Internet Technology & Web Engineering
Internet Relay Chat (IRC)

Dipl.-Inform. Matthäus Wander

Universität Duisburg-Essen

Overview

- Distributed system for real-time text chat
- Users have nicknames
- One-to-one chat between users
- One-to-many group chat in channels
- Multiple independent networks co-exist
- Each network consists of 1..n IRC servers
- Started in 1988, first RFC 1459 appeared 1993
- Current RFCs 2810-2813 are outdated
  - RFCs describe version 2.10, reference implementation is 2.11
 - Other networks use adapted server software

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IRC Client

Architecture

- Client/Server
  - Control data shared by all servers
  - Chat messages routed as needed
- Multicast tree structure (no cycles)
- All servers trusted in a network
  - Manual setup of server links
- Text-based data transfer
- TCP connections
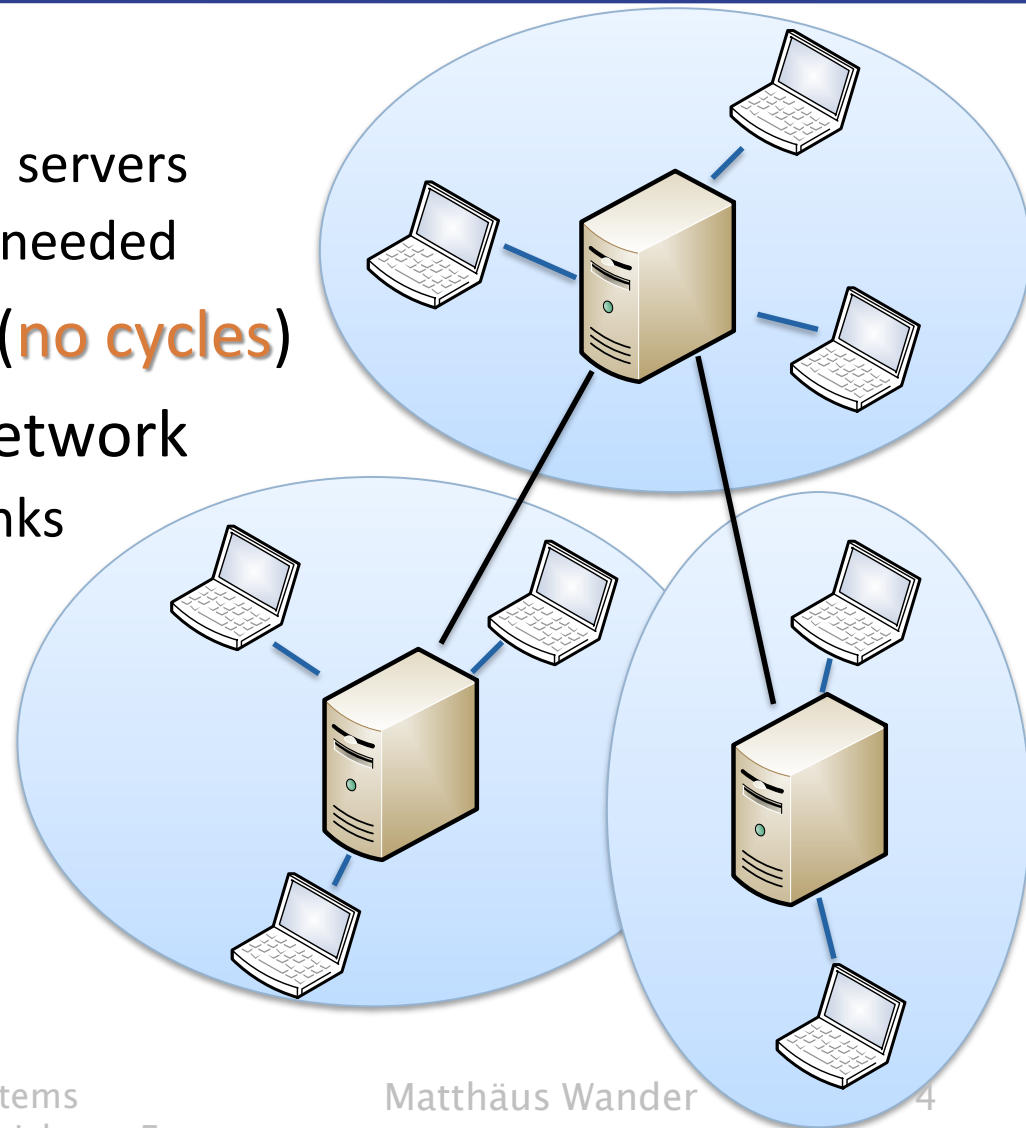
IRC Protocol

- Text-based protocol
  - 8-bit messages except NUL (0x00), CR, LF
  - No character set specified (usually ISO 8859-1, recently UTF-8)
  - Nickname characters: A..Z, a..z, 0..9, {, |, }, ~, [, \,], ^, `, _, -

- Stateful session

- Asynchronous message communication
  - No strict command/reply – reply may follow later

- Authentication optional
  - Plaintext login/password (rarely for users)
  - DNS Hostname Lookup

- SSL/TLS optional (rarely for users in popular networks)

