



MW4ALL

Survey insights (discussion draft)

Investigating the Potential of a Large-Scale Deployment of
Magic Wormhole: Identity-Free File Transfer

Least Authority, September 2020

Supported by Horizon 2020 - Next Generation Internet / NGI Net





About this project

About the grant

- This work is supported by The Next Generation Internet initiative by the Digital Single Market of the European Commission.
- We participated in the NGI_TRUST 2nd Open Call, focusing on proposals for innovative technological solutions to ensure privacy and enhance trust for the human-centric Internet.
- In this project we are assessing the technical and commercial viability of Magic Wormhole to be deployed for broader use cases as an option for identity-free, secure and easy file transfer between two computers.
- We also applied and were awarded a follow-up grant for project MW4ALL 2.0, where we will seek to execute on the plans we develop during the first project.

Project objectives

1. Learn **technical needs that are required to scale** Magic Wormhole in a decentralized and potentially anonymous way to many users, including how to ensure it can withstand certain types of attacks or adversarial network observers.
2. Better **understand the various use cases** in order to make it easier to use, including what interfaces and integrations may be necessary.
3. **Determine an approach to setting up a commercial product or other options for sustainability** so that the solution remains available for long-term and widespread use, and can be sufficiently maintained (with security patches, necessary updates, etc).



What is Magic Wormhole?

What is Magic Wormhole?

- *Get things from one computer to another, safely.*
- Magic Wormhole makes it possible to get arbitrary-sized files and directories (or short pieces of text) from one computer to another.
- The two endpoints are identified by using identical “wormhole codes”: in general, the sending machine generates and displays the code, which must then be typed into the receiving machine.

From <https://github.com/warner/magic-wormhole>

Demo of tool based on MW: <https://webwormhole.io>

Magic Wormhole (possible) strengths

1. Instant connection between sender and recipient
2. Not needing to log in
3. Not needing proximity
4. Not needing the identity of others
5. Not needing to add recipient to a contact list
6. Sender does not need to have or reveal their own identity when sharing/connecting
7. End-to-end encrypted transfer of information
8. Can be operating system and device agnostic
9. Ephemeral nature of transfer

Magic Wormhole (possible) weaknesses

1. Needing a secondary channel of communication to pass on code
2. Needing to be online simultaneously
3. Needing to install an application first
4. Risk of denial of service attacks on server
5. Risk of name-plate guessing / on-path attacks
6. Low current adoption



Lead-up to the survey

Lead-up to the survey

- Developed a range of use cases
- Scoped out comparable tools
- Developed a survey to gather information about how the comparable tools are used, and what their pros and cons are

Survey methodology

- 58 mostly open-ended questions about file sharing, file transfer and device connection
- We focused on popular technologies, provided open fields for other tools, and sought out feedback on key scenarios:
 - Sending a file to yourself
 - Sending a file to someone in the same room
 - Connecting multiple devices
- The survey was completed by 102 people from across 25 of 27 European Union countries.



What did we want to learn?

