GÉANT
Networks • Services • People

Instant Messaging Security and Privacy

Chat and more while safeguarding your privacy

Klaus Möller
WP8-T1

Webinar, 24th of September 2020

Public

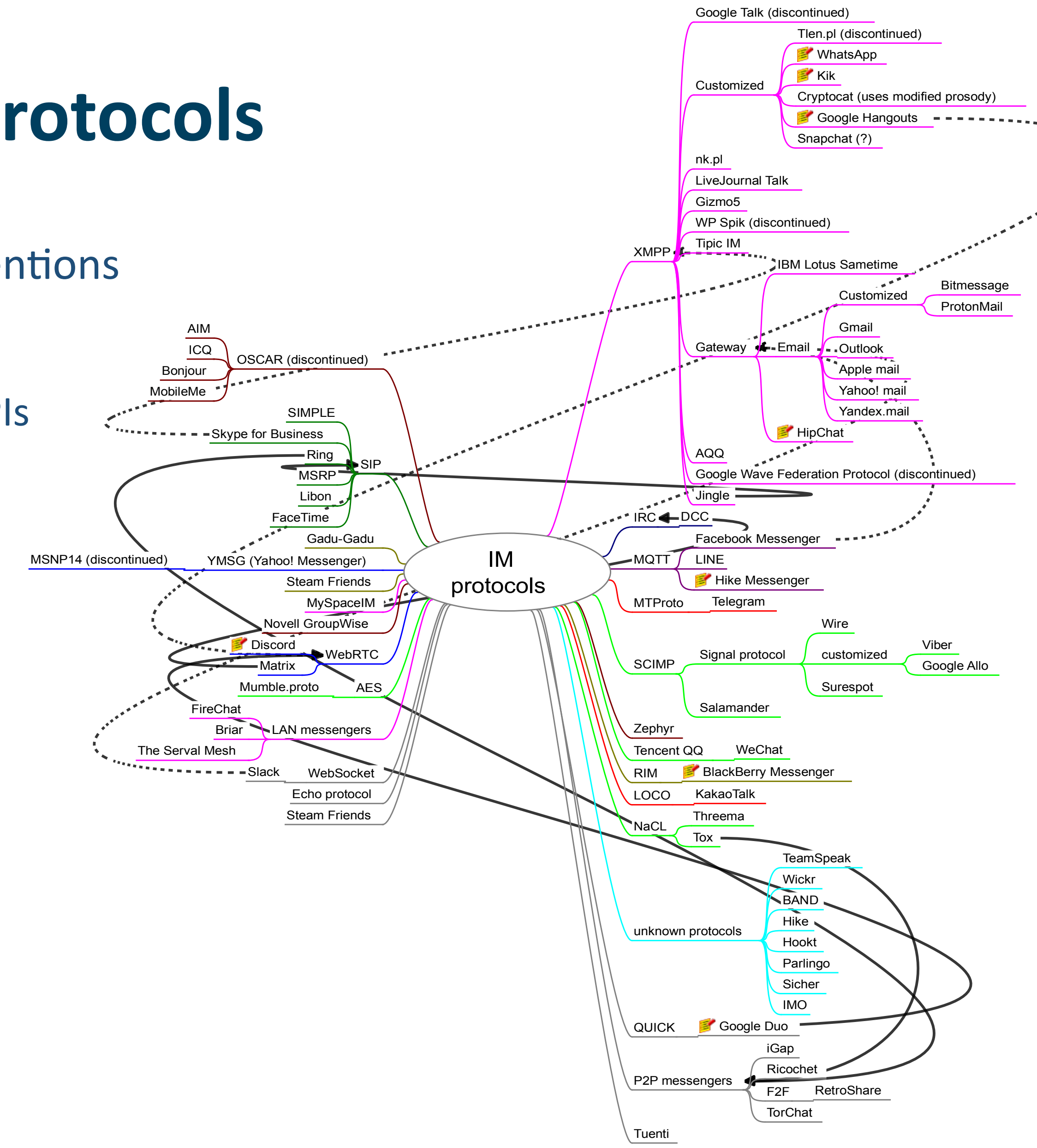
www.geant.org

Instant Messaging (IM) Introduction

- Other names: *Mobile Messaging* or simply *Online Chat*
- Originally: Sending (small) text messages to other users
  - First: on the same computer, later: world wide
  - User (person) had to be online to receive message
    - Some systems allow delivery from server later
    - Or use Chat-Bots (workaround in the beginning)
- Not limited to text anymore
  - Photos, Sounds, Video
  - File transfer between users
- Additional feature of Voice-/Videoconferencing systems

Instant Messaging Protocols

- Wide variety, some notable mentions
- HTTP(s)
  - As part of WebRTC or REST APIs
  - Discord, …
- SIP (Telephony)
  - Skype, Facetime, …
- SCIMP, NaCl
  - More secure messaging
  - Signal, Element(Riot)
  - Threema
- IRC, XMPP, …
  - Legacy?



