CS550 Programming Assignment 2 (PA#2)

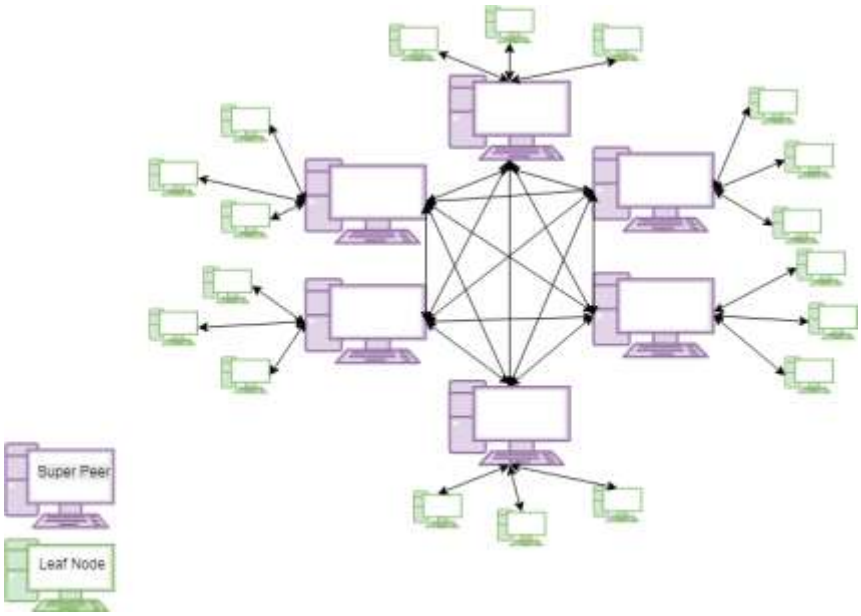
A Hierarchical Gnutella-style P2P File Sharing System

Abstract:

Gnutella was the very first decentralized P2P file sharing system. In Gnutella, there are no explicitly defined servers but rather the clients are used to search and retrieve data using messages. These clients are called peers where they communicate directly with each other. Since there is no central indexing server, the search is done in a distributed manner. Each peer also maintains the list of neighbouring peers.

In the programming assignment we are designing a hierarchical Gnutella-style P2P system. There are two types of peers in this network. One is called a leaf-node where it has only one connection open. And the other is called a super peer where it acts like a proxy indexing server and is connected to the other super peers. All leaf nodes register the files in the connected super-peer. Whenever a query request comes from a leaf node, the super-peer first searches the local storage i.e. checking whether it is present in its connected leaf nodes. If the file is not present in the local storage it broadcasts to all the super-peer neighbours.

System Design:



The Above diagram illustrates the hierarchical style P2P network where there are two types of peers, namely, the leaf nodes and the Super-peer.

1. Super Peer: The super peer behaves as a proxy indexing server for the leaf nodes. It maintains the list of all the files present in the local storage i.e. present in the connected leaf nodes. It also maintains its neighbours list.
2. Leaf Node: The leaf node registers its files to the connected Super peer.

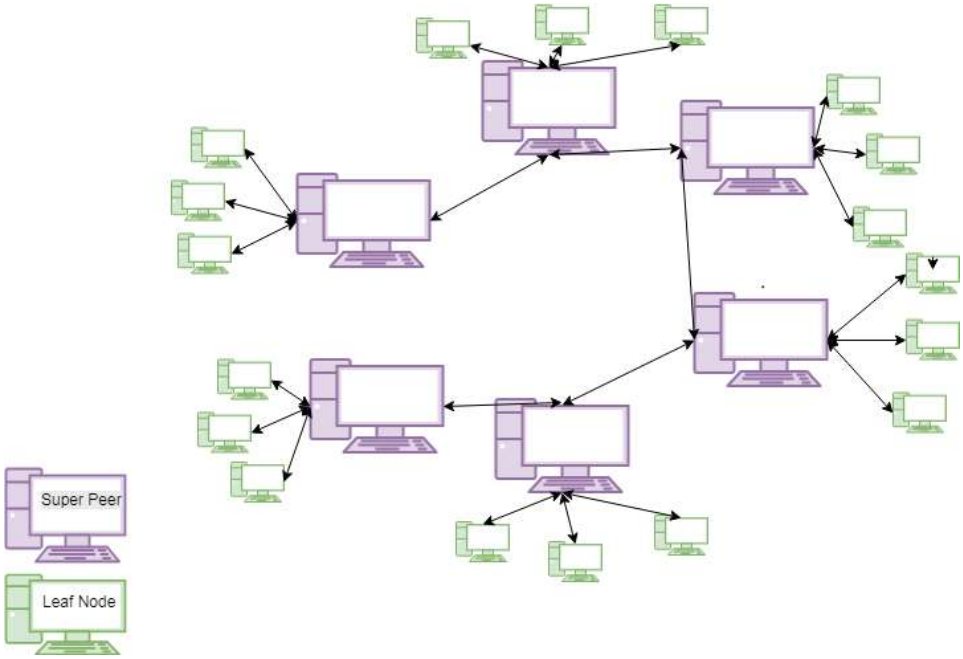
Implementation:

Configuration:

As we are not implementing a dynamic Gnutella network, we initialize and define the topology structure in the config properties file. We also declare the peer details, i.e. associated port number, IP address and the shared directory in the file.

The hierarchical gnutella has super peers. We define super peers as the peers which have more than one neighbours. The peers with only one neighbour are the leaf nodes that are connected to the super peer (the neighbour which is mentioned).

An Example of a Linear Topology:



Components of the Gnutella P2P System:

1. Peer:

   There are two types of peers in the system, namely a Leaf node and a super Peer.

   i. Leaf node: A leaf node is a normal client which registers its files to the super peer. It has methods to search for a file and download it.

   ii. Super Peer: A Super peer acts like a proxy indexing server to the leaf nodes. It maintains the list of all the files which are registered by the peer. Additionally it also maintains the list of all the neighbouring super peers.

2. Peer Interface:
    a. Obtain:

        The method used to download the file from one peer to another.
    b. Query:

        This is used to send out a query message asking for a file, where this is first checked in the local storage (Super peer's proxy index server) if found it returns else it broadcasts the query message to all the neighbours of the Super peer.
    c. Registry:

        A leaf node will register all the files it has with the super peer.

3. Hit Query:

    When a client sends a query asking for a desired file, it is broadcasted when the file is not present on the local storage. When the desired file is found on the network, the Hit query is executed which basically returns the location of the desired file i.e. the leaf node's IP address and port number. It also maintains the traversed path of the query message.

Design Trade-Offs:

1. Currently the network topology is statically defined and initialized using a configuration file.
2. There is no sophisticated searching algorithm present, but rather we only use exact string match.

Further Proposed Improvements:

1. One area of improvement is removal of static initialization. One could enhance it by configuring the peer in the network dynamically.
2. The ping and pong messages have not been implemented in the above system where one could survey the network and get to know the neighbouring peers, instead this is also initialized in the configuration file.
3. Time to live parameter is constant in the whole network, it does not grow as there is growth in the network.