Cryptography for Grassroots Organizing

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RWC 2023
Tokyo, Japan

*speaker

"Cryptography rearranges power"

–Philip Rogaway

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"Cryptographers are professional catastrophizers."

–Lucy Qin

"Cryptography rearranges power"

–Philip Rogaway

"Cryptographers are professional catastrophizers."

–Lucy Qin

"Awareness is two steps forward— paranoia is two steps back."

–Kim Marks/Civil Liberties Defense Center

How do we, as cryptographers, understand
systems of power?

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How does our understanding inform our threat modeling and design choices?

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How does our understanding inform our threat modeling and design choices?

How might we work toward building power for communities?

Threat Modeling Paradigm Shift

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One Size Fits One: Protocol design begins with the unique needs of the population the protocol is meant to serve

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Full Compromise Security: Threat modeling is redesigned to center people's actual needs and lived experiences

Threat Modeling Paradigm Shift

One Size Fits One: Protocol design begins with the unique needs of the population the protocol is meant to serve

Trust Is Human: Digital trust is recognized as an extension of highly complex human trust relationships

Full Compromise Security: Threat modeling is redesigned to center people's actual needs and lived experiences

Grassroots Optimization: Scale, efficiency, and accessibility are optimized for communities (not coroporations and governments)

Cryptography for Grassroots Organizing

o Introduction

o Threat Modeling Paradigm Shift

o Definition of Grassroots Organizing

o Lessons from History

o Lessons from the Current Landscape

o tigro: Trust Infrastructure for Grassroots Organizing

o Conclusion

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Definition of Grassroots Organizing

Grassroots organizing is a process by which people work from within marginalized communities to effect social, political, economic, and environmental change.

Operation Vula

South Africa (1986–1990): African National Congress (ANC) creates cryptography for grassroots organizing
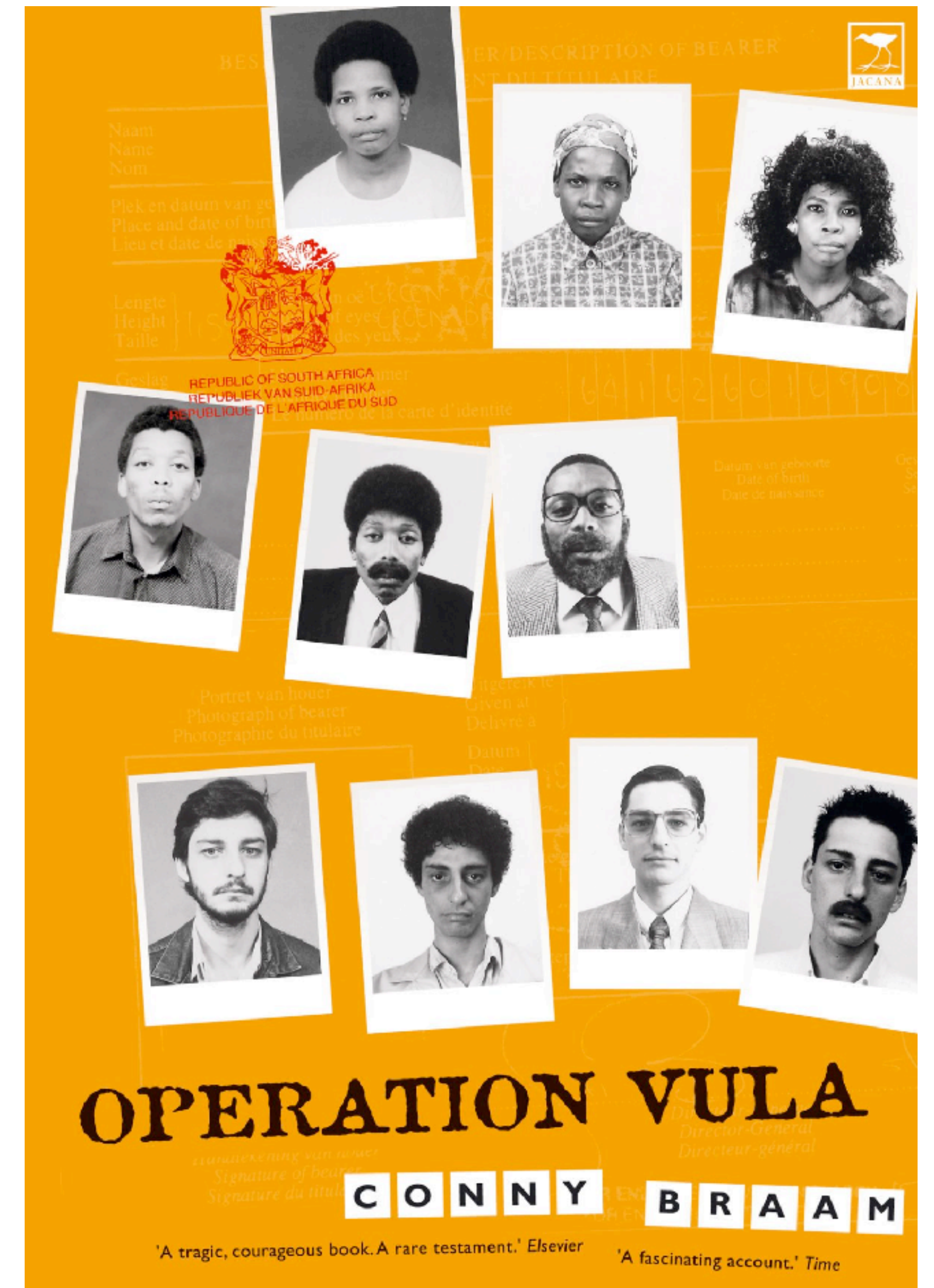
Image Credits: Jacana Media (2004), AP Photo/Udo Weitz, File (1990) via The Washington Post (2019)

Operation Vula

South Africa (1986–1990): African
National Congress (ANC) creates
cryptography for grassroots organizing

Requirements:
Asysnchronous, Covert,
Long Distance, Public
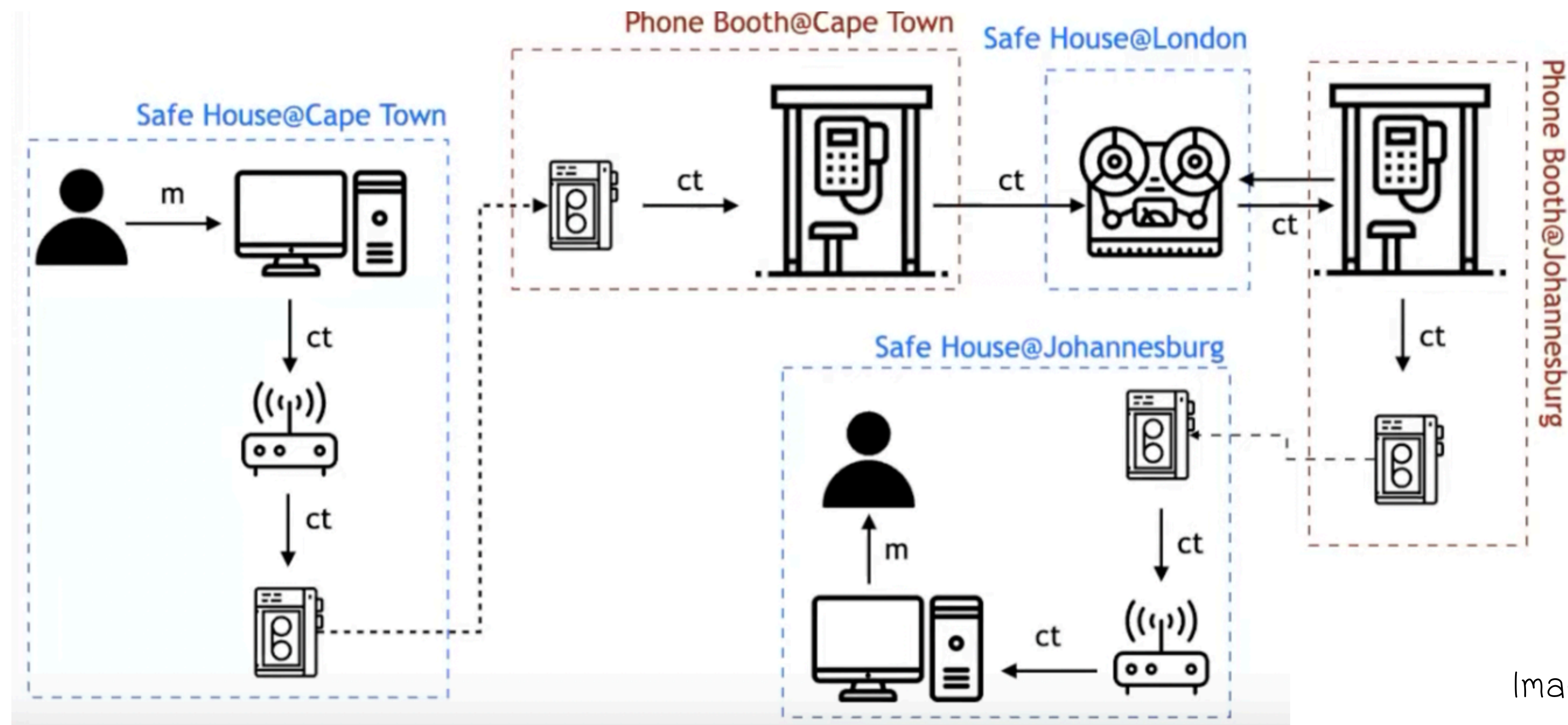
Operation Vula

ANC Activist Tim Jenkin (1995): "I went to find out about secure encryption algorithms...