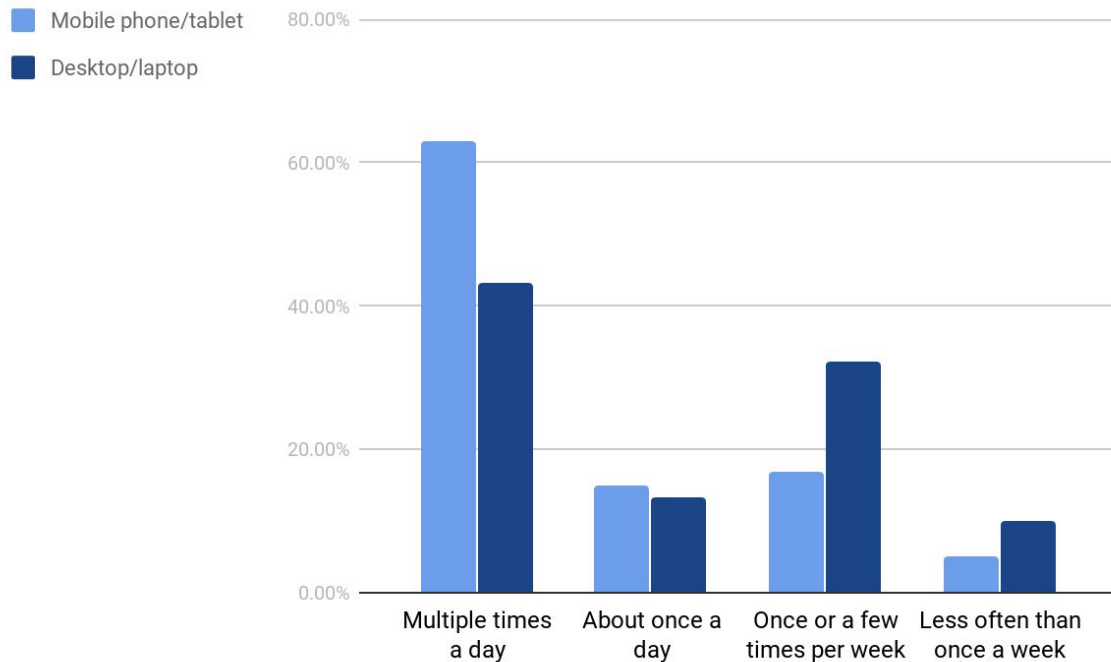
Research questions

1. In what circumstances (purpose/context/content) do people transfer files to people in their physical proximity (both new and old connections)?
2. In what circumstances do people transfer files to people not in the same space (both new and old connections)?
3. In what circumstances do people transfer files between devices that they own?
4. In what circumstances do people introduce a connection between two devices/applications?
5. What applications/technologies do people use to take the above actions?
6. What do people use specific file transfer technologies for (per technology)?
7. What are the main challenges people are experiencing when transferring files or when connecting devices/applications?
8. What are the main delights people are experiencing when transferring files or when connecting devices/applications?

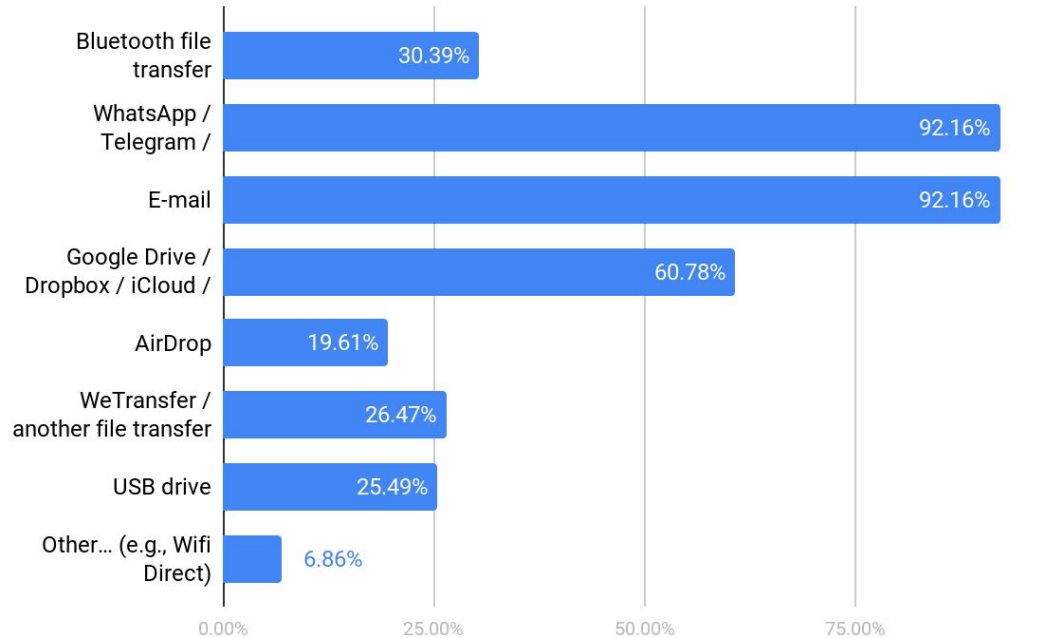


What did we learn?