Centralized Instant Messaging Networks

- One central authority administers one or more central servers
- All users connect to these servers
- Facebook Messenger, Microsoft Live, etc.

- Pros:
  - New features can be added quickly
  - Fast updates (if clients are also centrally administered with auto-updates)
  - Few interoperability problems
- Cons:
  - At the mercy of the operator (Dishonesty, policy changes)
  - Transparency? (Code reviews, independent audits)
  - Connecting your own client? (Protocol or API documentation?)
  - Government backdoor?

DFN DEUTSCHES FORSCHUNGSNETZ DFN CERT®

GÉANT

Federated Instant Messaging Networks

  - Many authorities administer their own server(s)
  - Servers are interconnected to form a (backbone) network
  - Users connect to server of their choice, but still see (one) unified network
- Pros:
  - More control/trust over servers (if provided by a trusted party)
  - Can run your own server on premise
  - Source code (may be) available for review
- Cons:
  - Interoperability requirement makes modification of IM protocol difficult
  - Users have to trust their server operator
  - Conflicts between server operators may lead to network splits

Peer-to-Peer Instant Messaging Networks

- No servers, clients find each other through P2P mechanisms

- Pros:
  - Very little information exposed, nothing kept on servers
  - E2EE by design (if encryption is part of the protocol)
- Cons:
  - How to initially connect to the network?
  - No asynchronous delivery via server
    - But client may send message later
  - IP-address still visible on the internet - P2P networks may be crawled
  - Connectivity in the presence of NAT and Firewalls?
  - Staying on the P2P network requires constantly sending keepalives, even if user is inactive
    - Drain on mobile device battery

General IM Risks

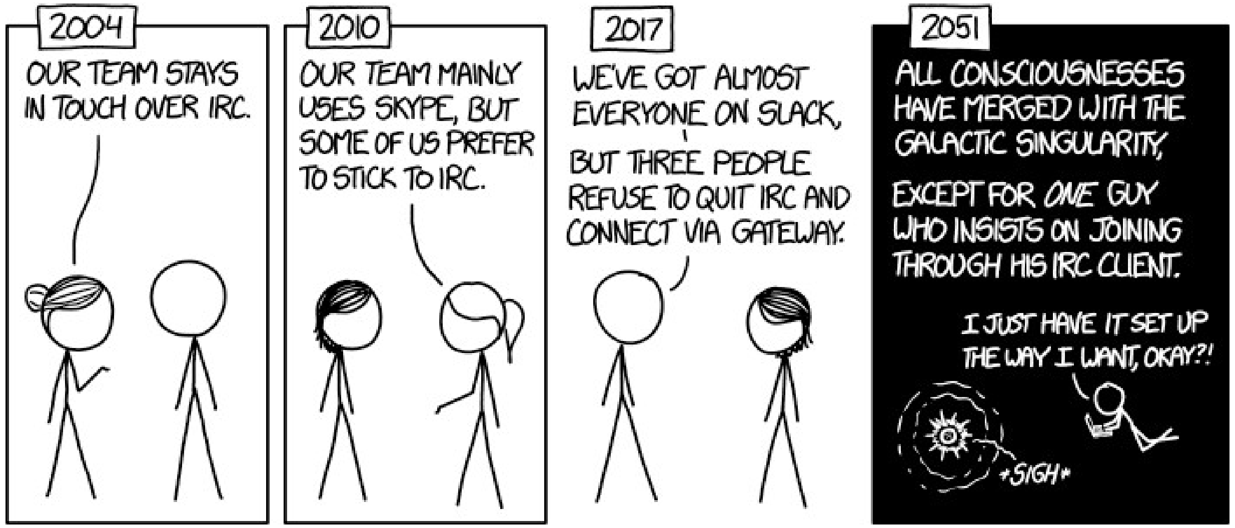
- Implementation Errors
- Identity theft
- Reputation
- Malware download
- Data exfiltration
- Botnet Command & Control Channels
- SPIM
- Archiving requirements, eDiscovery

