Selective querying and other proposals for a congested Gnutella network

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INTRODUCTION

• Peer to peer systems do away with traditional client server models

• A peer can act as both SERver and cliENT, hence the name SERVENT

• Network congestion and look-up times are of prime concern in such networks
PEER TO PEER NETWORKS

• Peer to peer (P2P) networks, such as Gnutella, is of the Distributed type

• Gnutella has evolved from version 0.4 to 0.6 and finally 2.0

• The main disadvantage of P2P: Initial messages sent in BFS fashion, hence consumes a lot of bandwidth

• Caching of messages to handle this problem, incorporated from version 2.0
THE GNUTELLA PROTOCOL

Messages:

PING: Used to actively discover other servants on the network

PONG: A response to a ping

QUERY: A mechanism for distributed data searching in Gnutella environment

QUERYHIT: A response to a Query message suggesting that a match has been found

PUSH: a mechanism by which a servant behind a firewall forwards a file to another servant
THE GNUTELLA PROTOCOL

Initial PING - PONG messages

1. Asking nodes

Forwarding the messages

2. Broadcasting the message

Data transfer from a peer

3. Sending to node
# Packet Formats

## Ping Packet:

<table>
<thead>
<tr>
<th>Desc Id</th>
<th>Payload Descriptor</th>
<th>TTL</th>
<th>Hops</th>
<th>Payload length</th>
</tr>
</thead>
</table>

## Pong Packet:

<table>
<thead>
<tr>
<th>Port</th>
<th>IP Address</th>
<th>No. of files shared</th>
<th>No. of Kb shared</th>
</tr>
</thead>
</table>
CONTRIBUTION

• Selecting profitable peers
  • A subset of the positive respondents are selected
  • Query message sent only to them
  • Reduce unnecessary bandwidth consumption

• PONG packet header changes
  • ‘IString’ field in PONG packet to reveal more information

• Handling asymmetric peers
  • Download speed of a host is 3 to 8 times faster than Upload
PO NG  PA CK E T  C H A N G E S

Standard PONG packet

<table>
<thead>
<tr>
<th>Port</th>
<th>IP Address</th>
<th>No. of files shared</th>
<th>No. of Kb shared</th>
</tr>
</thead>
</table>

‘Istring’ field replaces ‘No. of files’ shared

Istring: Indicates not just the no. of files shared, but also the no. of files beginning with a particular letter

Eg: 2a4b3c14p23r means 2 files starting with ‘a’, 4 with ‘b’…
Algorithm to select profitable peer

- IString format: \( w_1a_1w_2a_2w_3a_3…w_ia_i…w_na_n \)
  
  where \( w_ia_i \) means \( w_i \) files beginning with \( a_i \)

- After a host receives a no. of PONGs, we calculate \( W_{tot} = \text{Summation}(W_i) \) for \( i=1 \) to \( i=k \), for a given \( a_i \)
  
  \( k = \) total no. of pongs

- Probability of finding a file beginning with alphabet \( a_i \) is 
  \( P(F_i) = w_i / W_{tot} \) where \( i=1,2,3…k \)

- Selecting a profitable peer is hence a function of Probabilitity and HopCount
ILLUSTRATION

Hop 0

Hop 1

Hop 2

Np=5
Pr=5/30

Np=17
Pr=17/30

Np=8
Pr=8/30

Np=12
Pr=12/50

Np=18
Pr=18/50

Np=10
Pr=10/50

Np=10
Pr=10/50

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Discussion of the Algorithm

• We have 3 nodes at hop = 1 and 4 nodes at hop = 2
• The probability for a node to possess the queried file is mentioned alongside the node
• We notice at Hop = 1, the second node, with Max probability, also possesses the queried file
• We also notice at Hop = 2, the second node is most probable to possess the queried file, but the first node actually possesses it

• Hence we can conclude that most probable node is not always the most profitable, but it reduces our search space considerably
ASSYMMETRIC PEERS

• When the Queried host is behind a firewall, downloading of data is not possible

• In this case, a PUSH command is sent, which makes the queried host send the file to the querying Host

• This is a case of Uploading for the Queried host, rather than Downloading for the Querying host

• Upload is 3 to 8 times slower than download, especially in ADSL/cable connections

• This increases the data transfer time considerably
ADVANTAGES & DISADVANTAGES

• Advantages:
  
  • Selecting a node depending on the ‘No. of files shared’, converges closer to the desired file
  
  • Concurrent search could be conducted on each word of the queried file name, leading to optimised search

• Disadvantages
  
  • A file name like, ‘A Nice Song.mp3’, could be saved as ‘Nice song.mp3’, by a particular node
  
  • In that case, the algorithm needs to adjust the queried filename, for similar use cases
SETUP AND IMPLEMENTATION

• Simulation of the Gnutella network
  • Independent processes act as nodes
  • Processes exchanged messages as per the specification
  • Hops and delays were preset
  • We use a single threaded lookup approach
  • A n-threaded lookup approach, where n is the no. of characters in the filename, can also be implemented
  • Lookup times improve considerably
FUTURE WORK

• Further analysis and study of a Distributed hash table approach for Gnutella

• DHT based research – Pastry, Chord and Content Addressable Networks

• Hosts required to store content based on hash calculated on a file object

• A more closer simulation of Decentralised AdHoc networks for more accurate testing
THANK YOU

- All of you here, for your valuable time
- It is my first attempt to present my work at a conference of this magnitude, so thank you all for bearing with me
Questions and Queries

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