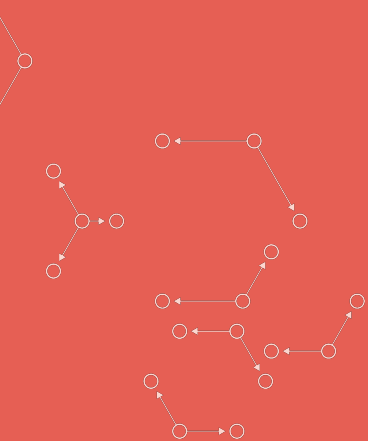
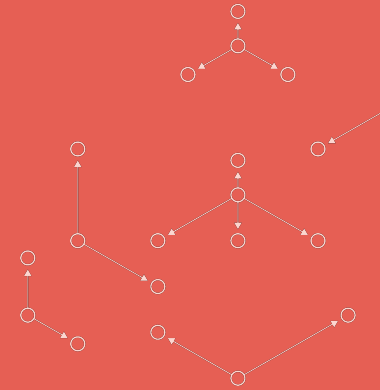
Frequency of sharing files with others



Technologies/applications recently used to send a file to someone else/yourself



People mix and match what tool
they use based on their needs and
tools' pros & cons



Bluetooth

"I chose Bluetooth as it's more convenient when sending a few pictures to someone that's in your proximity. Messaging apps tend to lower picture quality and emails have max size of attached documents."

Purpose:

- Send photos/screen shot - 53.13%
- Send MP3/music - 25.00%
- Send document/text file - 12.50%
- Send PDF (incl. scanned docs) - 6.25%

Highlights in comparison with others:

- ❖ Send MP3/music

Pro

- Easy/convenient (compared to others) - 21.43%
- Speed (of transfer) - 19.05%
- Safe - 7.14%

Highlights in comparison with others

- ❖ Wireless/Not needing a cord
- ❖ No Internet connection needed/present
- ❖ Quick to connect

Con

- Slow send/transfer/upload/download speed - 34.78%
- (Nothing - 21.74%)
- Range (limited) - 13.04%
- Difficult to set up - 8.70%
- Connectivity problems - 8.70%

Highlights in comparison with others

- ❖ Range (limited)
- ❖ Difficult to set up
- ❖ Slow send/transfer/upload/download speed

Messaging apps

(e.g., WhatsApp, Telegram, iMessage)

"We all have this messaging app, so it is convenient. It works well, as it is fast and downloads files almost immediately. Besides, everyone is using it;"

Purpose:

- Send photos/screen shot - 60.92%
- Send PDF (incl. scanned docs) - 11.49%
- Send video - 10.34%
- Send document/text - 9.20%
- Send link - 5.75%

Highlights in comparison with others:

❖ -

Pro

- Easy/convenient - 27.59%
- Speed (of transfer) - 22.07%
- Everyone uses this - 8.28%
- Conversation already in that tool / forwarding something received there - 8.28%
- Other person asked me to / Receiver preference - 5.52%

Highlights in comparison with others

- ❖ Easy to send pictures
- ❖ Contact established as soon as phone # added to contacts
- ❖ Supports almost all kinds of files
- ❖ Confirmation the other person received / saw it

Con

- Nothing - 35.56%
- Pictures compressed/lose quality - 13.33%
- File size limit - 11.11%

Highlights in comparison with others

- ❖ Fiddly to use on phone
- ❖ Works best on phones / does not sync well with computer
- ❖ Pictures compressed / lose quality
- ❖ Takes up device storage space

Email

"For professional documents, email is the most appropriate method. I can keep records of the sent mails."

Purpose:

- Send document/text - 35.58%
- Send PDF - 28.85%
- Send photos/screen shot - 15.38%
- Send spreadsheet - 9.62%

Highlights in comparison with others:

- ❖ Send spreadsheet
- ❖ Send PDF (incl. scanned docs)
- ❖ Send document/text

Pro

- Appropriate for professional/formal use - 14.50%
- Conversation already in that tool / forwarding something received in that tool - 6.87%
- Safe - 6.11%
- No max. file size - 6.11%
- File already stored on / easy to send files from PC - 6.11%
- Record-keeping / directly saves a copy - 6.11%

Highlights in comparison with others

- ❖ File already stored on / easy to send files from PC -
- ❖ Appropriate for important files
- ❖ Appropriate for this file type
- ❖ Appropriate for professional/formal use

Con

- (Nothing - 36.25%)
- File size limit - 25.00%
- No receipt or read confirmation - 6.25%

Highlights in comparison with others

- ❖ Is done on computer - inconvenient
- ❖ Usually takes longer to get a reply from someone
- ❖ No receipt/read confirmation
- ❖ File size limit

Cloud storage platform (e.g., Google Drive, Dropbox, iCloud)

"The most important feature of cloud storage platforms is that I can access to both my private and business files regardless which machine I am using (office pc, home laptop, tablet, smartphone). For me this is more important than sharing files."