Example Client Session

```
NICK Bob
USER Bob Bob random.ircd.de :Robert Example
:Uni-Erlangen.DE 020 * :Please wait while we process your connection.
:Uni-Erlangen.DE 433 * Bob :Nickname is already in use.
NICK MightyBob
:Uni-Erlangen.DE 001 MightyBob :Welcome to the Internet Relay Network
    MightyBob!~Bob@example.net
:Uni-Erlangen.DE 002 MightyBob :Your host is Uni-Erlangen.DE, running
    version 2.11.1p1
[...]
JOIN #example
:MightyBob!~Bob@example.net JOIN :#example
:Uni-Erlangen.DE 332 MightyBob #example :This is some topic
:Uni-Erlangen.DE 333 MightyBob #example Alice!~alice@example.net
    1331976347
:Uni-Erlangen.DE 353 MightyBob = #example :@Alice @Bob MightyBob
:Uni-Erlangen.DE 366 MightyBob # example :End of NAMES list.
PRIVMSG #example :What's up, guys?
:Alice!~alice@example.net PRIVMSG #example :Nothing much
QUIT :boooring
ERROR :Closing Link: MightyBob[~Bob@example.net] ("boooring")
```

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Message Format

`JOIN` `#example`
`:Uni-Erlangen.DE` `433` `* Bob :Nickname is already in use.`
`:Alice!~alice@example.net` `PRIVMSG` `#example :Nothing much`

- Prefix (optional)
  - Client: unused
  - Server: Indicates command originator
- Command
  - Literal or numeric
- Up to 15 command parameters separated by whitespace
  - Colon („:") indicates last parameter
  - Last parameter may contain whitespaces
- Line length ≤ 512 characters (including CR LF)

Channels

- Users can join and part channels
- First user joining becomes channel operator
  - Can give operator privilege to other users
  - Operator(s) can change channel modes, invite/kick users, …
  - User loses privilege when leaving/disconnecting
- Operators set/unset channel modes
  - MODE #foo +o Bob: give operator privilege
  - MODE #foo +b *!*@*.de: ban hostmask (prohibit joining)
  - Other modes: moderated, invite only, channel password, etc.
- Channel prefix determines type, e.g. #example
  - # regular (mostly used)
  - + modeless (no operators)

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Server-to-Server Connections

- All IRC servers in network must know all other servers, users, channels and modes
  - Scalability issues in large networks

- No redundant pathes (acyclic network graph)
  - If server link breaks down, the network splits

- If servers connect to each, the network joins
  - Servers exchange known servers, users, channels and modes

- Nickname collision → drop both („KILL" message)
  - Abuse netsplits to drop other users

- Channel collision → merge users with their privileges
  - Abuse netsplits to obtain chanop (channel takeover)

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Handling Collisions

- ## Nickname/channel delay during netsplit
  - Known nicknames remain blocked
  - Known empty channels don't give chanop

- ## Timestamping creation time of nickname/channel
  - Nicknames/channels remain available during netsplit
  - When network joins, the older ones are privileged

- ## Assign unique user IDs
  - If nickname collides, rename both users to their IDs

- ## Still, propagation delay can desync a channel

MODE #example
-o Bob

Alice

MODE #example
-o Alice

Bob

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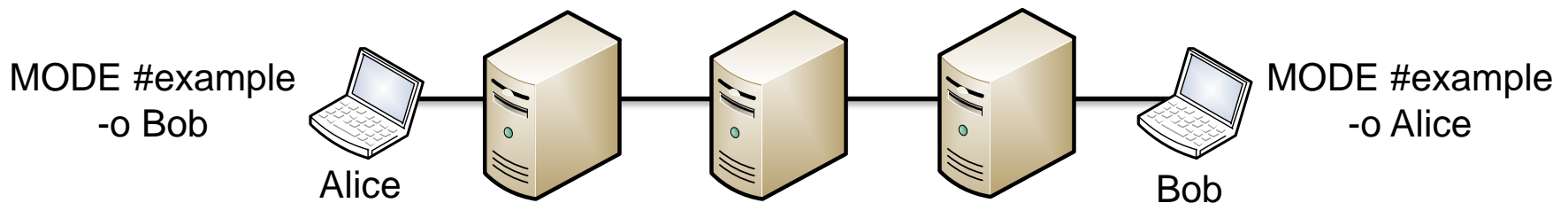
Connection Timeout & Flood Control

- PING message to detect connection timeouts
  - PING must be replied with PONG
- Users can cause high traffic in network
  - Channel hopping, spamming users on other server
- Flood control with „penalty" seconds
  - For every user message, process and add +2 penalty seconds
  - Penalty decrements when nothing is received (minimum: 0 sec)
  - Do not process messages if penalty $\geq$ 10
  - May add penalty seconds for ressource-intensive messages
- Allows for small bursts of up to 5 messages
- Drop user („Excess Flood") if input buffer overflows

Conclusion

- Distributed real-time chat system
- Name collisions (drop other users, obtain chanop)
  - DDoS attacks against IRC networks to cause netsplits
  - Technical measures to reduce exploitation of collisions
- Still, consistency is **not** enforced (channels can desync)
- Scalability is limited, but not a serious problem anymore
  - Ressources increased, number of users decreased
- RFC specification outdated
- No user privacy (see SILC for a secure system)