DIRECT FILE TRANSFER SYSTEM VIA WEBRTC

An Alternative to E-mail Attachments with Improved Security

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Mobile And Ubiquitous Internet

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Introduction

🔑 Key points

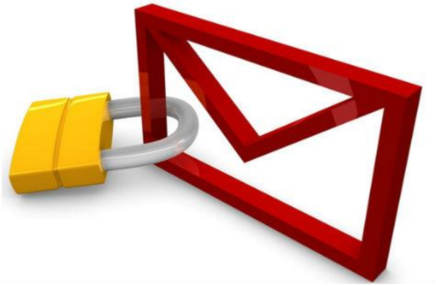
- Developed a prototype – SendIt

  Secure, *(Serverless,)* Electron & NodeJS-based, Direct Information Transfer

- Simple, user-friendly system
- Complimentary
  - Not a replacement
- Usable, improved security!
  - Absolutely security not the goal

Use cases

- Secure file transfer
  - Setup in person
  - Slightly inconvenient
  - Security comparable to PGP
- Easy way to transfer files
  - Setup over internet
  - Convenient
  - Reasonably secure
- Compliant with new regulations
  - Privacy & Data control
  - *GDPR* (EU) / *SP 800-171* (US/World)
  - Direct transfer – No storage in transit



Trust & Authentication

- Non-absolute authentication:
  - Timing
  - Files offered
  - Sender
- Used for first interaction only!
  - First time communicating
  - Share keys
- Authentication dependant on first trust:
  - Done in person – Best!

Goals & Contributions

Goals

Work

Contributions

Goals

- Improve security and ease of use for e-mail attachments
- Minimize risk of leakage and exposure of personal data
- Create a system with focus on usability, privacy and security
- Create a prototype to show feasibility

Contributions

- New type of system
- Client-only development
- New perspective on e-mail attachments
- Security to the people
- Serverless implementation
- Decentralized internet

Concepts & Design

Trust system

- Not suitable to use PKI
  - Requires setup
- Non-absolute authentication
- Used for first interaction only!
- Based on Web of Trust
  - Utilizes Public-key cryptography, like PGP
- Trust transitivity*
- Gradual trust building*
  - Negative > Positive
- Trust re-evaluated constantly*

*Not implemented but framework designed.

Authentication

- Public-key cryptography
- Identity represented by e-mail
- Authentication and connection setup combined
  - Usually separate processes
- WebRTC Offer & Answer
  - Includes endpoint authentication

- Keys shared:
  - Over P2P channel
  - Encrypted
  - During first connection
- Depends on first connection:
  - In person – More secure
    (Highest level of security in SendIt)
  - Open channel – Less secure

Implementation

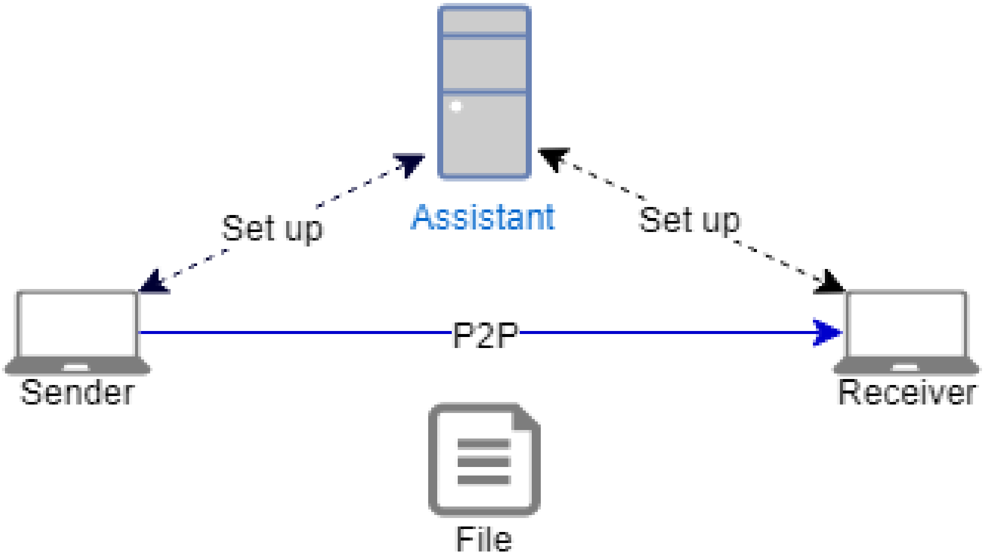
Technology

- System is built using:
  - NodeJS
  - Electron
  - WebRTC
    - Experimental technology!
- Enables easy development:
  - Desktop applications
  - Multi-platform support
  - Built-in NAT traversal
  - P2P communication
  - No server requirements

