10	
Bucket Nr	1	2	3	4	node 5
Node	4	7	2	11	
Bucket Nr	1	2	3	4	node 4
Node	5	7	1	13	
Bucket Nr	1	2	3	4	node 2
Node	-	1	4	15	
Bucket Nr	1	2	3	4	node 1
Node	0	2	5	14	
Bucket Nr	1	2	3	4	node 0
Node	1	2	7	9	

Routing tables of all nodes in the Kademlia network

a) What is the distance in binary notation of node 14 to the key 3? (2 points)

b) Fill in the dotted line (...) in the following table with the nodes that are being contacted during the routing process by node 6. (6 points)

Routing Steps	1	2	3	4
Node	14	...	...	...

c) What will the respective node at routing step 4 return and why does it stop at routing step 4? (3 points)