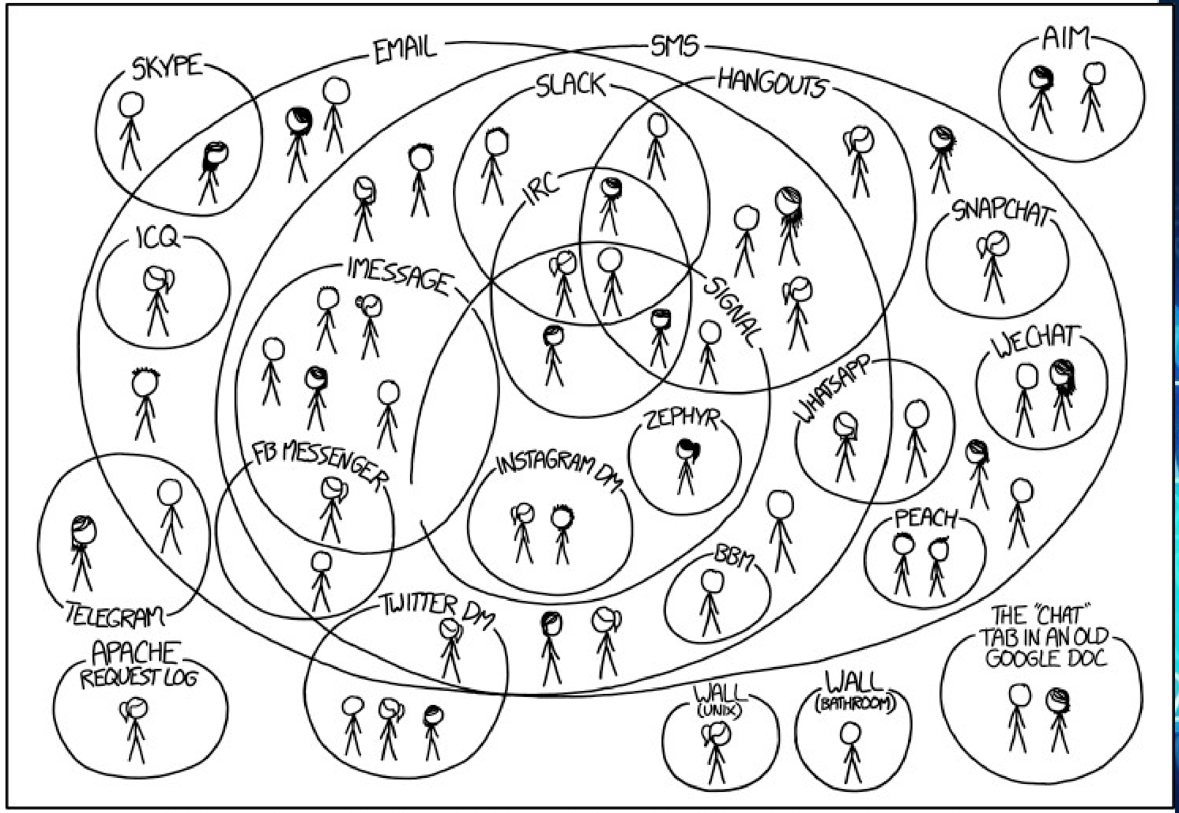
Implementation Errors

- They happen and IM software is no exception
  - Client- & Server-side
- If security relevant: vulnerability
  - Server/Client is reachable from the internet: Worldwide exposure
- Mitigation
  - Patch: As soon as possible (Auto-Updates)
  - Reduce attack surface: Enable only the features/functionality you really need
  - Easiest to fix on centralized networks, OTOH: software monoculture

Identity

- Who is reachable how?
- And is this really the person you want to talk to?


2004
OUR TEAM STAYS IN TOUCH OVER IRC.
2010
OUR TEAM MAINLY USES SKYPE, BUT SOME OF US PREFER TO STICK TO IRC.
2017
WE'VE GOT ALMOST EVERYONE ON SLACK, BUT THREE PEOPLE REFUSE TO QUIT IRC AND CONNECT VIA GATEWAY.
2051
ALL CONSCIOUSNESSES HAVE MERGED WITH THE GALACTIC SINGULARITY, EXCEPT FOR ONE GUY WHO INSISTS ON JOINING THROUGH HIS IRC CLIENT.
I JUST HAVE IT SET UP THE WAY I WANT, OKAY?!
SIGH



I HAVE A HARD TIME KEEPING TRACK OF WHICH CONTACTS USE WHICH CHAT SYSTEMS.