Modes

The modes only differ in how the *connection information* is shared

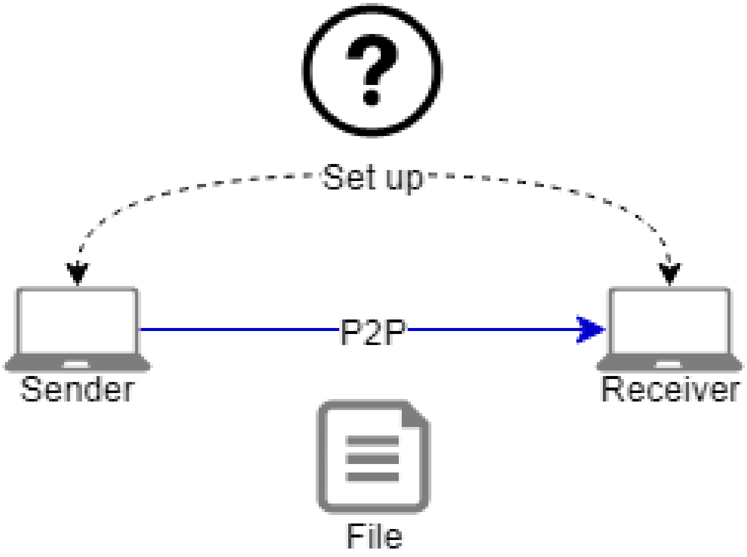
Assisted Connection Setup



__Automatic sharing:__

Easier to use – less secure

Serverless

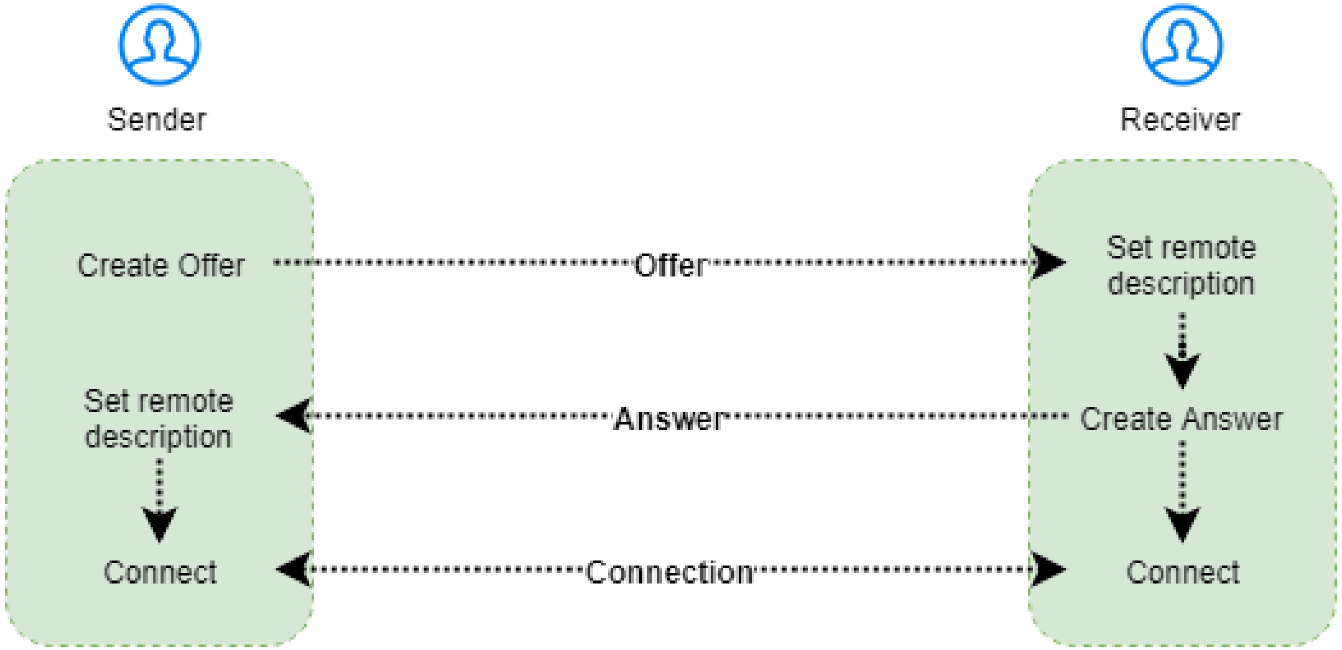


__Manual Sharing:__

Harder to use – more secure

Usability evaluation

- Only Serverless mode
- WebRTC connection setup
  - Experimental!
- Experiment
  - Simulating user behaviour
- Total setup time:
  - Around 6 minutes
- Offer last longer than Answer



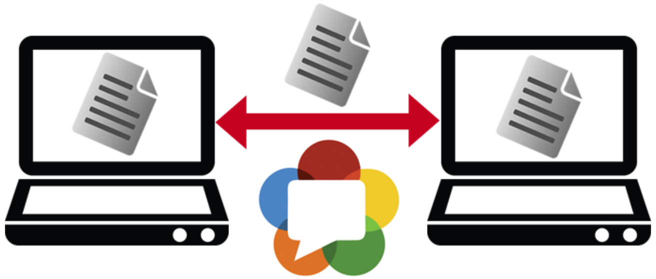
Transfer speed & efficiency

- Same as popular P2P systems
- Depends on network conditions
- Works on any network
  - Except Symmetrical NAT
  - Optimal = LAN

- Test transfer WIDE -> Yamato:
  - 40 Megabytes transferred
  - Completed: 34 Seconds
  - Speed > 10Mbyte/s!