All I discovered was that cryptology was an arcane science for bored mathematicians, not for underground activists.

However I learned a few tricks and used these to develop a system to meet our security needs."

COINTELPRO

United States (1956–1971): Federal Bureau of Investigation (FBI) illegally & extensively surveils activists

Image Credits: The Melanated Press (2014), Emory Douglas (1976)
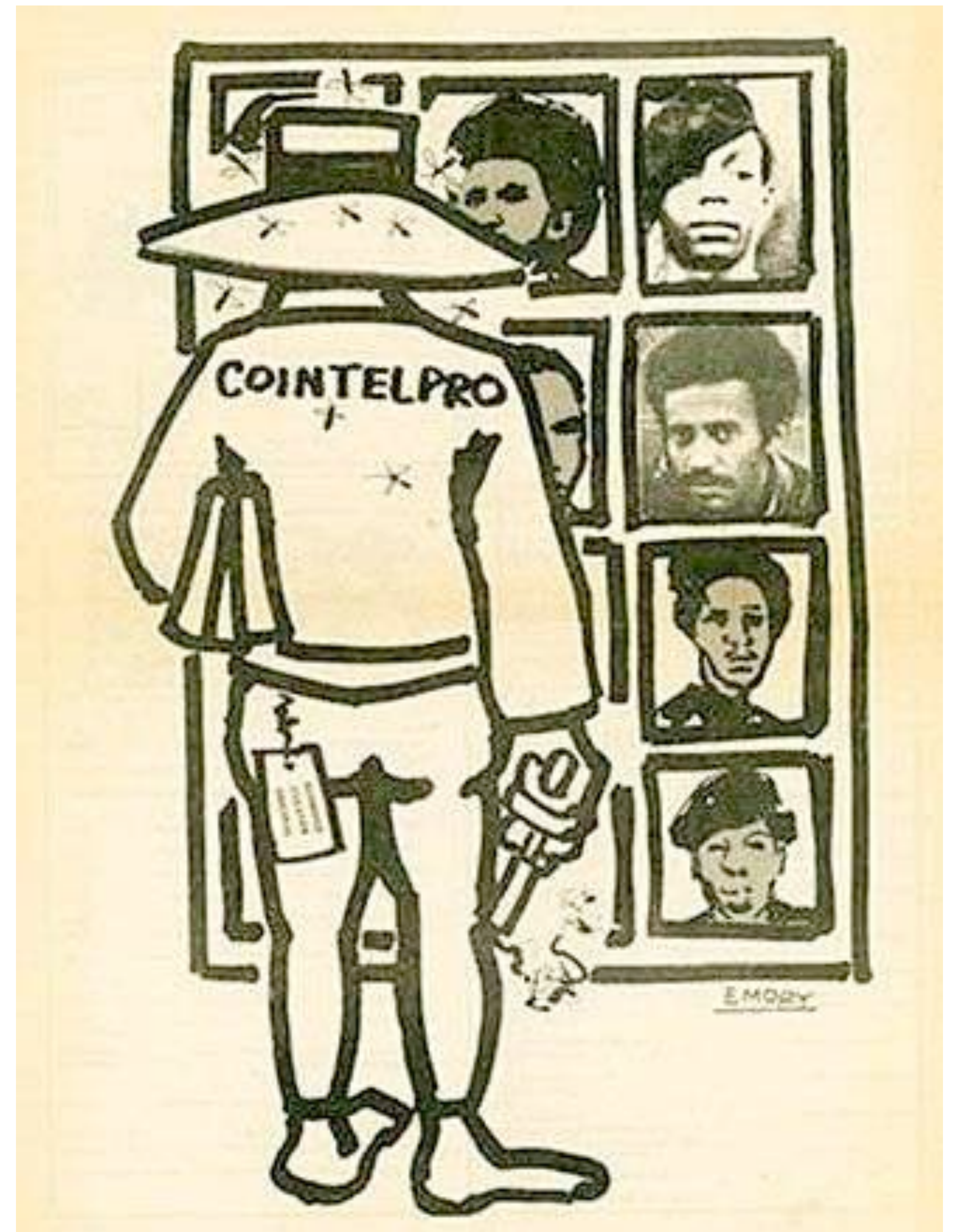
COINTELPRO

United States (1956–1971): Federal Bureau of Investigation (FBI) illegally & extensively surveils activists

Blurred Boundaries: Surveillance leads to assassination, incarceration

Fred Hampton (1948–1969)

Angela Davis   Mae Mallory   Ericka Huggins

COINTELPRO

United States (1956–1971): Federal Bureau of Investigation (FBI) illegally & extensively surveils activists

Blurred Boundaries: Surveillance leads to assassination, incarceration

The Church Committee Report (1975):

– Intimidation, manipulation, dragnet tactics

– No meaningful oversight & accountability

– Digital equivalents (Snowden 2013)

94TH CONGRESS } SENATE { REPORT
2d Session No. 94-755

FOREIGN AND MILITARY INTELLIGENCE

BOOK I

FINAL REPORT

OF THE

SELECT COMMITTEE
TO STUDY GOVERNMENTAL OPERATIONS

WITH RESPECT TO

INTELLIGENCE ACTIVITIES
UNITED STATES SENATE

TOGETHER WITH

ADDITIONAL, SUPPLEMENTAL, AND SEPARATE
VIEWS

APRIL 26 (legislative day, APRIL 14), 1976

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1976

69-983 O

Image Credit: U.S. Senate Select Committee on Intelligence (1975)

The Arab Spring

Many Countries (2010-2012): Tunisia, Libya, Egypt, Yemen, Syria, Bahrain, Morocco, Iraq, Algeria, Lebanon, Jordan, Kuwait, and many more with minor protests

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The Role of Social Media

– Speed, Scope, and Scale (Rosenbloom 2021)

– Facilitator rather than direct or independent cause of chage

Image Credits: Amin Ansari (2012), Anna Lena Schiller (2012), Wikimedia Commons (2011)

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Inspired Countless Movements

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Modes of Suppression (Borradaile 2021; Boykoff 2007)

1. Direct Violence

2. The Legal System

3. Employment Deprivation

4. Conspicuous Surveillance

5. Covert Surveillance

6. Deception

7. Mass Media Influence

Modes of Suppression (Borradaile 2021; Boykoff 2007)

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*Information Technology Interference

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*Confidentiality, Anonymity

*Integrity, Trust

Be Safe or Be Seen? (Lokot 2018)

Ethnographic Observation of Anti-Corruption Foundation Activists (Russia)

Image Credit: Evgeny Feldman/AP (2018)

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Conspicuous Security:

Tools and Education
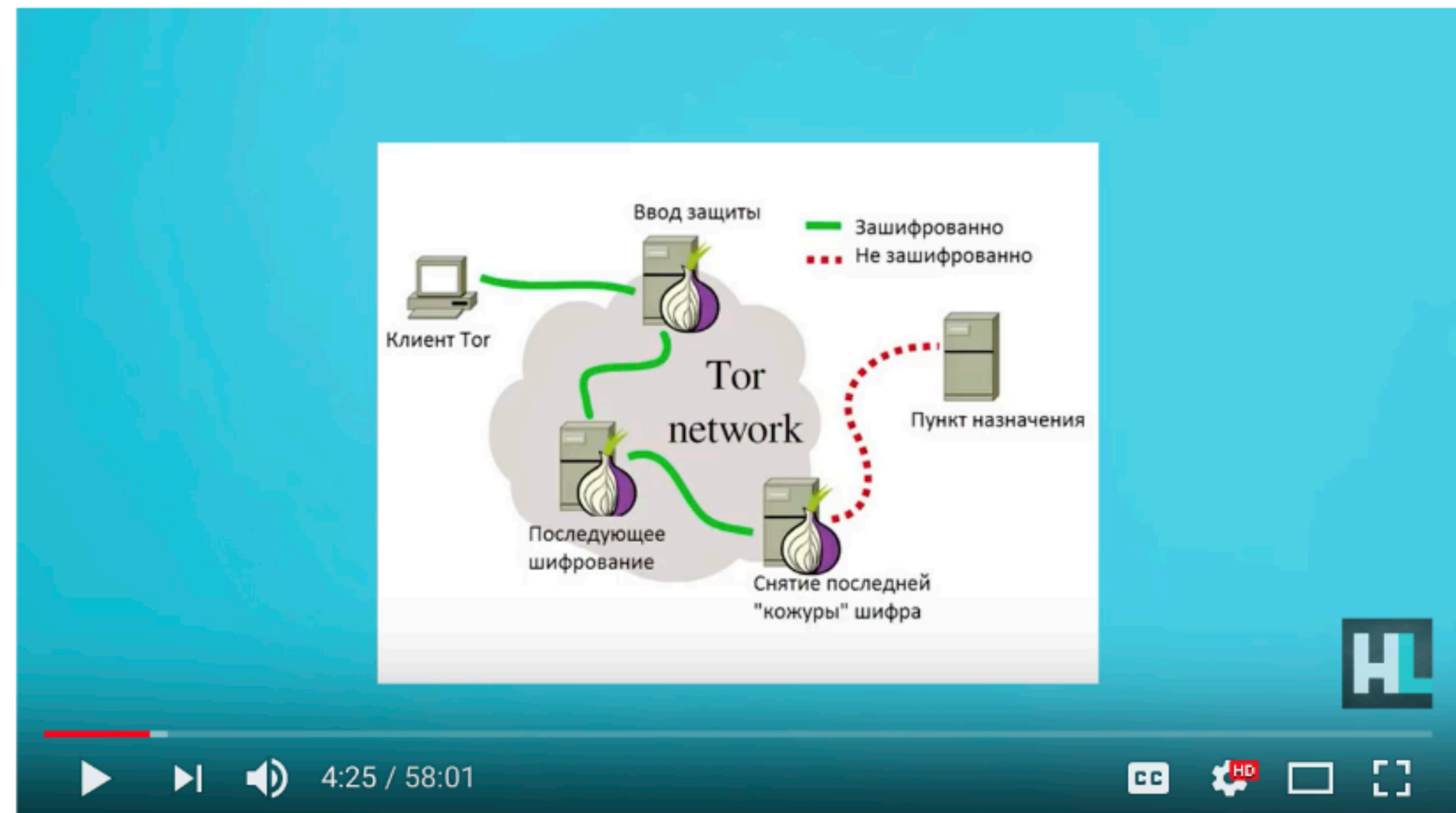
Figure 2. Screen grab from YouTube talk show "The Cloud," hosted by Leonid Volkov, explaining the basics of the Tor network. Episode 002 was devoted to online anonymity and circumventing website blocks.

Image Credit: Lokot (2018)

Be Safe or Be Seen? (Lokot 2018)

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Conspicuous Security:

Tools and Education

Strategic Visibility:

Transparency and Community
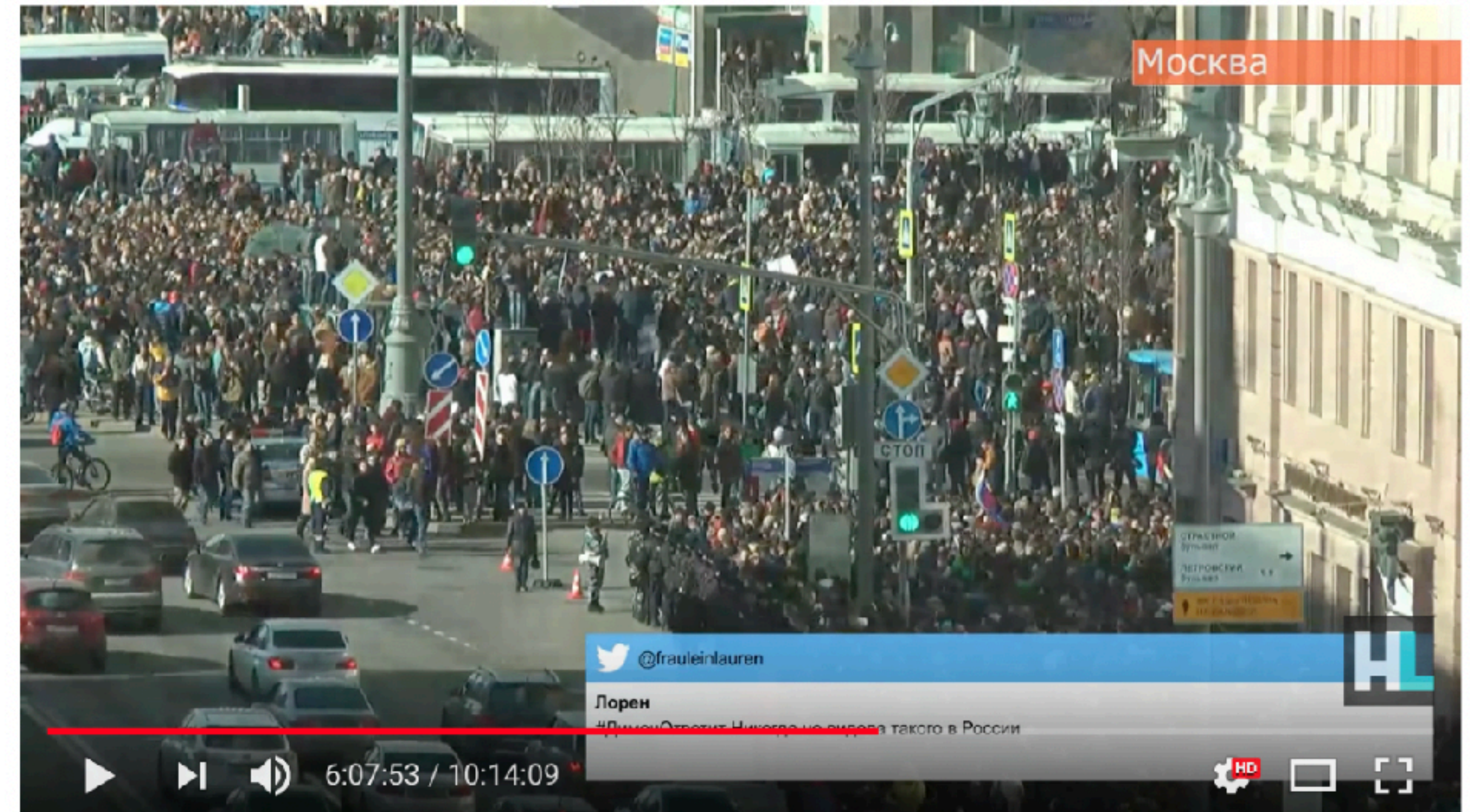
#ДимонОтветит. Митинги 26 марта по всей России. Прямой эфир

4,762,102 views   128K   17K   SHARE

Figure 3. Screen grab of YouTube live stream syndicated by FBK during the March 26, 2017, anti-corruption protests in Russia.

Image Credit: Lokot (2018)

Be Safe or Be Seen? (Lokot 2018)

Ethnographic Observation of Anti-Corruption Foundation Activists (Russia)

Conspicuous Security:
Tools and Education

Strategic Visibility:
Transparency and Community

Hong Kong (Albrecht et al. 2021): Bigger public groups, smaller encrypted groups with rigorous onboarding process

Digital Trust is Physical Trust (Rosenbloom 2020)

Semi-Structured Interviews with 50 Black Lives Matter Activists (U.S.)

Image Credit: Tyger Williams/AP (2020)

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Dangers of Immediacy, Anonymity:

Lack of information integrity online

Image Credit: Jason Peters (2020)

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Direct Action Decision-Making:

Word of mouth, community evaluation

Image Credits: Jason Peters (2020), Matt Rourke/AP (2020)

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Dangers of Immediacy, Anonymity:

Lack of information integrity online

Direct Action Decision-Making:

Word of mouth, community evaluation

Hong Kong (Albrecht et al. 2021): face-to-face preceeds phone-to-phone because "'standing on the front line together is very important for trust' (P10)"

Device Compromise and Deletion (Albrecht et al. 2021)

Semi-Structured Interviews with 11 Anti-ELAB Protesters (Hong Kong)

Image Credit: Anthony Kwan/Getty (2019)

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Full Compromise Security:

Detection and mitigation
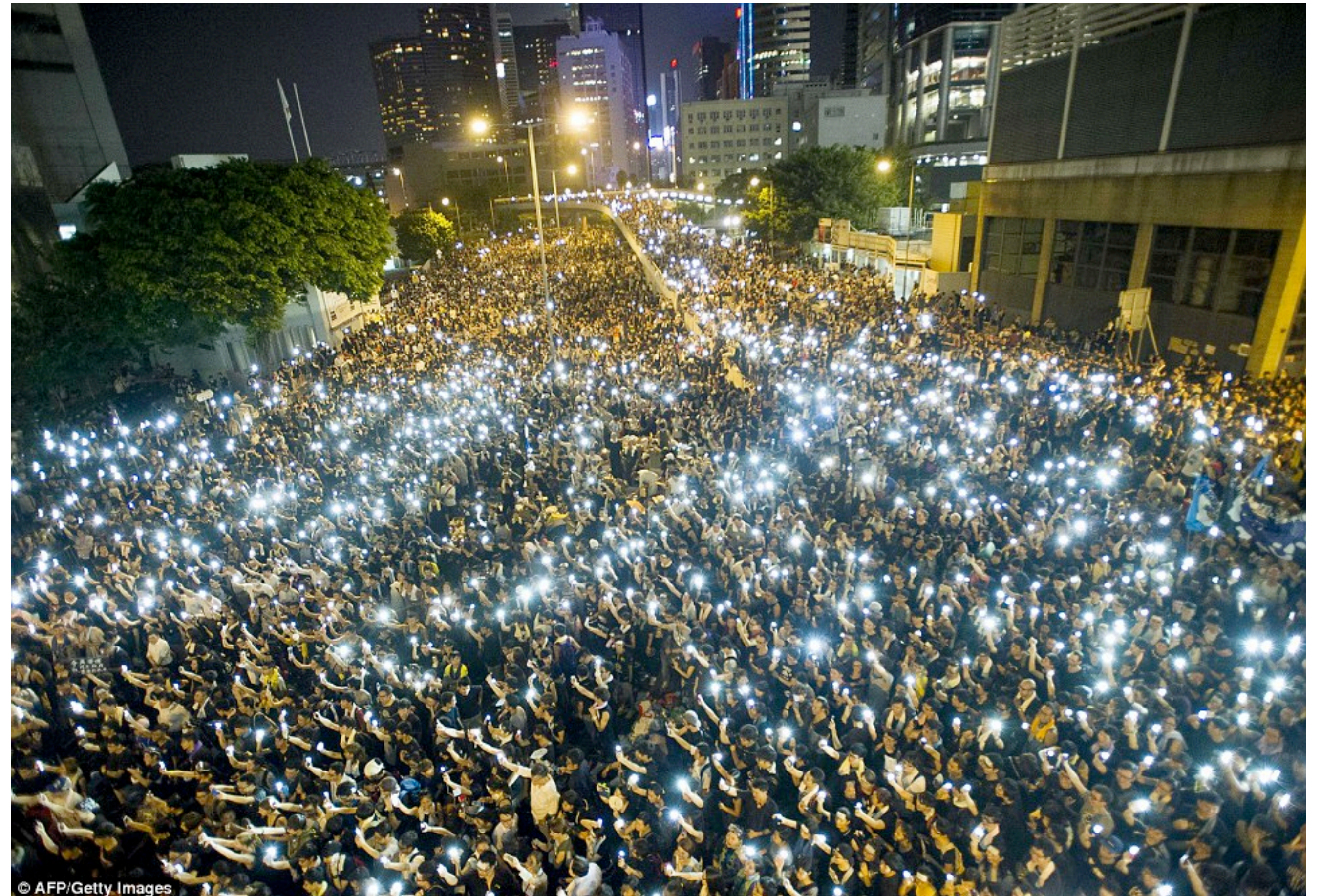
Image Credit: AFP/Getty (2019)

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Full Compromise Security:

Detection and mitigation

Scheduled v. Remote Deletion:

Arrest compromises contacts, logs

Why Telegram?

Private

Telegram messages are heavily encrypted and can self-destruct.
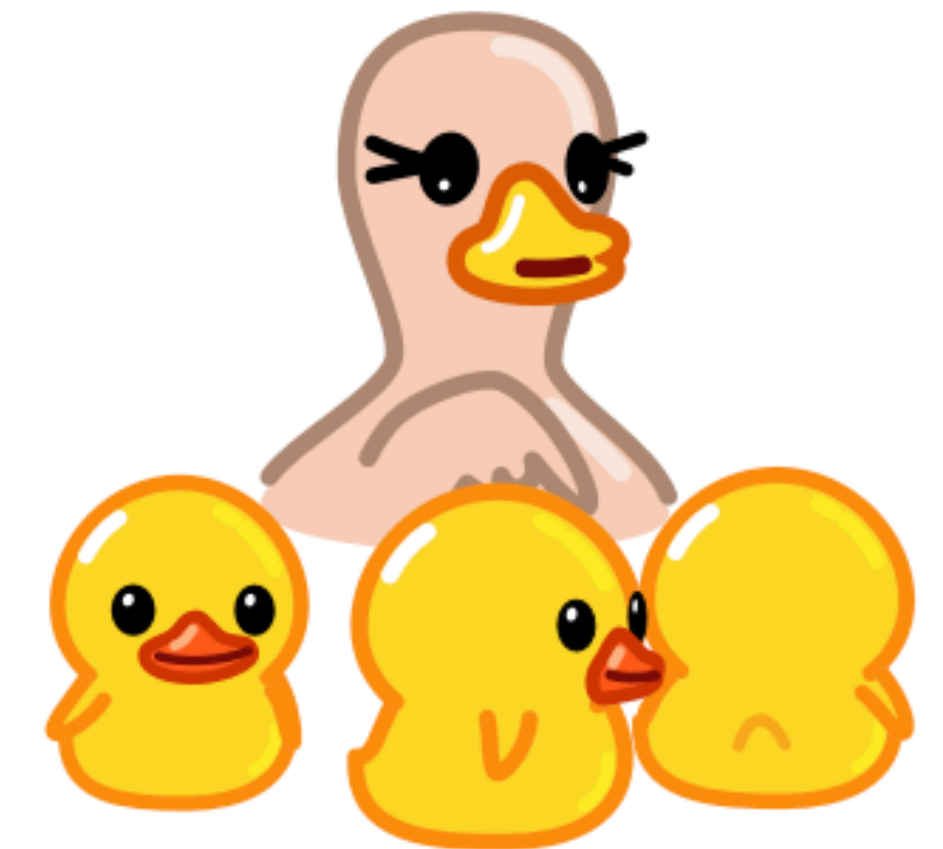
Social

Telegram groups can hold up to 200,000 members.

Image Credit: Telegram

Device Compromise and Deletion (Albrecht et al. 2021)

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Full Compromise Security:

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Collective Security Culture (Borradaile 2021): Group reflex to minimize information sharing, digitizing, and retaining

Image Credit: Alamy Live News (2019)

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tigro: Trust Infrastructure for Grassroots Organizing

How might we use cryptographic tools to adapt the existing trust and communication protocols of grassroots organizers from physical to digital spaces,

without increasing the risk of surveillance, disinformation, and infiltration of grassroots movements?

tigro: Trust Infrastructure for Grassroots Organizing

One Size Fits One: Flexible library of primitives; applies (private) trust network information to any digital setting

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Toward Full Compromise Security: Contacts hold minimal information; anyone with shared key can delete

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Grassroots Optimization: Individual device computation v. server computation over relatively small data sets

tigro Adversarial Model

How might we model <u>existing threats</u> and <u>mitigation strategies</u> in digital space?

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Digital Infiltration Adversary

– collects and aggregates as much information as possible

– corrupts (subpoenas) the server, corrupts (seizes) devices

– poses as a group member, spreads false information, entraps

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Semi-Honest Server: Privacy and Correctness

Malicious Server: Privacy but Not Correctness, Deletion

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Malicious Server: Privacy but Not Correctness, Deletion

Security Strategy

Establish digital equivalents of existing security practices

Establishing Security = Trust

Human trust as a core digital security concept

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Human trust as a core digital security concept

One Size Fits One

How organizers build and assess trust depends on:

– the person, place, or thing to be trusted (profiles, events, posts)

– the risk level associated with trust

– personal experience, collective security culture, etc.

Establishing Security = Trust

Human trust as a core digital security concept

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"Grounded" Cryptographic Protocols

Digital trust reduces to:

- physical interactions that establish "grounded pairs"

- qualitative trust measurements between grounded pairs

tigro Core Protocols

Ground Trust Ceremony

Like a key signing ceremony in spirit, but:

- Establishes a symmetric key linked to a physical meeting
- No PKI: digital activity is not linkable to a persistent identifier

tigro Core Protocols

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Grounded Annotation System

Allows grounded pairs to share digital annotations of arbitrary people, places, and things

tigro Core Protocols

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(Grounded) Trust Metrics

Quantify trust using social network analytics (eg. HITS algorithm)

Ground Trust Ceremony
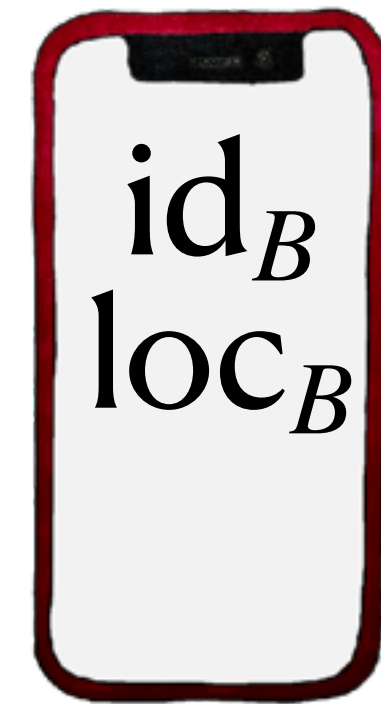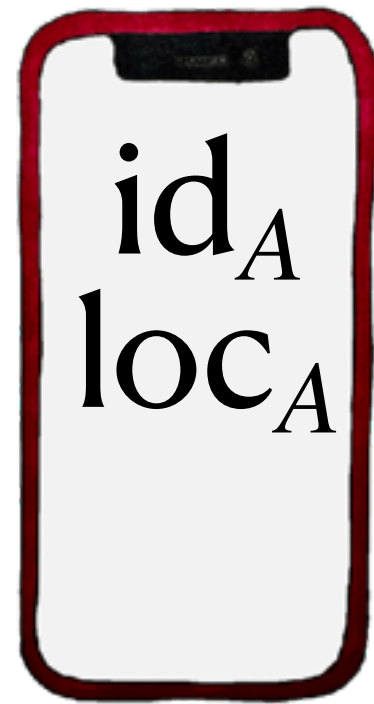
Ground Trust Ceremony