Purpose:

- Send document/text - 26.47%
- Send PDF - 16.18%
- Send photos/screen shot - 13.24%
- Send video - 13.24%
- Send spreadsheet - 11.76%
- Send presentation - 5.88%

Highlights in comparison with others:

- ❖ Send/store PC/backup
- ❖ Send presentation
- ❖ Send spreadsheet

Pro

- No max. file size / Ability to send larger files - 20.83%
- Ability to collaborate without sending back/forth - 7.29%
- Easy/convenient - 5.21%
- Ability to create shareable link (also for unknown people) - 5.21%
- Ability/ease to send to multiple people at once - 5.21%

Highlights in comparison with others

- ❖ Ability for recipients to easily download it
- ❖ Ability to collaborate without sending back/forth
- ❖ Version control capability
- ❖ Ability to create shareable link (also for unknown people)

Con

- (Nothing - 31.75%)
- Slow send / transfer / upload / download speed - 6.35%

Highlights in comparison with others

- ❖ No clear record of sharing with someone
- ❖ Needing to be careful about which account to upload to
- ❖ Recipient needs the same application
- ❖ Cannot sufficiently control who accesses it (e.g., link may get reshared)/ receiver may use it unsafely

AirDrop

"I just met the person and i had no contact with the person. We both just happen to use Iphones, so we shared a picture via Airdrop. Airdrop was fast, it was my first time of using it."

Purpose:

- Send photos/screen shot - 75.00%
- Send video - 10.00%
- Send document/text file - 5.00%
- Send PDF (incl. scanned docs) - 5.00%
- Sync/Transfer between my devices - 5.00%

Highlights in comparison with others:

❖ -

Pro

- Quick/Speed (undefined) - 15.79%
- Easy/convenient - 15.79%
- Picture quality uncompressed - 10.53%
- Speed (of transfer) - 7.89%
- Easy to send to someone in proximity - 7.89%
- Not needing to have recipient in contacts - 7.89%
- Other person asked me to / Receiver preference - 7.89%

Highlights in comparison with others

- ❖ Easy to send to someone in proximity
- ❖ Not needing to have recipient in contacts
- ❖ Good to connect phone to computer
- ❖ Picture quality uncompressed

Con

- (Nothing - 42.86%)
- Requiring proximity - 9.52%
- Connectivity problems - 9.52%
- Recipient needs the same OS - 9.52%

Highlights in comparison with others

- ❖ Requiring proximity
- ❖ Recipient needs the same OS

File transfer platform

(e.g., WeTransfer)

"When you have large files or multiple files to be sent that would not be possible to be sent through email or would take multiple emails, WeTransfer is super fast, super easy and free so the natural choice."

Purpose:

- Send video - 42.11%
- Send photos/screen shot - 26.32%
- Send presentation - 10.53%
- Send MP3/music - 5.26%
- Send document/text - 5.26%
- Send PDF - 5.26%

Highlights in comparison with others:

❖ -

Pro

- No max. file size / Ability to send larger files - 47.62%
- Easy/convenient (compared to others) - 9.52%
- Quick/Speed (undefined) - 7.14%

Highlights in comparison with others

- ❖ Not wanting to give access permission
- ❖ No max. file size / Ability to send larger files

Con

- (Nothing - 31.82%)
- Files expire - 13.64%
- Slow send / transfer / upload / download speed - 9.09%
- File size limit - 9.09%
- Security concerns - 9.09%

Highlights in comparison with others

- ❖ Files expire

USB drive

"Did not want to share my email or anyother online way with the specific person. It works for me because it's a quick way to get great amounts of files and without the need to get "personal"."