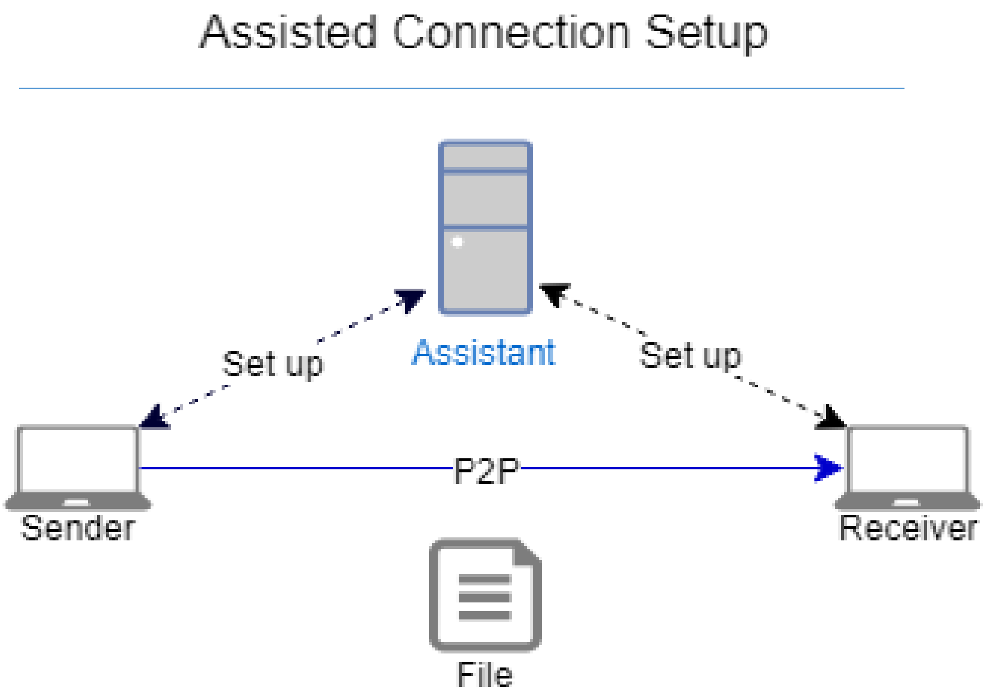
WIDE – Dl: 1000 Mbit/s, Ul: 735 Mbit/s

Yamato – DL: 85Mbit/s, Ul: 10Mbit/s

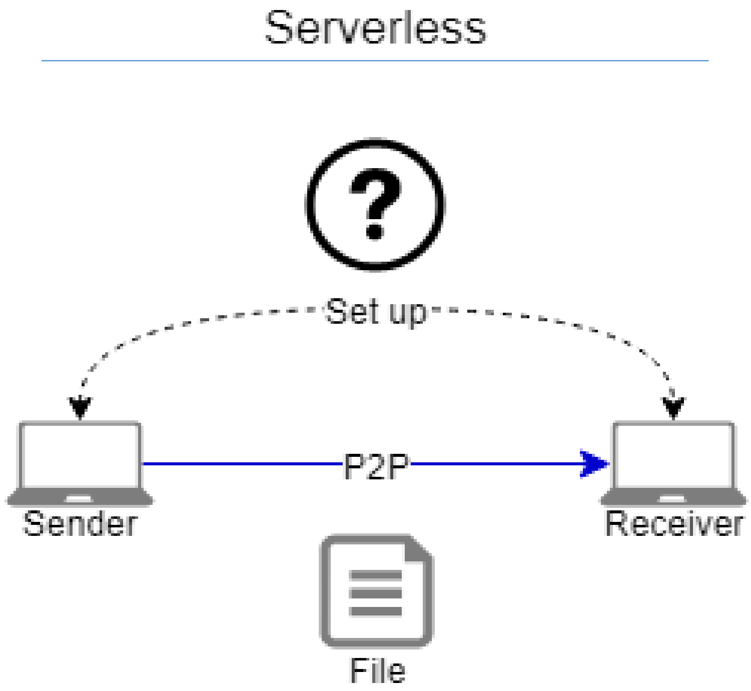


Demonstrations

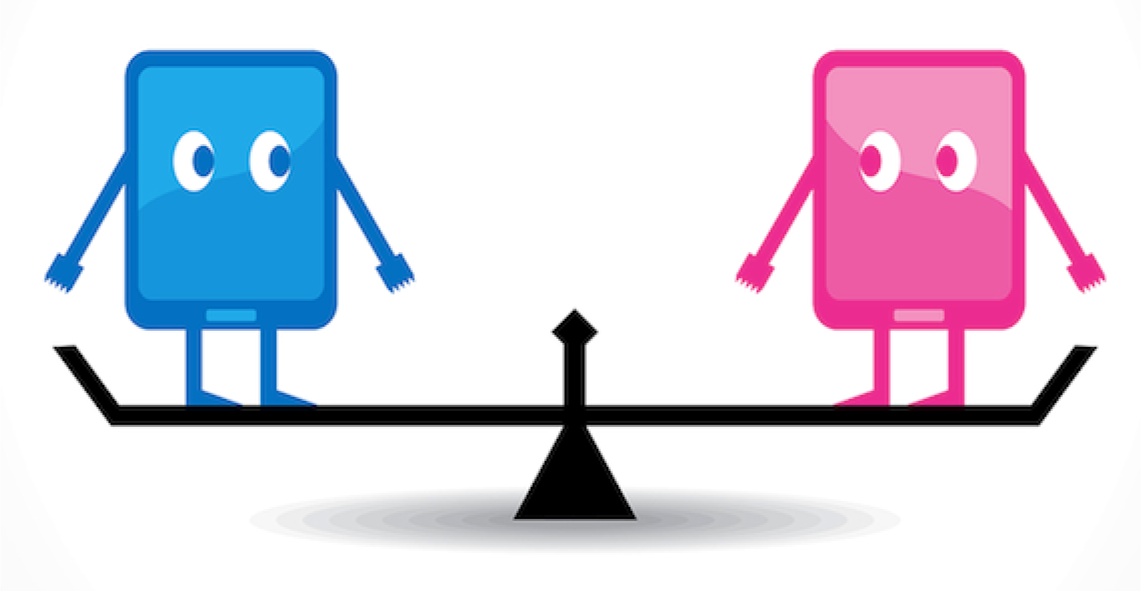
ACS Demo


Assisted Connection Setup
Assistant
Set up
Set up
P2P
Sender
Receiver
File

Serverless Demo



Evaluation & Comparison

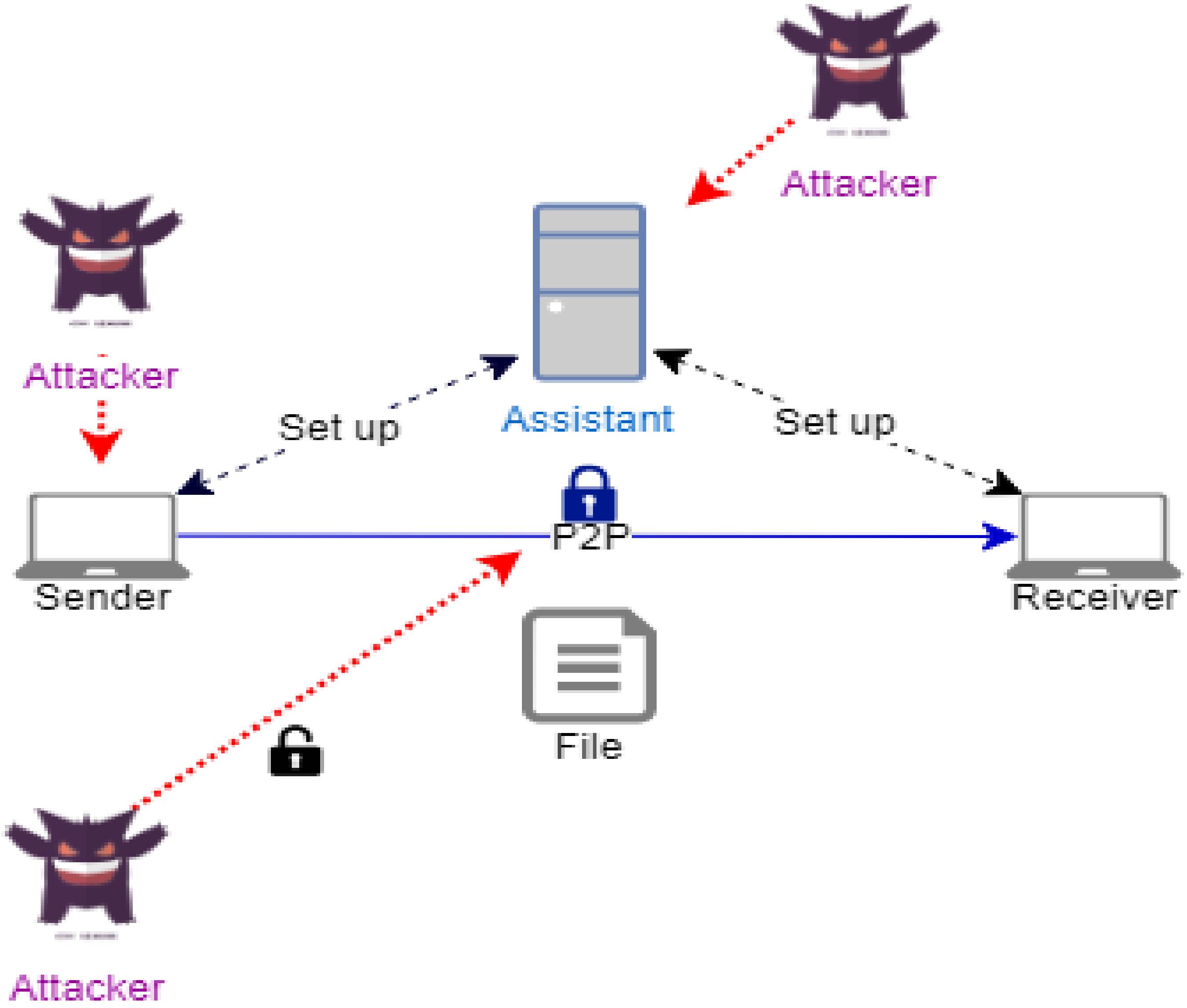


Evaluation

- Comparison based:
  - E-mail
  - Cloud- and SNS