$\mathcal{F}$GKA

Grounded Key
Agreement
Ideal Functionality

id_A
loc_A

Alice

id_B
loc_B

Bob

Ground Trust Ceremony

Ground Trust Ceremony

$\mathcal{F}$ GKA

Grounded Key
Agreement
Ideal Functionality

$$\text{if } loc_A = loc_B :$$
$$k_{AB} \leftarrow_{\$} \{0,1\}^{\lambda}$$

id_A
loc_A

Alice

id_B
loc_B

Bob

Ground Trust Ceremony

$\mathcal{F}$ GKA

Grounded Key
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k_{AB}

k_{AB}

Alice

id_A
loc_A

id_B
loc_B

Bob
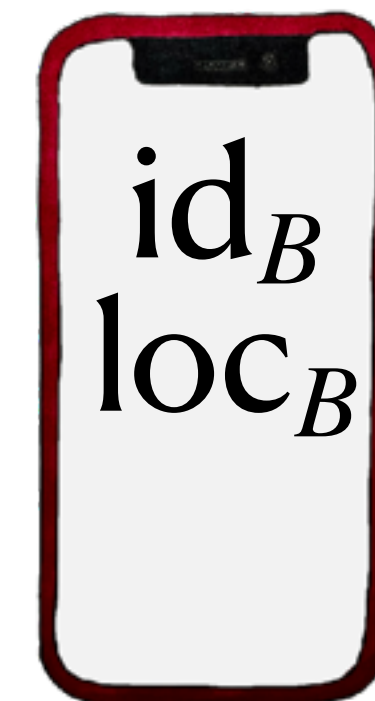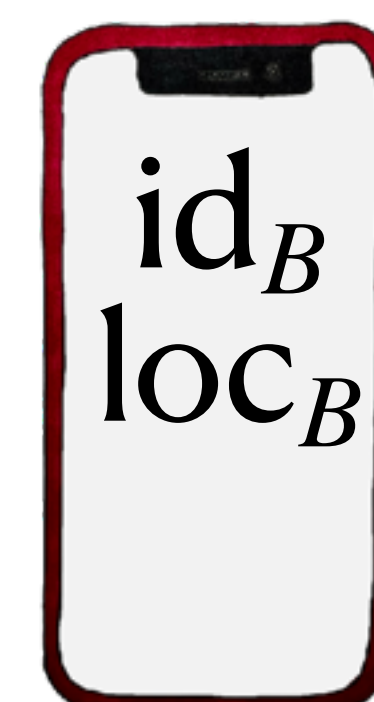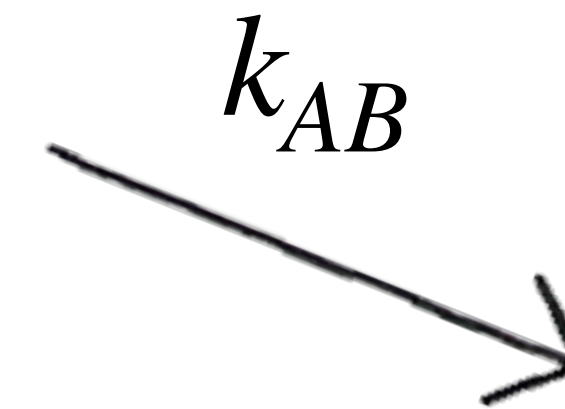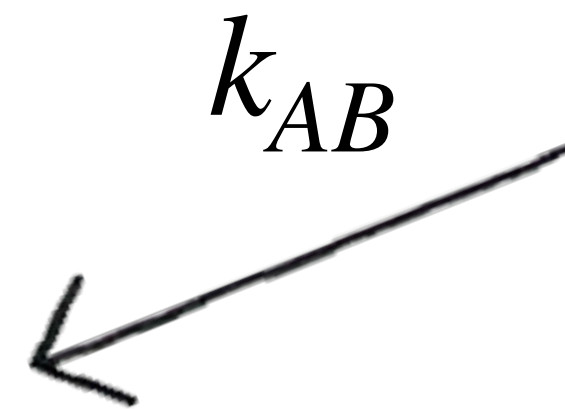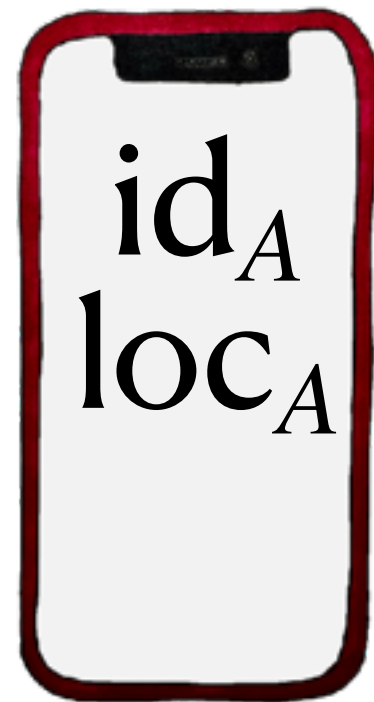
Ground Trust Ceremony

$\mathcal{F}_{GKA}$

Grounded Key
Agreement
Ideal Functionality

Alice

id_A
loc_A
k_{AB}

id_B
loc_B
k_{AB}

Bob

Ground Trust Ceremony

id$_A$

Alice

In practice, we can replace the key agreement ideal functionality with Diffie–Hellman over QR code exchange.

id$_B$

Bob
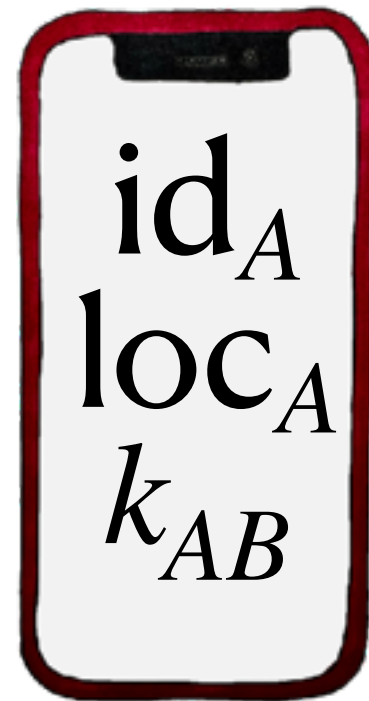
Ground Trust Ceremony

In practice, we can replace the key agreement ideal functionality with Diffie-Hellman over QR code exchange.

Alice and Bob can run further computations over an authenticated Bluetooth channel.

Ground Trust Ceremony

Alice

$$\text{id}_A$$
$$\text{loc}_A$$
$$k_{AB}$$
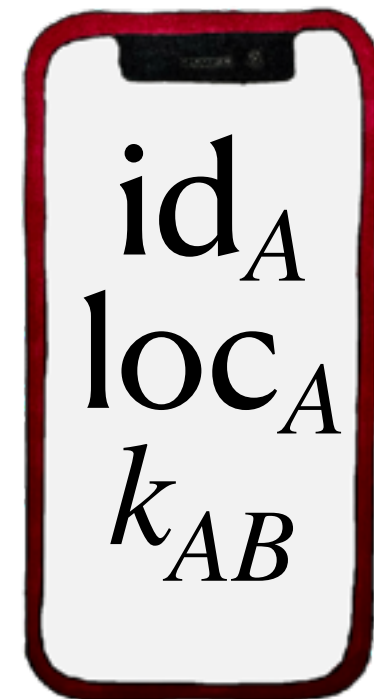
Alice and Bob now
share a key that is
rooted in their
<u>physical interaction</u>.

$$\text{id}_B$$
$$\text{loc}_B$$
$$k_{AB}$$
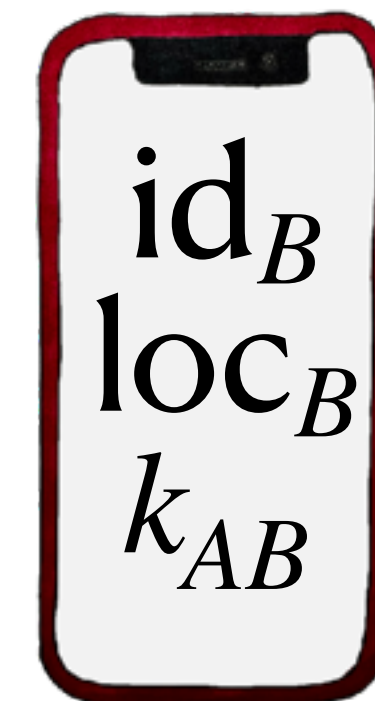
Bob

