Load Balancing in Mobile P2P

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Motivation

Smartphones present unique challenges with its limited battery power, CPU, bandwidth and memory. Technology has not been updated to address these challenges. Today, smartphones still use many technologies made for desktops and personal computers.

One of the example of such technology is file sharing. Currently, file sharing is done either by client-server model or by peer-to-peer model. However, both these models take huge amount of network bandwidth which is very valuable in wireless connections.

Aim

We present our solution by using load balancing in P2P network. The aim of our project is addressing the development of load balancing technique for P2P network of mobile smart devices, allowing load-balanced distribution of tasks among peers.

Energy efficiency is an important point of consideration during the design and development of the project. Some of the factors taken into account in the architecture of our work are mobile battery and the phone memory.

Some jargons

Peer-to-Peer

Peer-to-peer (P2P) computing or networking is a distributed application architecture that partitions tasks or workloads between peers. Peers are equally privileged, equipotent participants in the application.

Load Balancing

Load balancing is the distribution of workloads across multiple computing resources, such as computers, a computer cluster, network links, central processing units, or disk drives. Load balancing aims to optimize resource use, maximize throughput, minimize response time, and avoid overload of any single resource.

Approach

A group of peer mobile smart devices within the same location and connected to same network will elect the smart head based on the resources available (ram and battery power). Smart Head will maintain list of available files and the corresponding peers containing them. If a peer wants a file, it will send a request to the smart head which will then distribute the task of downloading that file to different peers containing the file.

Requirements

As per the above discussion of approach, our application will have the following functionalities:

- Elect a smart head
- Upload a new file
- Show the list of files available in the entire network
- Download a file from the list of available files

Design

Our application is divided into many modules, as follows:

1. Device discovery
2. Smart head election
3. File transfer
4. Fault tolerance

Device Discovery

Every new device joining the network will broadcast its presence across the entire network. Already present devices in the network will update their devices list and will respond back to the new device. The new device will populate its devices list by listening to the response of its announcement. This way, all devices are updated with latest information.

Election Algorithm

1. Find devices with charging status. If there are more than one devices with charging status and battery level greater than 30%, select the one with highest combination of battery level and available memory from the charging ones.
2. Combination of battery level and memory is calculated as 0.75 * battery percentage + 0.25 * normalized available memory.
3. In case of no devices with charging status, select the device with highest combination of battery level and memory.
4. If new smart head is different than the old one, inform all devices in the network about the new smart head.

File transfer

File transfer is done using separate port from command port. We use TCP for file transfer. File is sent as raw bytes over the network. Smart head manages the initiation of file transfer by broadcasting file sending and receiving requests over the network. File is divided into different parts before sending, for load balancing purposes.

File Division Algorithm

We have performed weighted division of file as follows:

1. Calculate combination of battery level and memory as ((0.75 * battery percentage) + (0.25 * normalized available memory)) for each device.
2. Calculate percentage for each device by dividing the current device's combination by sum of all device's combination.
3. Multiply file size by the above percentage to obtain the part of file for each device.

Fault Tolerance

Whenever a device leaves the network, it will send QUIT command across the network. Other devices will remove all the associated entries with that device and will show the updated list to the user. If the dropped device was a smart head, election will take place again and new smart head will be elected.

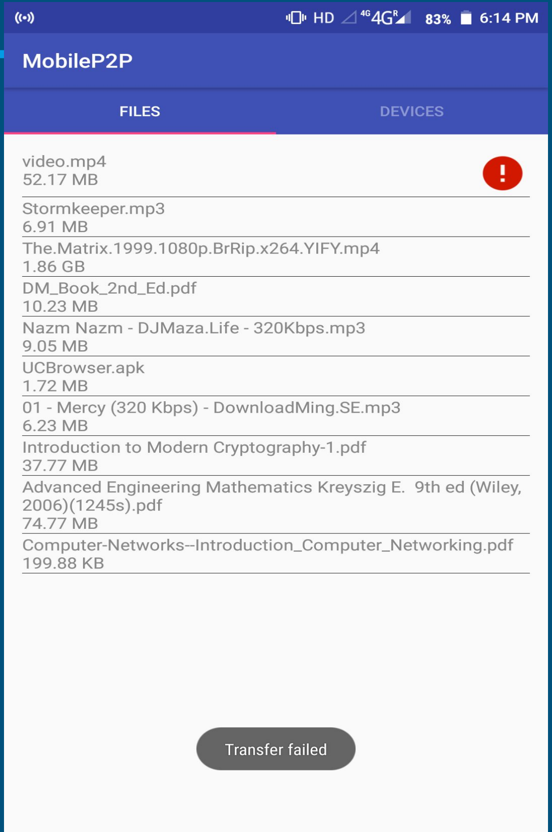
Results

For testing our claim, we selected a video file with size 52.17 MB.