- E-mail offers no guarantee of any security features
  - Anything is an improvement
- File storage in Cloud- and SNS-based systems:
  - Large attack surface
  - Low content control
- SendIt's main weakness:
  - First trust abuse

SendIt threat evaluation

- Authenticate with false identity *(First exchange)*
- Key theft
- XSS
- Malicious Assisted Connection Setup
- Break encryption
- Compromise Sender's computer



Comparison

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- Asynchronous
  - Must be online simultaniously
- First connection is trusted
- Requires connection setup
- No multicast support

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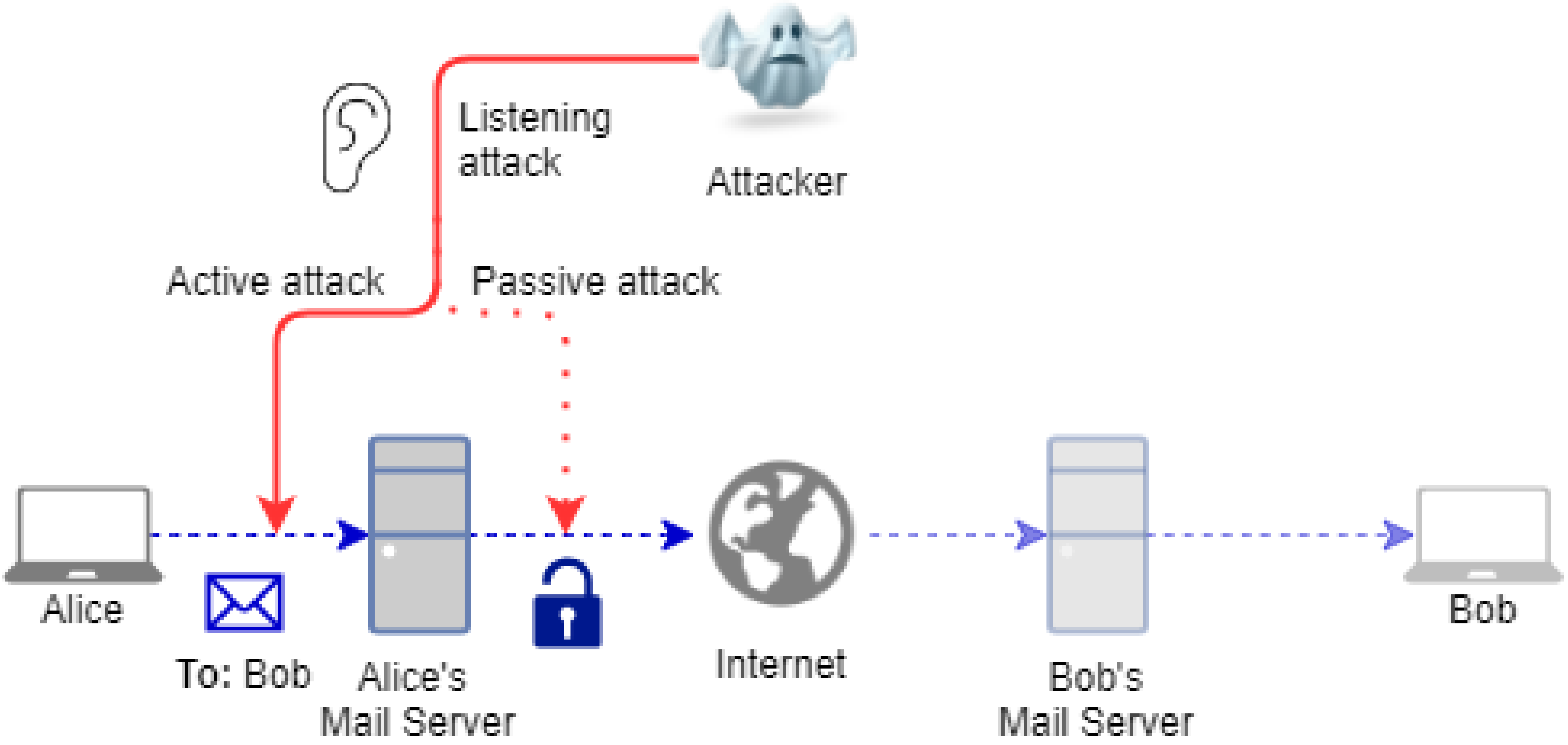
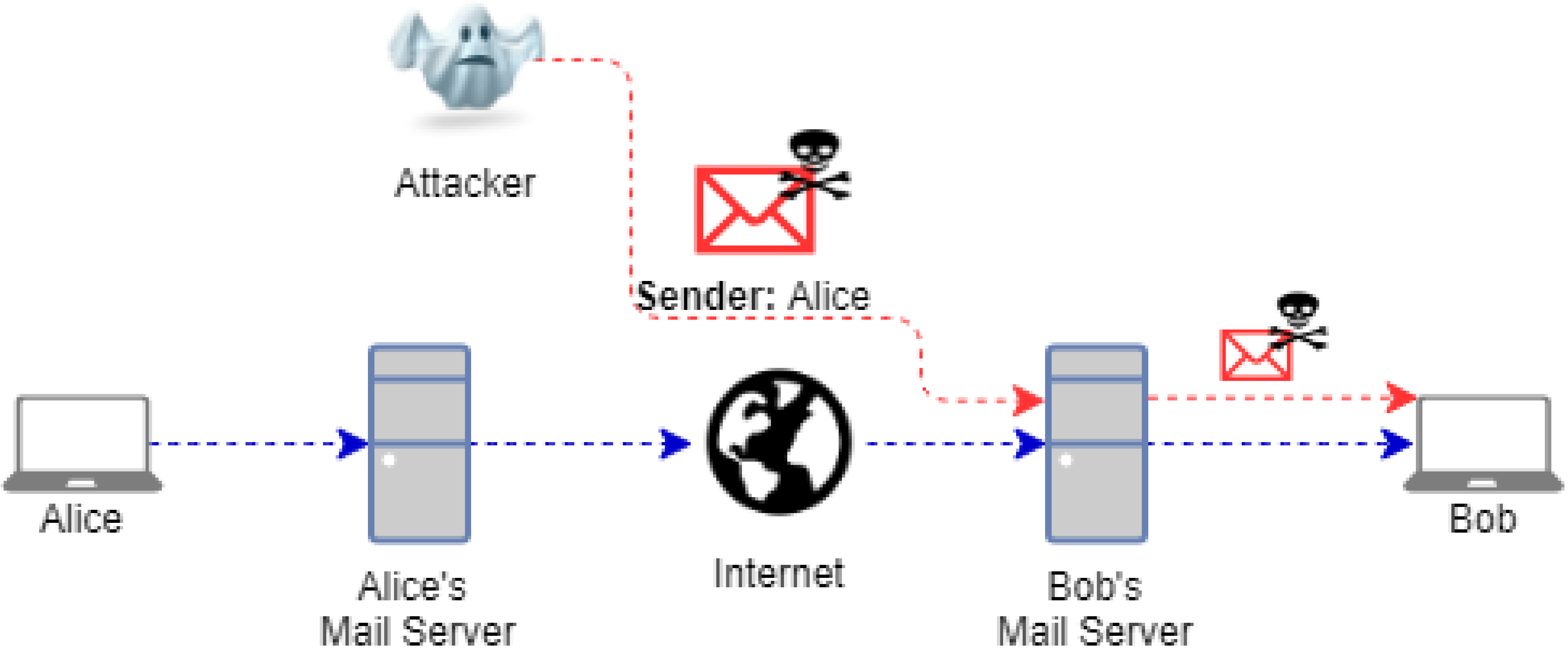
- **Low attack surface**
- **Direct transfer**
- Easy to use
- Simple system
- Reasonably secure
- Content control
- Authentication