Annotation System
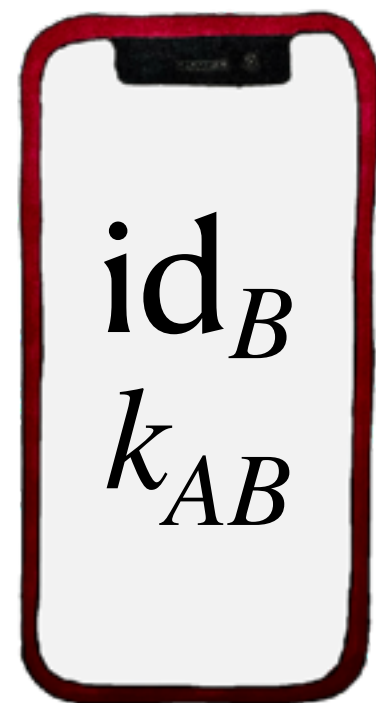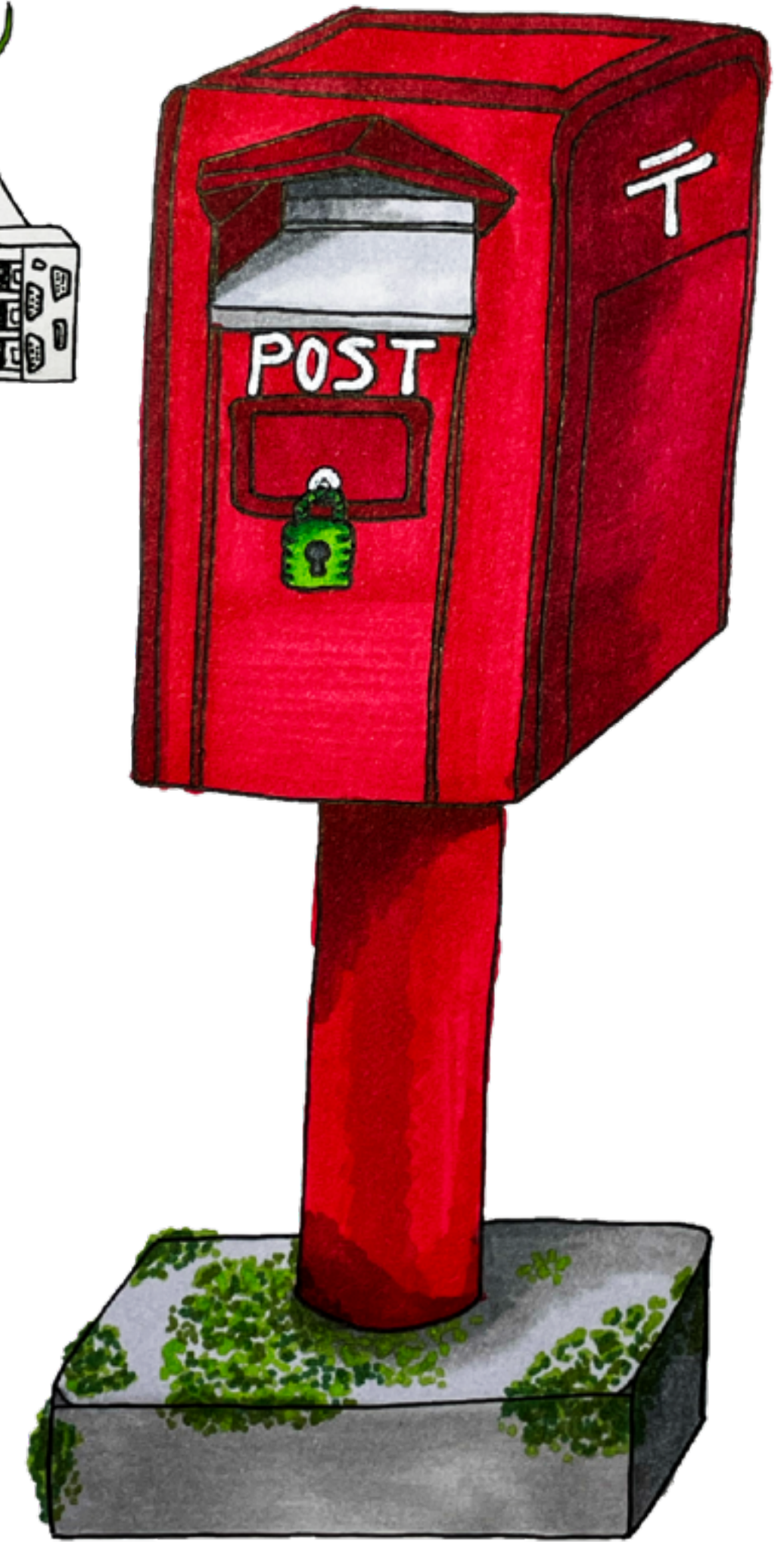
Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Tigro Server

Shared Encrypted Mailbox (EMB)

Annotation System

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}
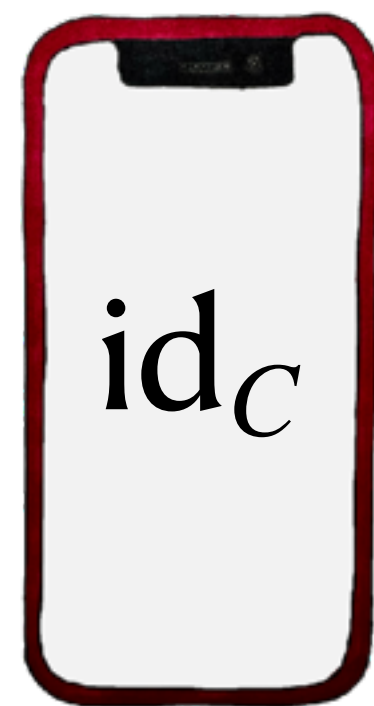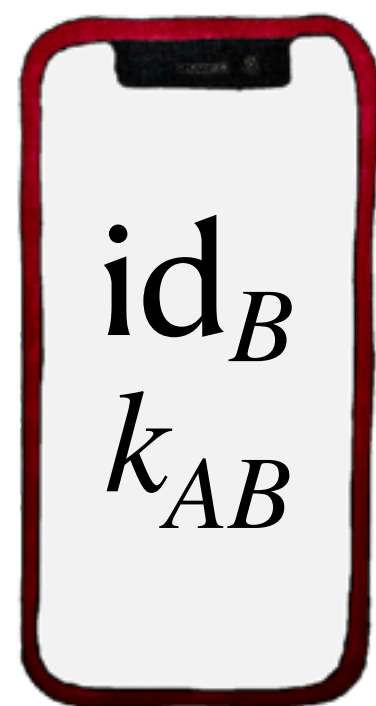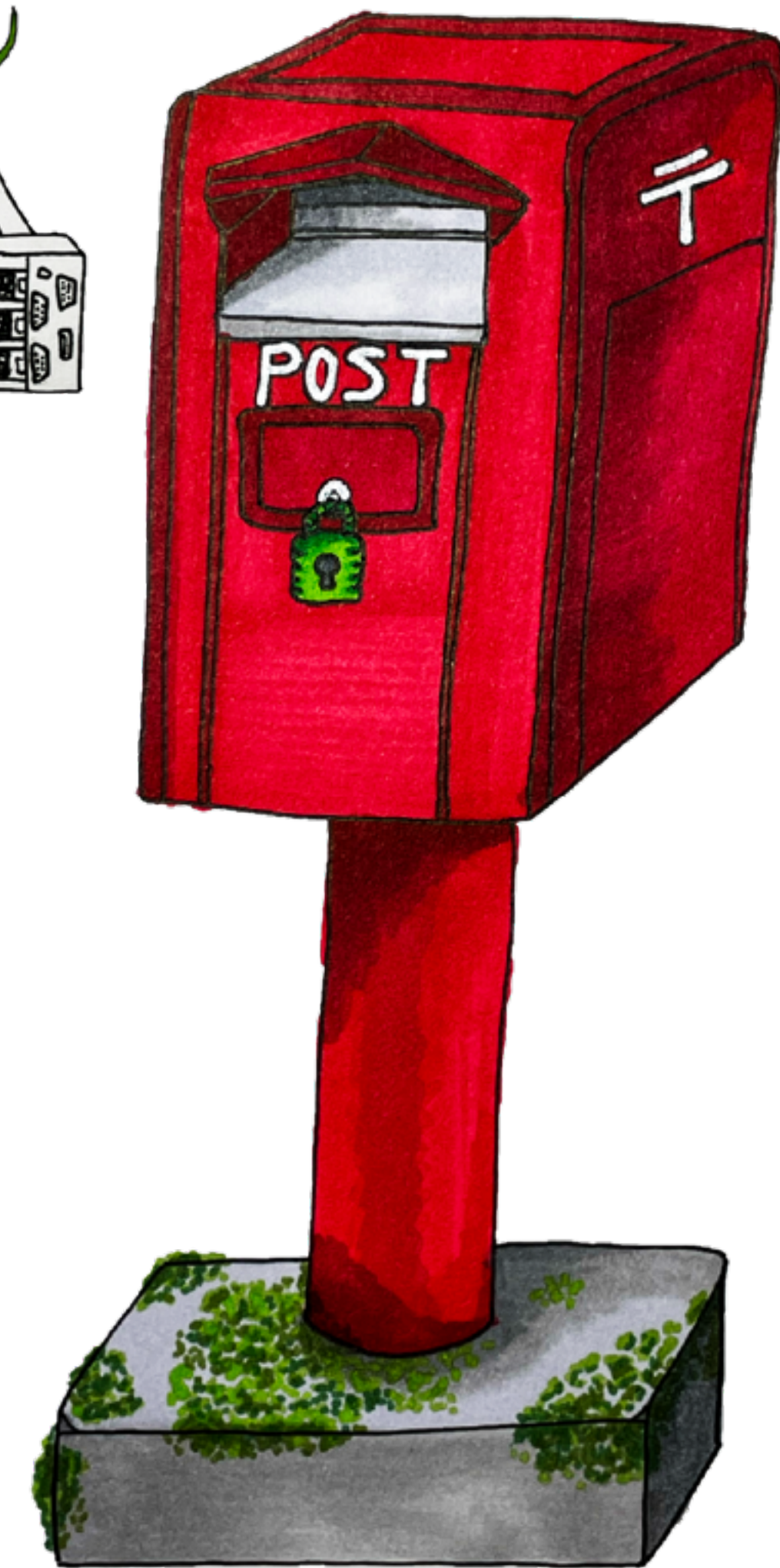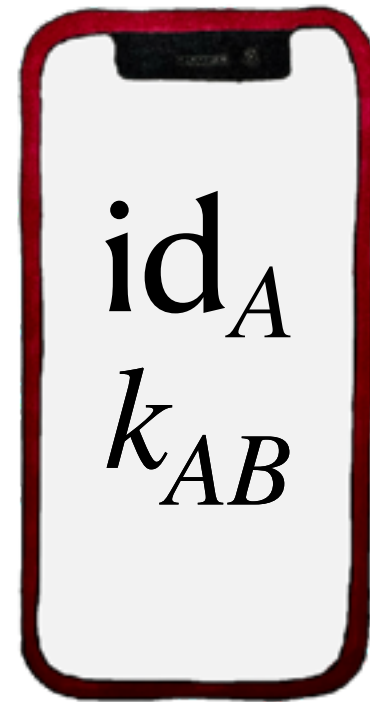
Annotate id_C :
I met them at a
mutual aid event.
They seem
trustworthy.