Purpose:

- Send video - 22.73%
- Send MP3/music - 18.18%
- Send photos/screen shot - 13.64%
- Send PDF - 13.64%
- Send presentation - 9.09%
- Sync/Transfer between my devices - 9.09%

Highlights in comparison with others:

- ❖ Sync/Transfer (undefined file type) between my devices
- ❖ Send/store PC/backup
- ❖ Send APK/computer program

Pro

- No max. file size / Ability to send larger files - 25.00%
- Speed (of transfer) - 7%
- Quick/Speed (undefined) - 7%
- Safe - 7%
- Integration with other app - 7%
- No alternative - 7%
- Certainty that I can keep files/ not being deleted - 7%
- Easy to move around the data/Needing the file(s) to be portable - 7%

Highlights in comparison with others

- ❖ Easy to move around the data/Needing the file(s) to be portable
- ❖ Certainty that I can keep files/ not being deleted
- ❖ Integration with other app

Con

- (Nothing - 20.00%)
- Files get corrupted / issue with opening the file - 12.00%
- Storage space limit - 8.00%
- Risk of losing the drive - 8.00%
- Needing to mail it in the post - 8.00%

Highlights in comparison with others

- ❖ Files get corrupted / issue with opening the file
- ❖ Risk of losing the drive
- ❖ Needing to mail it in the post
- ❖ Storage space limit

Use case: send to yourself

"I use one drive to sync files between devices, I use whatsapp for quick file transfer between my devices, I use e-mail to send myself files to work computer, I use bluetooth to transfer files from mobile to PC."

Purpose:

- Send photos/screen shot - 55.34%
- Send document/text - 8.74%
- Send link - 8.74%
- Send notes to self - 7.77%
- Send PDF - 7.77%

Highlights in comparison with others:

- ❖ Send notes to self
- ❖ Send link
- ❖ Send photos/screen shot

Pro

- Easy/convenient (compared to others) - 29.55%
- Quick/Speed (undefined) - 21.97%
- Ability to access from across devices - 5.30%

Highlights in comparison with others

- ❖ Good for being reminded
- ❖ Ability to access from across devices
- ❖ Easy to retrieve
- ❖ Ability to sync across devices (laptop/tablet/desktop)

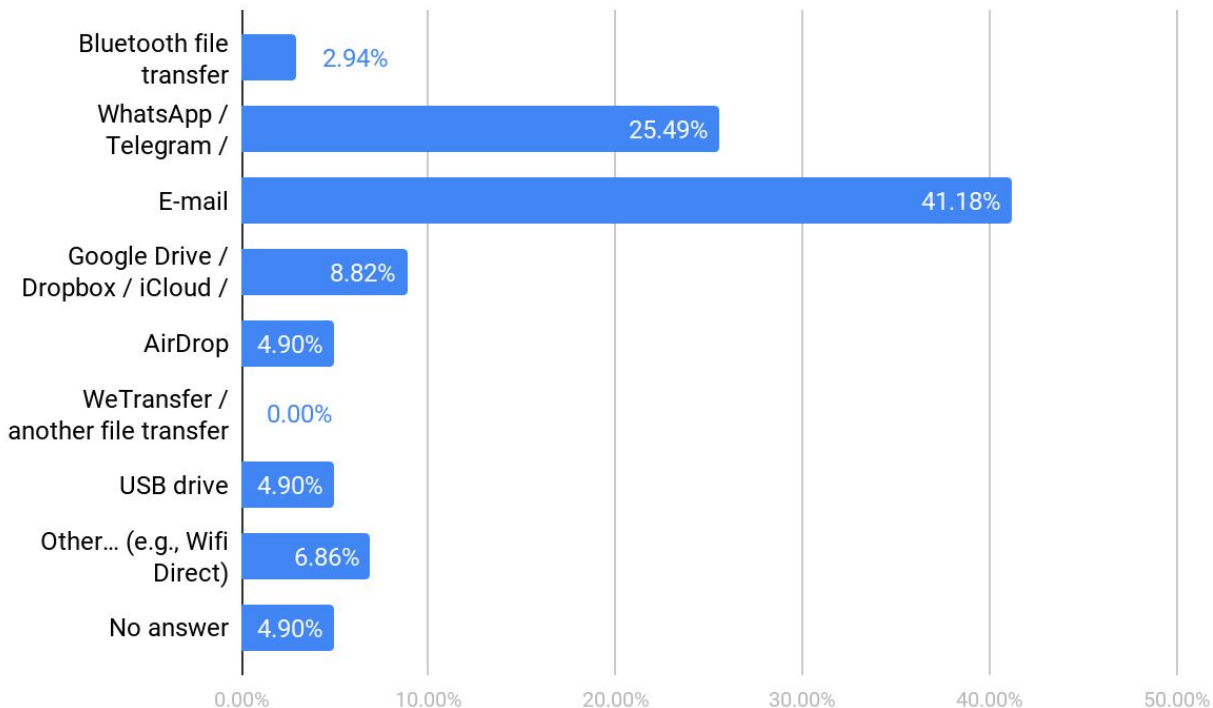
Con

- (Nothing - 42.05%)
- File size limit -9.09%
- Slow send / transfer / upload / download speed - 5.68%
- Not easy to use - 5.68%

