# Solutions to Homework Questions on P2P Networking

**Q1.** As discussed in the lecture, a DHT is a pure overlay network. Consequently, the assignment of keys to the peers does not take into account the underlying network topology. Do you think this may have an impact of the search performance?

A1. Yes. The delay between successive nodes in DHT can be high because they may be separated by a long distance. It is also possible that the throughput between two successive nodes is low because the underlying network has a low bandwidth.

---

**Q2.** Consider the circular DHT example that we discussed in the lecture. Explain how peer 6 would join the DHT assuming that peer 15 is the designated contact peer for the DHT.

A2. The sequence of actions is:

1. Peer 6 will contact Peer 15 with a join request.

2. Peer 15, whose successor is peer 1, knows that Peer 6 should not be its successor. Peer 15 will forward the join request from Peer 6 to Peer 1.

3. Peer 1, whose successor is peer 3, knows that Peer 6 should not be its successor. Peer 1 will forward the join request from Peer 6 to Peer 3. The actions of peers 3 and 4 are identical to those of peers 15 and 1.

4. The join request will finally arrive at peer 5. Peer 5 knows that its current successor is peer 8, therefore peer 6 should become its new successor. Peer 5 will let peer 6 knows that its successor is peer 8. At the same time, peer 5 updates its successor to be peer 6.

---

**Q3.** Consider a new peer Alice that joins BitTorrent without possessing any chunks. Without any chunks, she cannot become a top-four uploader for any of the peers, since she has nothing to upload. How then will Alice get her first chunk?

A3. Alice will get her first chunk as a result of she being selected by one of her neighbors as a result of an "optimistic unchoke," for sending out chunks to her. Recall that a peer periodically selects one of its neighbours at random as a peer for uploading irrespective of whether this neighbour is uploading data to it or not.

---

**Q4.** Consider distributing a file of F = 10 Gbits to N peers. The server has an upload rate of us = 20Mbps, and each peer has a download rate of di = 1 Mbps and an upload rate of u. For N=10, 100 and 1000 and u = 200Kbps, 600 Kbps and 1 Mbps, prepare a chart giving the minimum distribution time for each of the combinations of N and u for both client-server distribution and P2P distribution.

---

**A4.** For calculating the minimum distribution time for client-server distribution, we use the following formula:

$D_{cs} = \max \{NF/u_s, F/d_{min}\}$

Similarly, for calculating the minimum distribution time for P2P distribution, we use the following formula:

---

$D_{p2p} = \max\{F/u_s , F/d_{min} , NF/(u_s + \sum_{i=1}^{N} U_i)\}$

where, F = 10 Gbits = 10 * 1024 Mbits
$u_s$ = 20 Mbps
$d_{min} = d_i$ = 1 Mbps

---

Client Server

| | | N | | |
|---|---|---|---|---|
| | | **10** | **100** | **1000** |
| **u** | **200 Kbps** | 10240 | 51200 | 512000 |
| | **600 Kbps** | 10240 | 51200 | 512000 |
| | **1 Mbps** | 10240 | 51200 | 512000 |

Peer to Peer

| | | N | | |
|---|---|---|---|---|
| | | **10** | **100** | **1000** |
| **u** | **200 Kbps** | 10240 | 25904.3 | 47559.33 |
| | **600 Kbps** | 10240 | 13029.6 | 16899.64 |
| | **1 Mbps** | 10240 | 10240 | 10240 |

**End of homework**

---