Tigro
Server

POST

Shared Encrypted
Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}
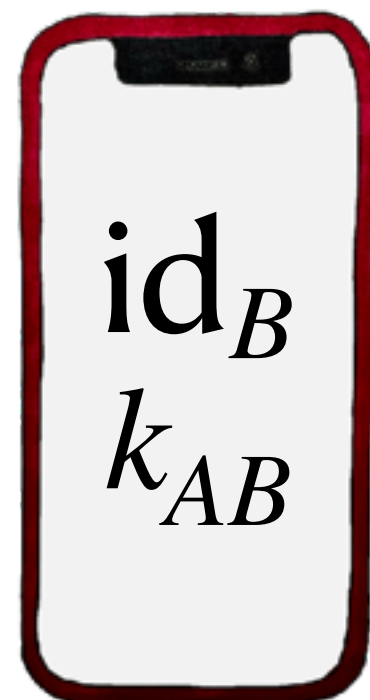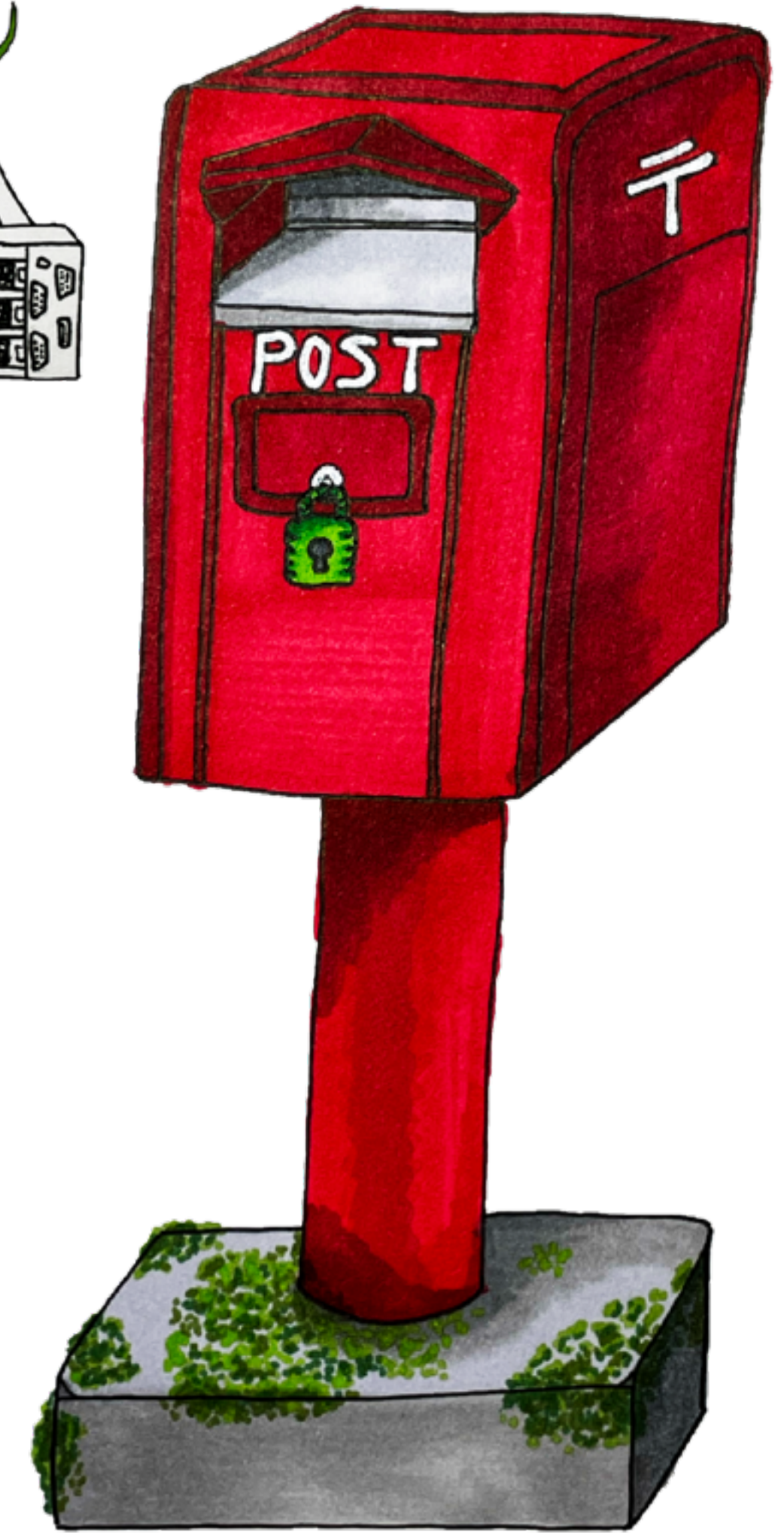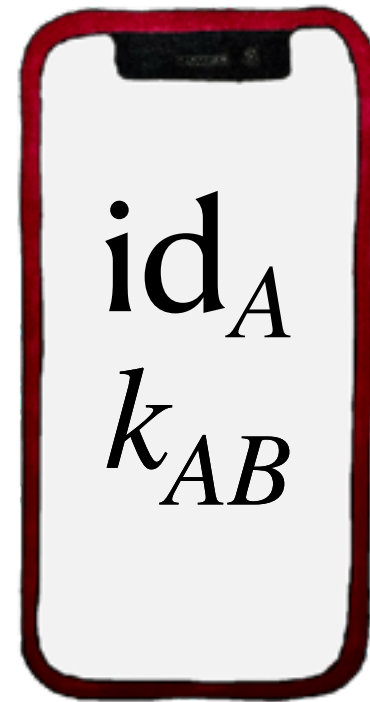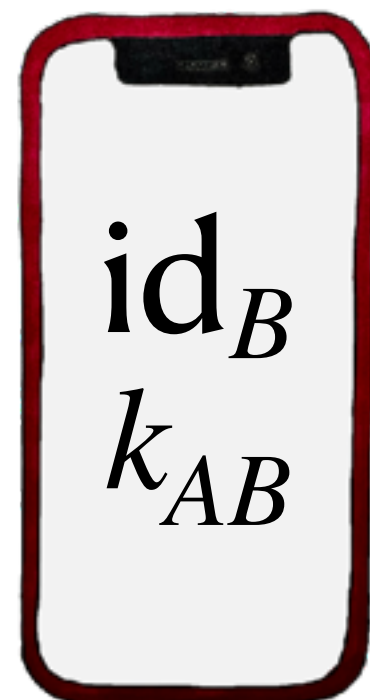
Annotate id_C :
This person was agitating at a sit-in. Vibes were off.