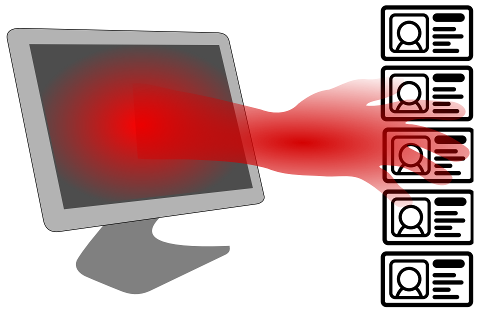
https://xkcd.com/1810

https://xkcd.com/1782

Identity: Problems

- Problem 1: Finding the person we're looking for
  - Central directory/search not on all networks (most often on centralized ones)
  - Real names do not need to have a relation to the ID on the network
    - Pseudonyms (may be necessary for self help groups, etc.)
    - Or just cool nicknames
  - Is the same name the same person on a different network?
- Problem 2: How do we know it is the real person?
  - Name collisions (John Smith)
  - Similar looking names (JohnnyS389, JohnnyS999, JohnnyS007, …)
  - Deliberate Fakes (the_real_john_smith)
  - Phone number?

Identity: Theft



- I.e. your credentials to the IM network are compromised
  - Or even more, depending on whats in the directory
- Or someone creates an account with your name before you do
- Complain with the operators
  - How do you prove you are you?
  - And why should you have more rights to a name than the other person with the same name?

☑ Keep a good watch on your login credentials & logins

- ☑ Enable notifications from your ID provider for logins from unfamiliar sources
- ☑ Use 2FA if possible

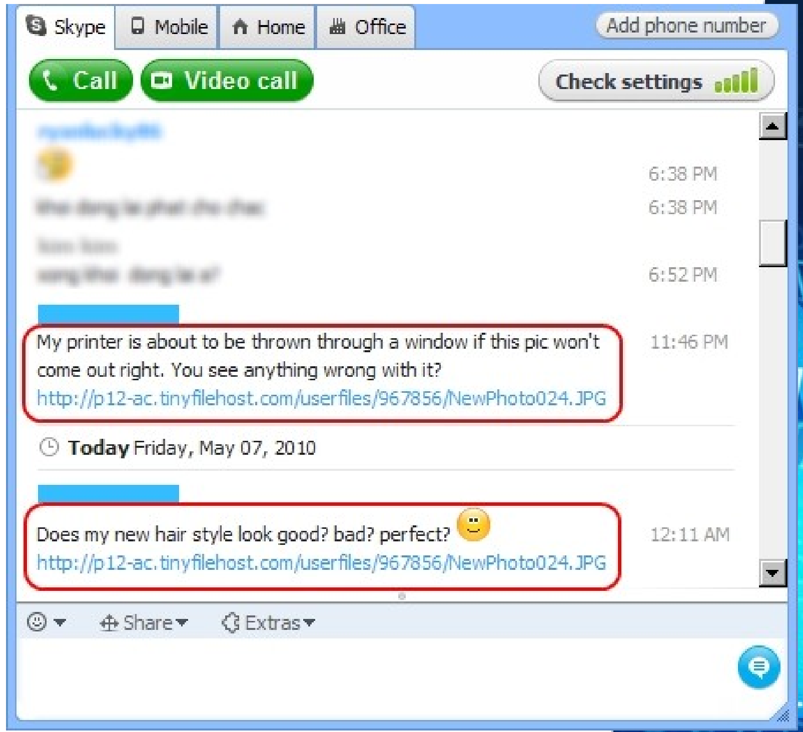
☑ Use external sources to verify the identity of persons behind accounts

- ☑ Email, web pages, public keys, meet face-to-face

Malware Download

- Most IM protocols allow to download/share files
  - IRC, XMPP, …
- Malware can be sent over these links
  - Custom protocols often not scanned
  - Esp. if the communication link is encrypted
- Or indirectly through HTTP links
- Esp. problematic if download is accepted automatically

☑ Disable that feature in your client, or disable downloads completely



6:38 PM
6:38 PM
6:52 PM

My printer is about to be thrown through a window if this pic won't come out right. You see anything wrong with it? http://p12-ac.tinyfilehost.com/userfiles/967856/NewPhoto024.JPG 11:46 PM