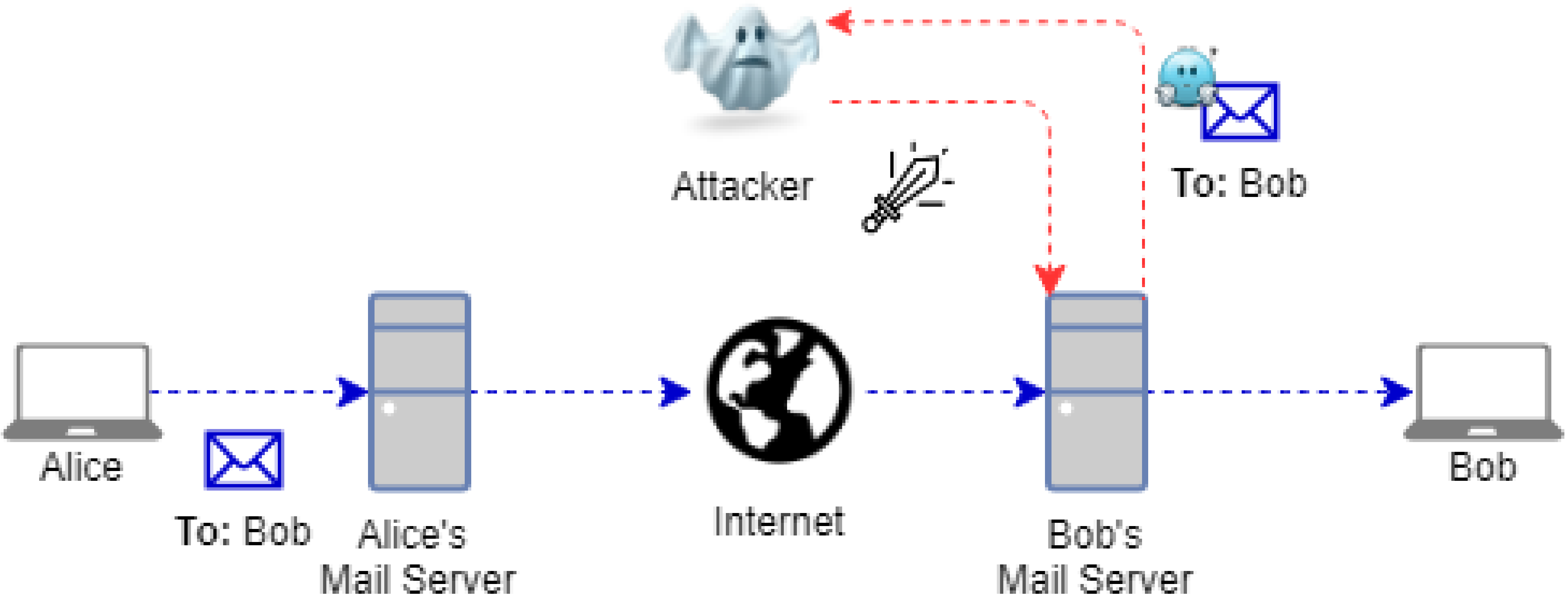
E-mail threat 1



E-mail threat 2



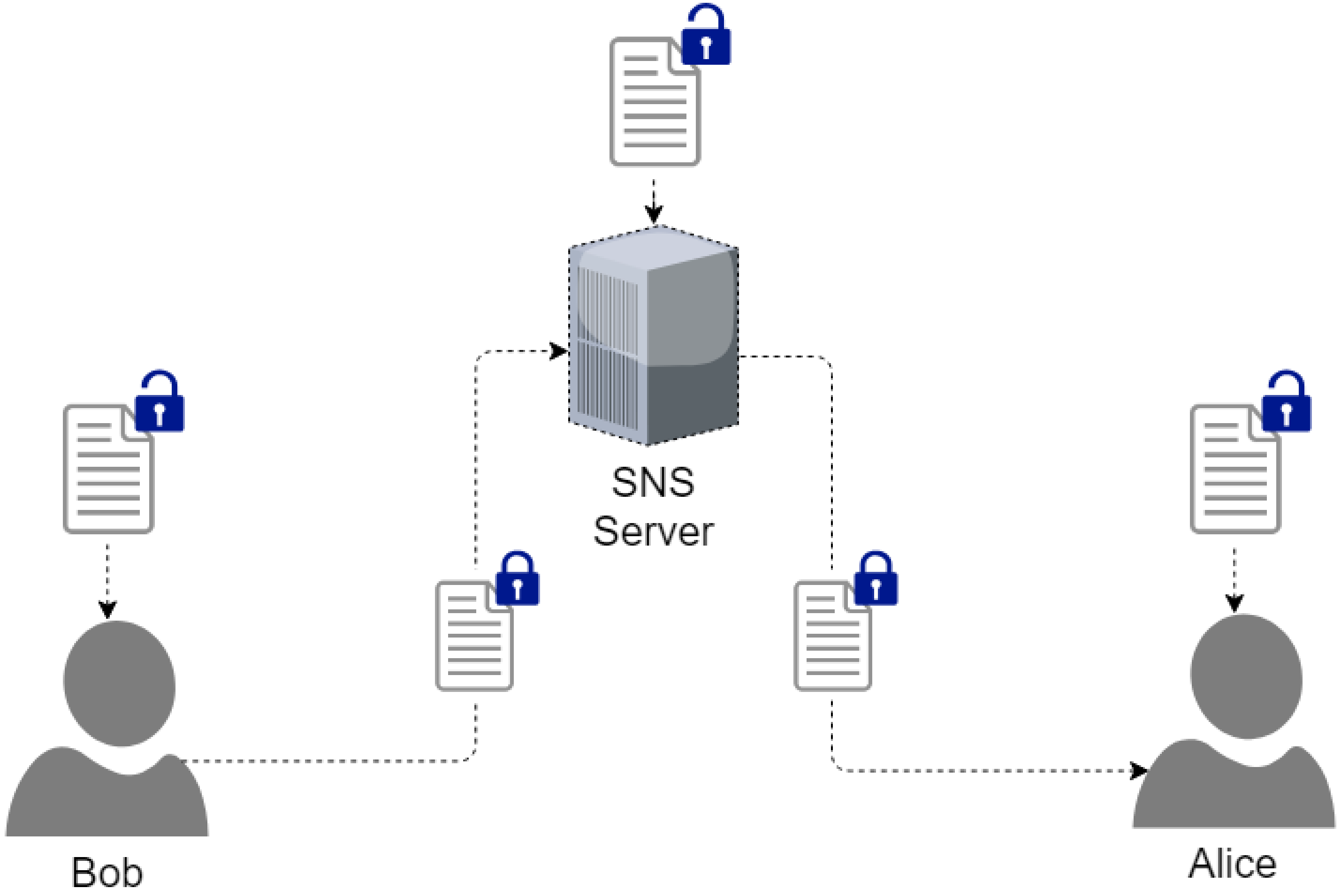
E-mail threat 3



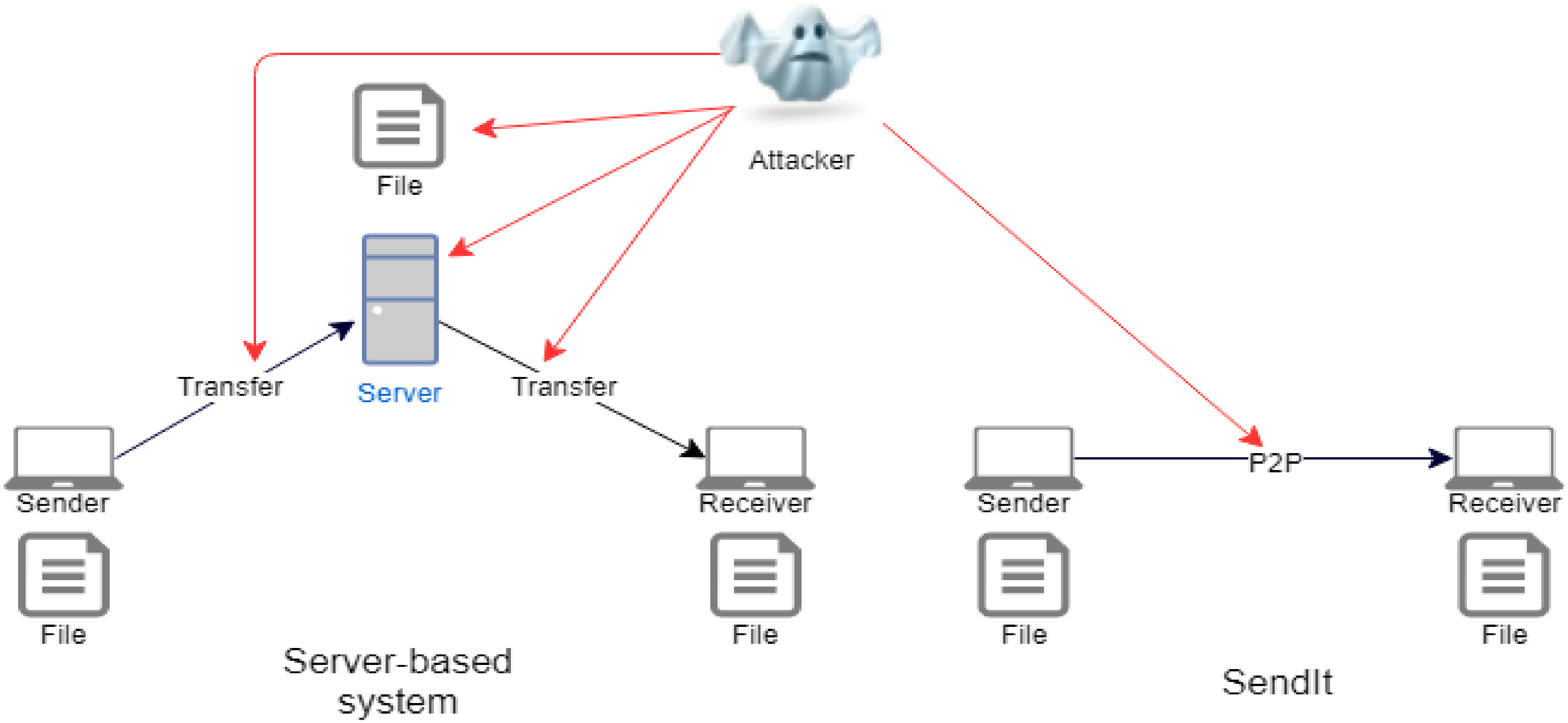
E-mail attachment issues

- Automatic spreading
- No way of stopping file
- No integrity guarantee
- Stored multiple locations
  - Server
  - PC
- Hard to notice
  - Impersonation
  - Hidden
- Common attack vector