Highlights in comparison with others

- ❖ Clutters mailbox or device or storage space
- ❖ Not easy to use
- ❖ Doesn't (always) work
- ❖ Requires Internet connection

Use case: send to yourself



Use case: send to someone in same room

“Only [downside] that to transfer file to unknown person first need to be added to the contact list.”

Purpose:

- Send photos/screen shot - 49.38%
- Send document/text - 13.58%
- Send link - 12.35%
- Send video - 9.88%

Highlights in comparison with others:

- ❖ Login details
- ❖ Send link

Pro

- Easy/convenient (compared to others) - 26.40%
- Quick/Speed (undefined) - 25.60%
- We both use this platform (so this is easiest/fastest) - 7.20%
- (Almost) Everyone uses/has this - 5.60%

Highlights in comparison with others

- ❖ We both use this platform (so this is easiest/fastest)
- ❖ Quick/Speed (undefined)
- ❖ (Almost) Everyone uses/has this
- ❖ I use this application a lot/habit

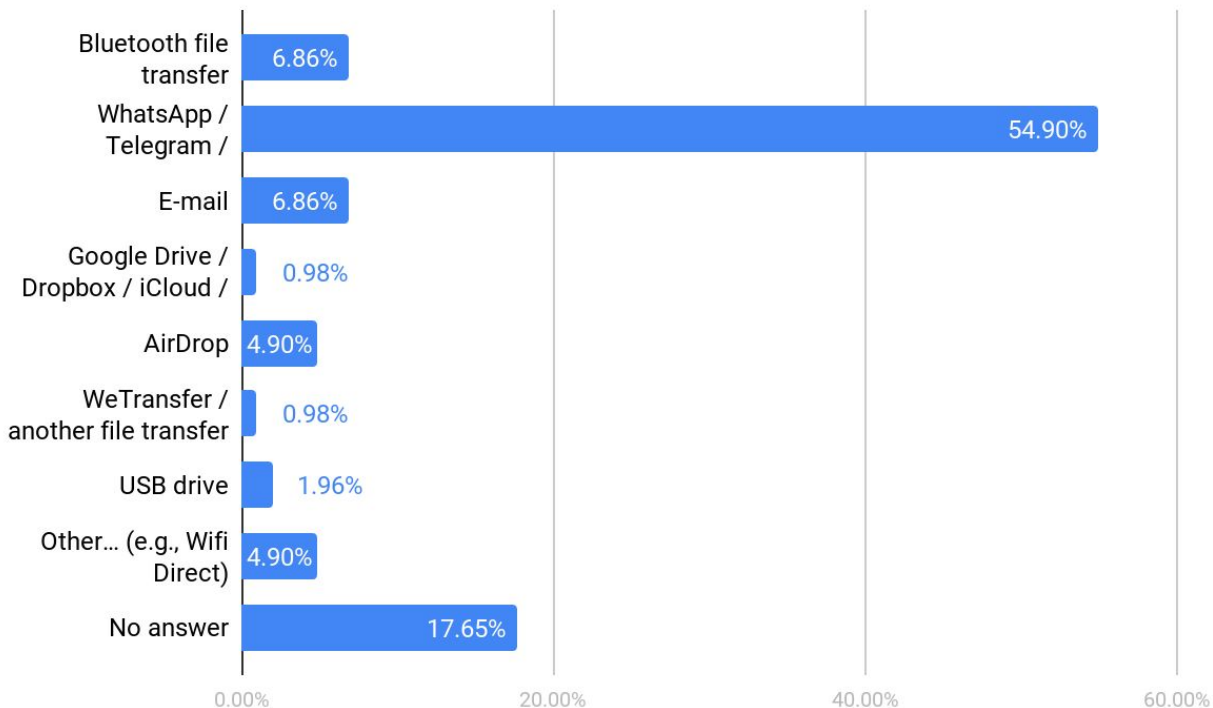
Con

- (Nothing - 40.63%)
- Needing to add person to contacts - 7.81%
- Clutters mailbox or device or storage space - 6.25%