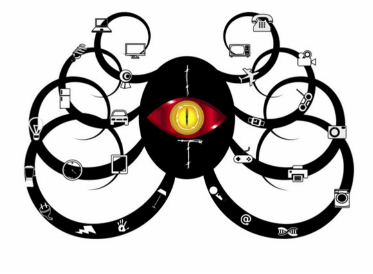
Today Friday, May 07, 2010

Does my new hair style look good? bad? perfect? http://p12-ac.tinyfilehost.com/userfiles/967856/NewPhoto024.JPG 12:11 AM

Data Exfiltration

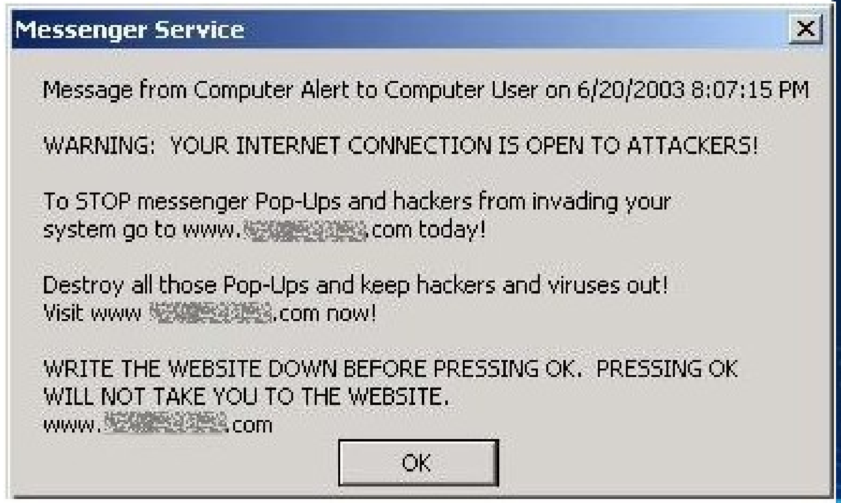
- Similar to Malware downloads, but in the other direction
- Can be used to send sensible/private information to outside parties
  - HTTP(S) or E-Mail often scanned by proxies/firewalls
  - Custom IM protocols usually not, esp. if encrypted
- How?
  - Accidentally
  - Intentionally (insider attack)
  - Client/account taken over or attacker mimics IM traffic
- Be careful when sending files
- Watch for unusual traffic patterns
  - Different servers (DNS), amount of traffic, etc.

Botnet Command & Control



- IM context: While user is offline (or occupied) a program can work as a stand-in
  - Bot: Program that holds connection to the IM network/channel
  - Level of functionality depends on programming
- Bot as Malware
  - Bot as a method to remotely control a system
  - For sending SPAM, conducting DDoS, exfiltrating data, etc.
  - Bots with connection to IRC channels (much declined, but still there)
  - Today: HTTPS connections
  - Rare: Bots with other IM protocols (JabberBot: XMPP)

SPIM


Messenger Service

Message from Computer Alert to Computer User on 6/20/2003 8:07:15 PM

WARNING: YOUR INTERNET CONNECTION IS OPEN TO ATTACKERS!

To STOP messenger Pop-Ups and hackers from invading your system go to www.[redacted].com today!

Destroy all those Pop-Ups and keep hackers and viruses out! Visit www [redacted].com now!

WRITE THE WEBSITE DOWN BEFORE PRESSING OK. PRESSING OK WILL NOT TAKE YOU TO THE WEBSITE. www.[redacted].com

- **SP**am over **I**nstant **M**essaging
- Text with links or images sent through IM
- Primarily on public networks with open groups
  - Also on private servers, if not sealed off from the internet
- Mitigation
  - ☑ Block/Ignore/Ban/Report SPIM account – spammer will move to another
  - ☑ Stay on invite-only groups/channels – doesn't work if IM net allows direct messages (once your ID is known)
  - ☑ Receive only messages from IDs on your contact list – may get in the way of finding new contacts
  - ☑ Limiting the number messages users can send (server-side)

Archiving

- Laws may require relevant communications/documents to be archived
  - HIPPA, Sarbanes-Oxley, etc.
- This will include IM data if used for business relevant communication
- Legal Risk: What if IM data is not preserved/archived?
  - Related Problem: How to find communications/documents in the organizations archive/storage (eDiscovery)
- May collide with E2EE
  - Key escrow for business?
- OTOH: How long to keep logs of sessions (privacy protection)

  ☑ Check the logging settings of client (and server)

Encryption

- Most desirable: End-to-End Encryption (E2EE)
  - Messages get encrypted at the sender and decrypted by the receiver
- Second best: Transport Encryption (most often: TLS)
  - Message is encrypted on the way to the server, but unencrypted there
- Problem: Nontransparent, it is often unclear whether
  - Is encryption is used by default?
  - Is it E2EE or Transport Encryption?
  - What crypto-algorithms/key lengths are used?
  - Do the algorithms allow Forward Secrecy?
  - Do the algorithms allow deniability?

