



Lab Class *Protocol-Design*

P2P-Overlay, Part III



P2P-Protokol, Version 0.1

Optimized Forwarding

- Flooding very inefficient
 - many more message copies than needed
 - additional overhead for detecting duplicates
 - unnecessary high network load
- Ways to optimize forwarding:
 - Layer 2 like (e.g., learning switches)
 - Layer 3 like (routing)



P2P-Protokol, Version 0.1

Optimized Forwarding

- Layer-2-like: similar to smart Ethernet switches
- For every extract remember:
 - original sender of message
 - incoming link / neighbour
- Forwarding of messages using this table:
 - if we get messages sent by a node over a connection, then we can reach this node using this connection (at least for some time)!
- Table called '*Forwarding Table*'



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Optimized Forwarding

- Automatically learns paths
- Problems:
 - Stale entries when nodes die
 - > use timeouts to remove/replace old entries
 - > refresh with new packets
 - What to do when learning other paths
 - > store TTLs, higher TTL means nearer



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Optimized Forwarding

■ Algorithm - Learning

- extract Node-ID of originator (FROM) from message
- Enter new / replace existing entry:
 - using originator Node-ID as key
 - replace if better TTL
 - store neighbour/connection, TTL and timestamp
- If neighbour dies, remove all entries using this neighbour

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Optimized Forwarding

- Algorithm - Forwarding
 - Update Forwarding Table (learning)!
 - lookup *destination* Node-ID in table (FOR)
 - if found
 - if(now - timestamp) < 120 sec // entry is up-to-date
 - forward over connection/neighbour found in table
 - else // entry too old
 - remove entry
 - flood
 - if not found
 - flood



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Automated Session Setups

- Inconvenient to establish connections manually
- Solution:
 - use NEIGHBOUR info from HELLO-Handshake
 - automatically uphold 4 active connections



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Automated Session Setups

- Send neighbour Node-IDs during HELLO-Handshake
- store received NEIGHBOUR list in queue (FIFO)
- After successful session setup:
 - Store Node-IDs learned during HELLO-Handshake in queue (no duplicates!)
 - while less than 4 active connections, connect to nodes from queue



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Automated Session Setups

- What about failed connection attempts?
 - remove Node-ID from queue, try next one
- What to do if an active connections dies?
 - add Node-ID of neighbour to queue
- How to recognize if an *active* connection has died?
 - mark connections as being active



P2P-Protokol, Version 0.2

- Protocol in version 0.1 too limited
 - cannot transport user data
=> no downloads/uploads possible
 - doesn't support additional message parameters
 - doesn't support multiple applications
(aka. port numbers)

P2P-Protokol, Version 0.2

- Solution: do it like HTTP :-)
 - Separate message header and body
=> allows user data transfer
 - allow multiline headers
=> allows additional parameters
=> can distinguish different applications,
e.g., file transfer, routing protocol, ...

P2P-Protokol, Version 0.2

- Message format: Header
 - multiline
 - first line like version 0.1, but P2P/0.2
 - contains one or more option lines:
 - <parameter> : <value> \r\n
 - e.g. Content-Length: 0
 - header ends with empty line (\r\n)

P2P-Protokol, Version 0.2

- Message format: Body
 - up to 2048 bytes (2K) in size
 - may be empty

 - Size of body as message option!
Content-Length: 2048
 - If empty (= no body)
Content-Length: 0

P2P-Protokol, Version 0.2

- Handshake Messages:
 - needs empty line...
 - but no parameters or body
- Mandatory header parameters for **non-handshake** messages:
 - Content-Length
 - Application
- For **all non-handshake** messages so far:
 - No body: `Content-Length: 0`
 - No Application: `Application: none`

P2P-Protokol, Version 0.2

■ Implementation Issues

- before reacting to messages, first need to read messages **completely!**
- Must not intersperse message parts!
First process and forward one message before looking at next one!

P2P-Protokol, Version 0.2

- Reading messages (assumes non-blocking I/O)

```
check $sock->eof() and $sock->error()
# might take multiple entries into while() loop to read
# complete message -> keep per-Connection array to
#                               store header lines
while ($line = <$sock>) {
    # check header end
    if($line eq "\r\n") {
        # now have complete message header!!
        # lookup 'Content-Length: <size>' in @msg
        # read size bytes of body

        # NOW have complete message!!
        # process message in @msg
        # delete message
        @msg = ( );

    } else {
        # append $line at end of @msg
    }
}
```