- Transfer from one device took 25.41 seconds to complete.
- While, transfer from two devices took 18.3 seconds.

Hence, we can clearly see decrease in download time and increase in transfer speed.

Screenshots



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52.17 MB

Stormkeeper.mp3
6.91 MB

The.Matrix.1999.1080p.BrRip.x264.YIFY.mp4
1.86 GB

DM_Book_2nd_Ed.pdf
10.23 MB

Nazm Nazm - DJMaza.Life - 320Kbps.mp3
9.05 MB

UCBrowser.apk
1.72 MB

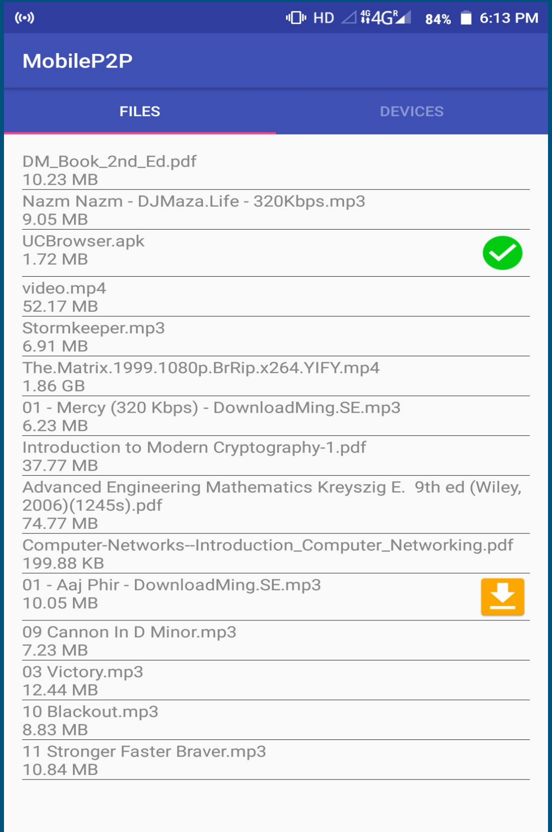
01 - Mercy (320 Kbps) - DownloadMing.SE.mp3
6.23 MB

Introduction to Modern Cryptography-1.pdf
37.77 MB

Advanced Engineering Mathematics Kreyszig E. 9th ed (Wiley, 2006)(1245s).pdf
74.77 MB

Computer-Networks--Introduction_Computer_Networking.pdf
199.88 KB

Transfer failed



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09 Cannon In D Minor.mp3
7.23 MB

03 Victory.mp3
12.44 MB

10 Blackout.mp3
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11 Stronger Faster Braver.mp3
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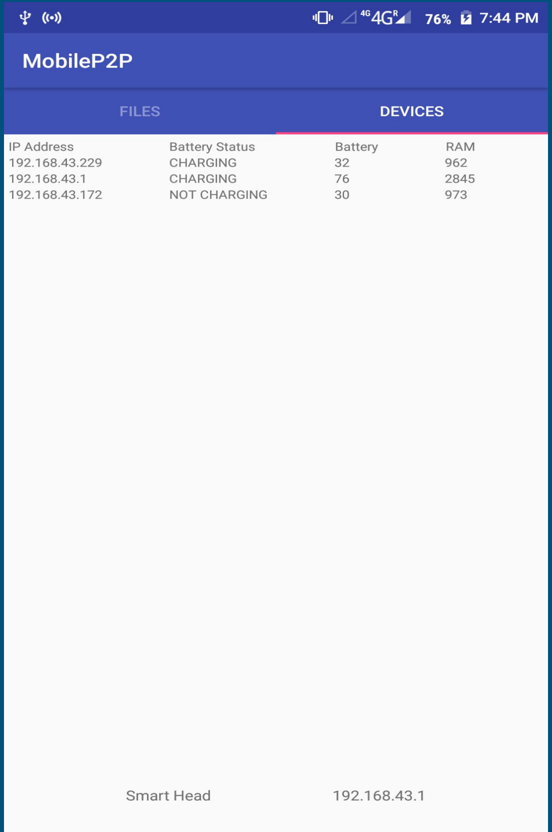

IP Address	Battery Status	Battery	RAM
192.168.43.229	CHARGING	32	962
192.168.43.1	CHARGING	76	2845
192.168.43.172	NOT CHARGING	30	973

Smart Head 192.168.43.1

Conclusion

As seen from results, our scheme achieved significant reduction in download time even for file size as small as 50 MB. Therefore, this scheme can replace traditional schemes in many areas. This will help reduce the amount of battery consumption and network bandwidth used in mobile devices.

Thank You