Encryption: Key Management

- With the messages encrypted, how is the key management done?
- By the network/server operator?
  - Must be trustworthy
  - Transparency of the process?
  - Can users notice when the operator changes or discloses keys?
- By the end user?
  - Eliminates the trust problem with the network/server operator
  - But must be done right
  - Do they have the required knowledge?
  - How is the key publication/revocation done?

Deniable Authentication in Instant Messaging

- Cryptography enables encrypted and integrity protected messages
  - But: The sender can’t deny that messages were from him
  - This “non-repudiation” property is often desired
  - I.e. business communications
- Use case/problem: Outsider breaks into channel (i.e. knows session key)
  - Can participants (later) deny that messages were send by them?
  - While still maintaining integrity (among them)?
- Why?
  - Participants may face prosecution (i.e. dissidents, whistle-blowers, ...)

Deniable Authentication Protocols

- Basic Idea: Authentication/Integrity Key is derived from the session key
  - If outsiders can get/break the session key, they also get the authentication key
  - And can thus forge (authentic) messages
  - So all participants can later deny that a message was sent from them
  - While the session key is unbroken, everything is fine (for the participants)
- Sample Protocols:
  - Off The Record (OTR) Messaging
    - On top of other protocols like XMPP, often through plug-ins
  - Silent Circle Instant Messaging Protocol (SCIMP)
    - Client: Silent Circle Phone

Deniable Authentication Caveats

- Metadata analysis of communication is still possible
  - Esp. for P2P-Networks
  - Need for VPN/TOR
- Human factor
  - What if somebody records the messages?
  - Someone discloses who was participating
- Endpoint security
  - I.e. somebody breaks into your device
- Legal
  - Judges have to believe in the cryptographic (technical) argument
  - As of yet unproven in courts

Instant Messaging Recommendations

- By the Electronic Frontier Foundation (EFF)
  - Communications encrypted in transit between all the links in the communication path
  - Communications encrypted with keys the provider does not have access to (E2EE)
  - Users can independently verify their correspondent's identity eg. by comparing key fingerprints
  - Past communications are secure if the encryption keys are stolen (forward secrecy)
  - Having the source code open to independent review (open source)
  - Having the software's security designs well-documented
  - Having a recent independent security audit

DFN DEUTSCHES FORSCHUNGSNETZ DFN CERT

GÉANT

Instant Messaging Recommendations (cont.)

- Further (recommendations to users)
  - ☑ Do not log or store any information regarding any message or its contents
  - ☑ Do not log or store any information regarding any session or event
  - ☑ Do not rely on a central authority for the relaying of messages (decentralized computing)
- Recommended Messengers (from `privacytools.io`)
  - Centralized: Signal
  - Federated: Element (formerly Riot)
  - P2P: Briar, Jami

GÉANT
Networks • Services • People

Thank you

Any questions?

Next module: ***Videoconferencing Security & Privacy***

28th of September 2020

www.geant.org

© GÉANT Association on behalf of the GN4 Phase 2 project (GN4-2).
The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under Grant Agreement No. 731122 (GN4-2).

References

- JabberBot Analysis: https://www.welivesecurity.com/2013/01/30/walking-through-win32jabberbot-a-instant-messaging-cc/
- XMPP based botnet: https://blog.checkpoint.com/2015/08/31/global-xmpp-android-ransomware-campaign-hits-tens-of-thousands-of-devices/
- EFF Recommendations: https://web.archive.org/web/20191022070029/https://www.eff.org/node/82654
- OTR: https://otr.cypherpunks.ca/index.php
- SCIMP: https://netzpolitik.org/wp-upload/SCIMP-paper.pdf
- Signal Messaging Protocol Audit: https://eprint.iacr.org/2016/1013.pdf
- Matrix Specfications: https://matrix.org/docs/spec/

Tools

- https://www.privacytools.io/software/real-time-communication/
- Signal: https://signal.org/
- Matrix: https://matrix.org/docs/guides/introduction
- Element: https://element.io/
- Briar: https://briarproject.org/
- Jami: https://jami.net/
- Keybase: https://keybase.io/