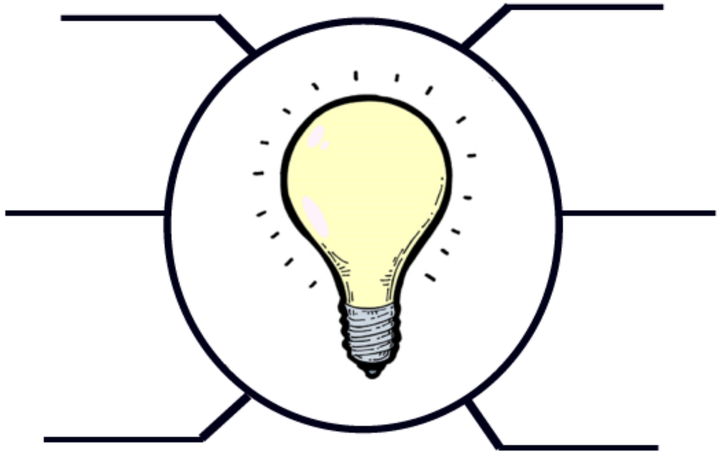
False end-to-end encryption



Threat comparison



Conclusion



Created a prototype (SendIt)

- Alternative to e-mail attachments
- Decentralized system
- Serverless
- Improvement to current e-mail system

Goals achieved:

✓Create a prototype to show feasibility.

Reduced attack surface

- Endpoint authentication
  - *Based on first trust*
- End-to-end encryption
- Direct communication
  - No temporary storage
- Continous trust evaluation

Goals achieved:

✓Improve security and ease of use for e-mail attachments.

✓Create a system with focus on usability, privacy and security.

✓Minimize risk of leakage and exposure of personal data.

Easy to use

- Automatic:
  - Key management
  - Trust system
  - Authentication
- No setup or sign-up required

Goals achieved:

✓Improve security and ease of use for e-mail attachments.

✓Create a system with focus on usability, privacy and security.

System Limitations

- First trust
- Synchronous
- Connection setup

Simple system focused on security

Improves security and ease of use for e-mail attachments!

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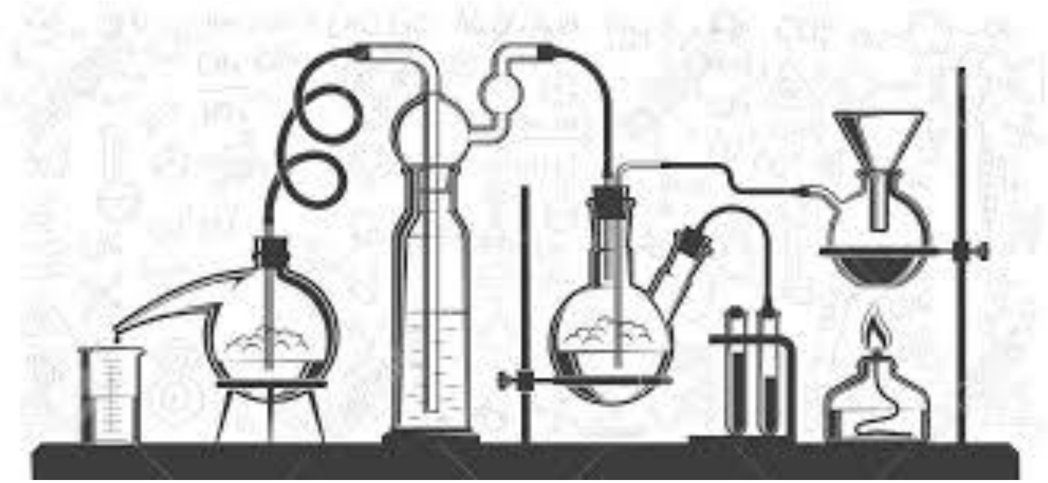
Appendix

Experiments

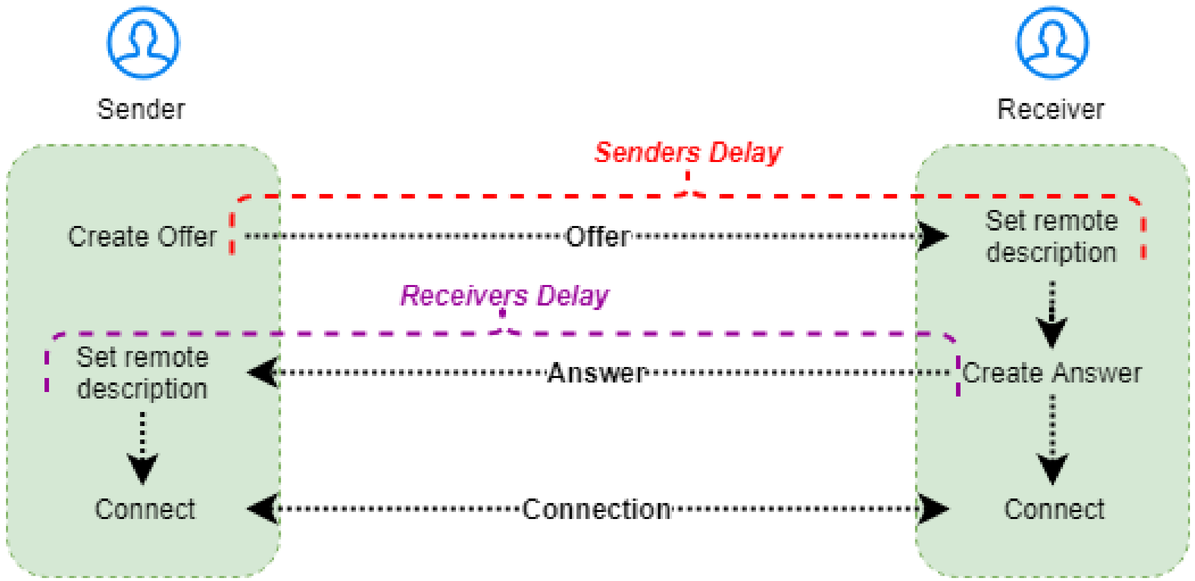


Goals

FIND:

- Average lifetime of Offer/Answer
- Most influential factor of the two
- Average lifetime of whole exchange

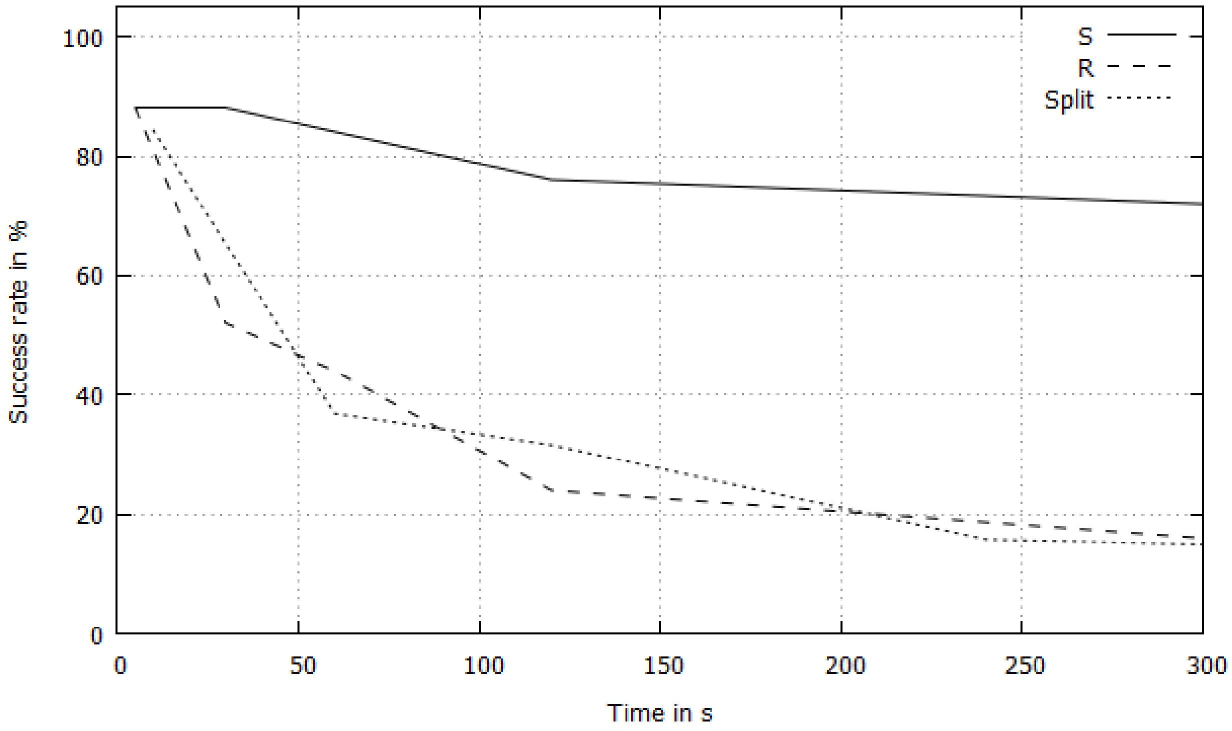
Terminology



Contribution to SendIt

- Which part is more time-constrained?
- How usable is the serverless mode?
- How to improve the serverless mode?

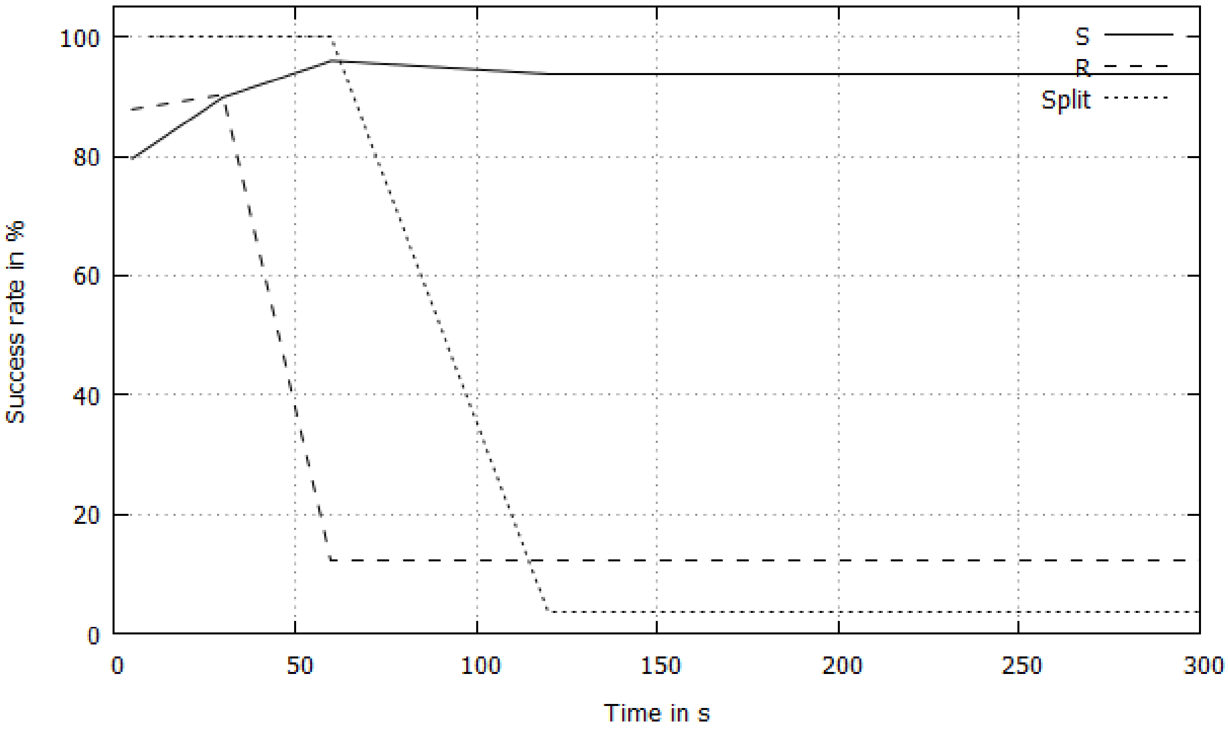
Result experiment 1



Method

- Server and Client tries to establish WebRTC connection
- Test with different delays when sharing offer and/or answer
    - Did experiment twice to verify results
- Simulates user behaviour

Result experiment 2



Results

- Both experiments gave similar results
- Only relevant for Serverless mode
- Offer: ~ 5 min
- Answer: ~1 min
- Total: ~6 minutes