Highlights in comparison with others

- ❖ Needing to add person to contacts
- ❖ Clutters mailbox or device or storage space
- ❖ Requires good Internet connection

Use case: send to someone in same room



Use case: connecting devices*

"i was trying to connect my phone and laptop to read messages on laptop"

*significant misunderstanding among survey participants about this use case, results less clear

Purpose:

- Connect 2 applications (possibly phone-computer) for access/application authorization - 43.24%
- Connect phone and laptop/desktop for file transfer (or unclear purpose) - 18.92%
- Connect 2 other devices - 9.46%

Highlights in comparison with others:

❖ -

Pro

- Reliable/ good connection/ it worked well - 29.31%
- Easy/convenient (compared to others) - 17.24%
- Quick/Speed (undefined) 15.52%
- Safe - 8.62%
- No login/registration needed - 8.62%
- Easy to connect / set-up - 6.90%
- Quick to connect - 5.17%

Highlights in comparison with others

- ❖ Reliable/ good connection/ it worked well
- ❖ No login/registration needed
- ❖ Quick to connect
- ❖ Easy to connect / set-up

Con

- (Nothing - 23.53%)
- Slow to set up - 11.76%
- Doesn't (always) work - 11.76%
- Slow (undefined) - 5.88%
- Requiring proximity - 5.88%
- Connectivity problems - 5.88%
- Security concerns - 5.88%
- Recipient needs the same OS - 5.88%
- Needing to get up to scan the code - 5.88%
- Requires a computer - 5.88%
- Rings all the devices at once - 5.88%
- Verification issues - 5.88%

Highlights in comparison with others

- ❖ Slow to set up
- ❖ Doesn't (always) work

Top pros mentioned

Easy/convenient · No max. file size · Quick/Speed / Speed (of transfer) · Reliable/works well · Safe · Conversation already in that tool / forwarding something received through that tool · Other person asked me to/Other person uses it/Receiver preference · Picture quality uncompressed · Free · (Almost) Everyone uses/has this · Appropriate for professional/formal use · No login/registration needed · Ability/ease to send to multiple people at once · Easy to connect / set-up · No alternative · Record-keeping / Directly/automatically saves a copy · Integration with other app · Quick to connect · Good to connect phone to computer · Ability/Ease to send multiple files at once · Easy to send/attach/upload file · Easy to send to someone in proximity

Top pros mentioned with potential MW strengths

Easy/convenient · No max. file size · Quick/Speed / Speed (of transfer) · Reliable/works well · Safe ·
Conversation already in that tool / forwarding something received through that tool · Other person asked
me to/Other person uses it/Receiver preference · Picture quality uncompressed · Free · (Almost)
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Ability/ease to send to multiple people at once · Easy to connect / set-up · No alternative ·
Record-keeping / Directly/automatically saves a copy · Integration with other app · Quick to connect ·
Good to connect phone to computer · Ability/Ease to send multiple files at once · Easy to
send/attach/upload file · Easy to send to someone in proximity

Top pros mentioned with potential MW weaknesses

Easy/convenient · No max. file size · Quick/Speed / Speed (of transfer) / Reliable/works well · Safe · *Conversation already in that tool / forwarding something received through that tool · Other person asked me to/Other person uses it/Receiver preference* · Picture quality uncompressed · Free · *(Almost) Everyone uses/has this · Appropriate for professional/formal use* · No login/registration needed · *Ability/ease to send to multiple people at once · Easy to connect / set-up* · No alternative · *Record-keeping / Directly/automatically saves a copy* · Integration with other app · Quick to connect · Good to connect phone to computer · Ability/Ease to send multiple files at once · Easy to send/attach/upload file · Easy to send to someone in proximity

Top cons mentioned

(Nothing) · Slow send/transfer/upload/download speed · File size limit · Security concerns · Connectivity problems · Pictures compressed/lose quality · Not easy to use · Slow (without specifying what) · Recipient needs the same OS · Slow to set up · Requiring proximity · Too many steps to send it / Requires extra effort · Doesn't (always) work · Difficult to set up · Files expire · Needing to add person to contacts · Range (limited) · Storage space limit · Accessing/finding older photos/files · Files get corrupted / issue with opening the file · Privacy/data protection concerns · Counterpart doesn't know how to use it

