Bilkent University

Department of Computer Engineering

Senior Design Project

Project Specification Report

Project Name: PeerNews

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1. Introduction

Media has been the main channel of communication between people since the invention of printing press. Lately, technological development migrated media from printing press to internet. These technological developments enabled media content creators to reach broader range of people because of the improvements in cost effectiveness and latency. Thanks to internet media, everyone is able to participate actively as content creator in social media. As a result, people's expectations from media have changed. People started getting more and more concerned about privacy, security and freedom of speech.

Media distribution has been centralized starting from the times of printing press where powerful authorities controlled the content. Even though technological developments enabled everyone to share their ideas rather than just consuming media, internet media such as Twitter, Facebook remained centralized. Centralized media distribution means trusted authority has the ability to abuse their power and restrict the freedom of speech by not allowing certain types of content to be distributed.

Decentralized architectures are becoming more popular due to recent improvements in peer to peer networking technologies. Crypto currencies such as Bitcoin, Ethereum and the file sharing systems such as Bittorrent are popular examples of renowned decentralized systems. PeerNews will provide a decentralized approach to media distribution by creating a peer to peer network among users. This decentralized architecture will not have a single point of failure or central authority. Thus everyone's freedom of speech rights will be protected by design.

1.1. Description

PeerNews will be a desktop application targeting everyone who wants to participate in an absolutely independent media. Users are able to share and consume messages from various mediums such as image, video or plain text messages. When consuming content, users able to specify their preferences in order to filter and interact with the messages they are interested in.

PeerNews will consist of a peer to peer networking protocol and a client application. Messages will be used to create a torrent file. Hash of the torrent and several other attributes will be distributed through our own peer to peer network. Then we will make use of the existing torrent network to seed and download the actual content of the message which will be significantly larger in size. Client application will download the content of messages from the torrent network according to user preferences. Client application will receive message from the peer to peer network and display them to the user appropriately. For instance, comments or upvotes will be an arbitrary message under the protocol layer but on the client application, they will be shown under the respective post.

Small messages containing metadata and torrent hash will be broadcasted to the whole network through peers. Each node will share the message with a certain number of its peers when they receive the message for the first time. This approach is latency and bandwidth efficient since each node needs to forward the message to a constant number of peers (at least 2), and the farthest node is guaranteed to receive the message in logarithmic time. Messages will be reserved in the client application for a set period of expiration time. Thus, users that were offline at the initial broadcast time of a message will still be able to request it from their peers. Once the expiration time is reached offline users will not be able to receive the message anymore. We believe that temporary nature of the messages will create an environment for users to share more freely.

1.2. Constraints

1.2.1. Economic Constraints

- Application will be free of charge.
- Application will be open source with MIT Licence and community will do the maintenance and further improvements as open source contributors.
- Due to P2P nature of the architecture, client side of the application will consume more internet bandwidth than a usual social media product would.

1.2.2. Implementation Constraints

- Application will be a desktop application. A web version can be developed in the future.
- Github will be used for version control and development collaboration.
- Implementation will be done in Java mainly.
- All news will be transferred through the Torrent network. Users will upload the message to the Torrent network and receive its hash code. Then, they will share the hash code with their peers through the network.

1.2.3. Time Constraints

- The project will be finished in December, 2019.

1.2.4. Ethical Constraints

- Users will have absolute freedom of speech. Messages will not be sent through a server. Thus, there is no power above users which is able to ban or limit them.
- No information is hidden from anyone in the network. All data is public and will be transferred through the Torrent network.
- Since developers don’t have any control over what is shared on the network, in no event shall the developers be liable for any claim, damages or other liability.

1.2.5. Sustainability Constraints

- We will have our own nodes in the network for the purposes of monitoring. These monitoring nodes will alert developers when there is an unexpected error.

1.3. Professional and Ethical Issues

- Since no data is transferred through a server, no one (including us, developers) will be able to manipulate the data flow.
- Application does not operate anything other than its purpose considering privacy. Since it will be an open-source application, this can be seen by users as well.

2. Requirements

2.1. Functional Requirements

- Users will have the option to download the source code and build the application themselves.
- Users will be authenticated using a P2P authentication protocol similar to Bitcoin's public-key cryptography based system. [1]
- When a user joins the network, they will connect to a known peer which will assist this new node on connecting to other nodes in the network.
- Users will be able to create content and broadcast the message to the network.
- Torrent hash of the message will be shared with the network, then underlying torrent network will be used to seed and download the actual content which will have a significantly higher size.
- Users will be able to filter what messages to receive based on their preferences.

- Users will be able to fetch messages that were missed when they were offline for a certain period of expiration time which will be determined later on.
- Users will be able to upvote the news and messages they like. [2]
- Users will be able to sort their feed by number of upvotes. [2]
- Users will be able to give feedback about the network and application.
- Users will be able to write comments on messages from other users.
- Messages can be any kind of file. We will initially support plain text messages, images and videos.
- Users will be able to live stream videos. Live stream will be performed by distributing the video in 10 seconds of chunks as separate torrent files.
- There will be two separate feeds. The first feed will be ranked according to personal preferences and the second feed will consist of popular messages.
- Users will be able to share messages on their feed through existing social media products. This will drive growth.
- Users will be able to search on the metadata of the messages. Metadata will include tags and short description in addition to the torrent hash of the actual content.

2.2. Nonfunctional Requirements

2.2.1. Usability

- Interface will be user-friendly so that non-technical users are also encouraged to participate in the peer to peer network.

2.2.2. Scalability

- Since PeerNews does not have a centralized server, there cannot be an overload of users or messages. The performance issues are all related to the performance of WebTorrent.

2.2.3. Extensibility

- Users will be able to modify their client applications since it will be open source. This will allow for customizations on the client side.

2.2.4. Performance

- Latency of broadcasting a message should be less than 10 minutes in a crowded network of over 1 million nodes. Furthermore latency will be asymptotically bounded by O(logN) where N is the number of nodes in the network.
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2.2.5. Reliability

- Application will be running all the time. Users will always have access to PeerNews.
- Messages will be accessible as long as there is at least one online node with that message since there is no single point of failure. Crash of one node does not harm any other node in the peer to peer network significantly.
- For the distribution of the actual content of the messages, existing torrent network will be used. Since torrent is an already established peer to peer network message-content delivery will be reliable.

3. References

[1] “Managing Trust in Peer-to-Peer Systems.” *10 Best Practices for Secure Software Development | Security, Data and Privacy | Subject Areas | Publishing and Editorial | BCS - The Chartered Institute for IT*, ITNOWextra, Jan. 2006, www.bcs.org/content/conWebDoc/3059.

[2] Kamvar, Sepandar D., et al. “The Eigentrust Algorithm for Reputation Management in P2P Networks.” *Contents: Using the Digital Library*, ACM, 20 May 2003, dl.acm.org/citation.cfm?id=775242.