Top cons mentioned with potential MW strengths

(Nothing) · Slow send/transfer/upload/download speed · File size limit · Security concerns · Connectivity problems · Pictures compressed/lose quality · Not easy to use · Slow (without specifying what) · Recipient needs the same OS · Slow to set up · Requiring proximity · Too many steps to send it / Requires extra effort · Doesn't (always) work · Difficult to set up · Files expire · Needing to add person to contacts · Range (limited) · Storage space limit · Accessing/finding older photos/files · Files get corrupted / issue with opening the file · Privacy/data protection concerns · Counterpart doesn't know how to use it

Top cons with potential MW weaknesses

(Nothing) · Slow send/transfer/upload/download speed · File size limit · *Security concerns* · *Connectivity problems* · Pictures compressed/lose quality · *Not easy to use* · Slow (without specifying what) · Recipient needs the same OS · *Slow to set up* · *Requiring proximity* · *Too many steps to send it / Requires extra effort* · Doesn't (always) work · *Difficult to set up* · *Files expire* · Needing to add person to contacts · Range (limited) · Storage space limit · *Accessing/finding older photos/files* · Files get corrupted / issue with opening the file · Privacy/data protection concerns · *Counterpart doesn't know how to use it*



Key results

Key survey input with needs matching MW potential

- **Easy/convenient**
- **No max. file size**
- **Quick/Speed**
- **Reliable/works well**
- **Safe**
- **Picture quality uncompressed**
- **Free**
- **No login/registration needed**
- **Integration with other app**
- **Quick to connect**
- **Good to connect phone to computer**
- **Ability/Ease to send multiple files at once**
- **Easy to send/attach/upload file**
- **Easy to send to someone in proximity**
- **Privacy-friendly**
- **OS-agnostic**
- **Not needing to add recipient to contacts**
- **File integrity assured**

Other, less popular needs:

- No Internet connection needed
- Not wanting to give access permission
- Wireless/Not needing a cord

Key survey input where MW is currently weaker

- Conversation already in that tool / forwarding something received through that tool
- Other person asked me to/Other person uses it/Receiver preference
- (Almost) Everyone uses/has this
- Appropriate for professional/formal use
- Easy to connect / set-up
- Record-keeping / Directly/automatically saves a copy
- Security concerns
- Connectivity problems
- Not easy to use
- Slow to set up
- Requiring proximity
- Too many steps to send it / Requires extra effort
- Difficult to set up
- Files expire
- Accessing/finding older photos / files
- Counterpart doesn't know how to use it

Key challenges & opportunities

Key MW challenges

1. Needing to install software, as sender and receiver
2. Needing to be online simultaneously
3. Needing a secondary communication channel

Key MW opportunities

1. Workflow speed/ease of use
2. Ability to send large files
3. Secure & private
4. Device/OS agnostic

Use cases best served by MW

1. Proximity file sharing (self or someone else)
2. One-time file sharing
3. Privacy-focussed file sharing
4. (Device/application introduction)*

* not have enough information to assess MW's comparative strengths vs. other technologies in this area --> potential to explore further

Key development opportunities

1. First-start ease of use
2. Availability & integration in current workflows
3. Persistent/repeat connections



Detailed development opportunities

1. Easy-to-use Magic Wormhole desktop/mobile apps + integration
2. WebRTC support / browser integration
(to not require app install + to interoperate with CLI and native apps)
3. CPACE
(for encryption standards)
4. Rust library
(for better integrations)
5. Dilated wormhole
(for repeat/persistent connection and for reducing synchrony challenges)
6. Reduce DoS vulnerabilities / reduce nameplate guessing
(pool of servers? shared app IDs for organizational use?)
7. Improve discoverability of peers + reduce dependency on relay server / integrate mailbox server
(to not need Internet connectivity + reduce bandwidth/server load)
8. Queuing function
(to reduce synchrony challenges + to send multiple files)
9. QR code support
(to address language and accessibility limitations)



Questions?

More resources [links removed]

- Study plan for survey
- Full survey results
- Coded analysis of survey (The Big Spreadsheet)
- Magic Wormhole pros/cons mapped against survey input
- Survey methodology lessons/notes