Tigro Server

Shared Encrypted Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob
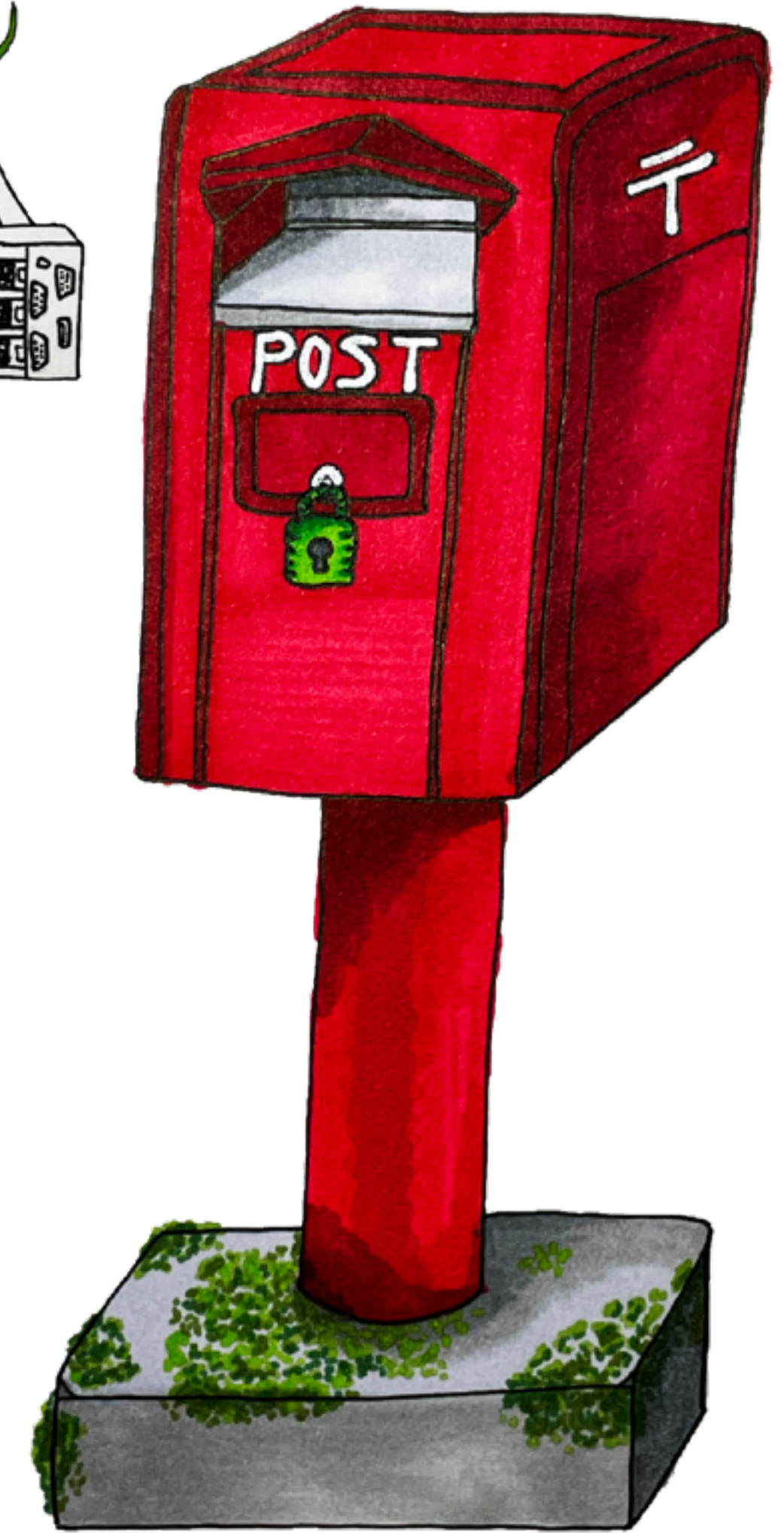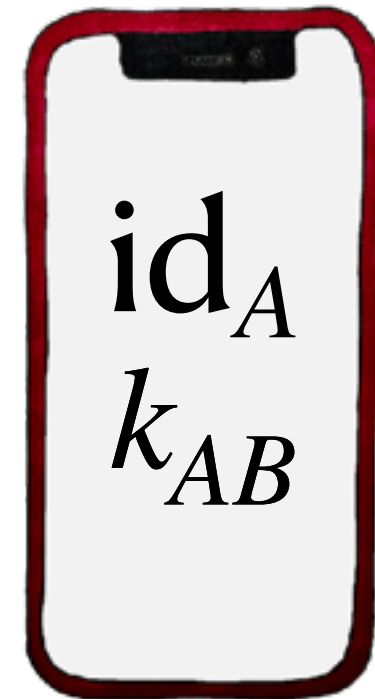
id_B
k_{AB}
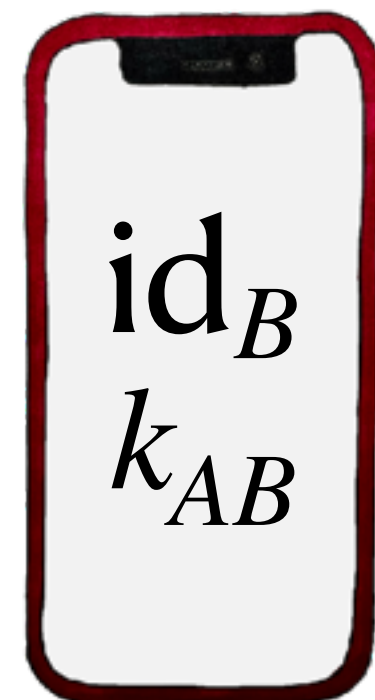
SendMail
$[id_C, \mathbf{anno}]_{k_{AB}}$

Tigro Server
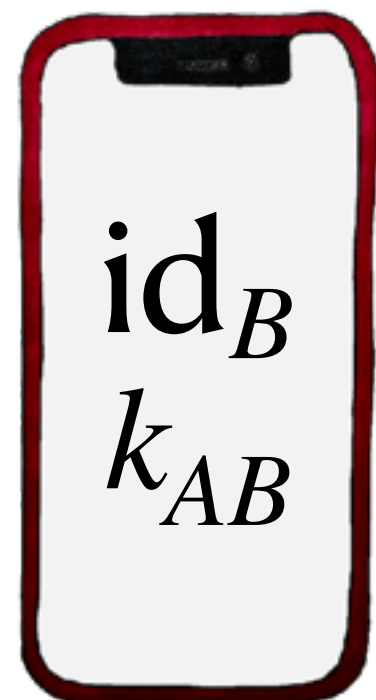
Shared Encrypted
Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Tigro Server

$[id_C, \mathbf{anno}]_{k_{AB}}$

Shared Encrypted Mailbox (EMB)
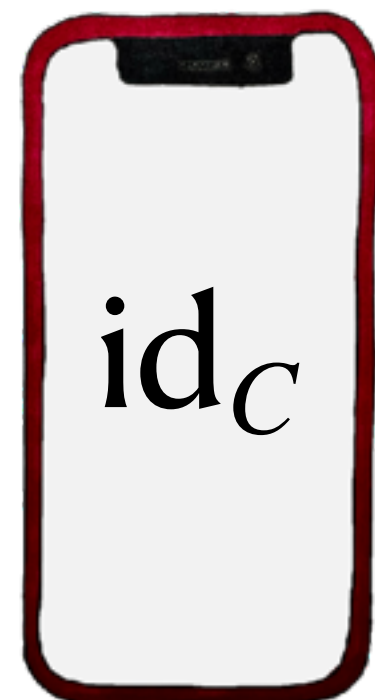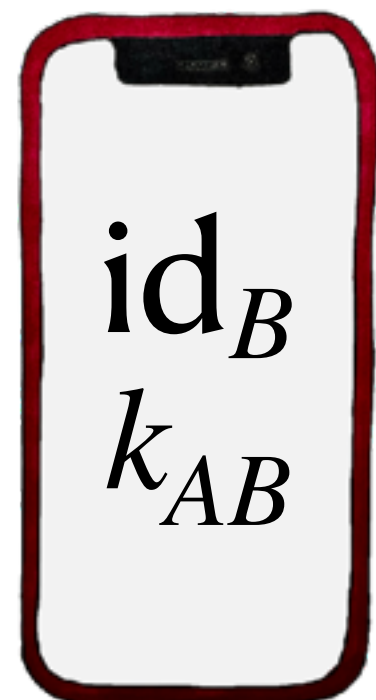
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k_{AB}

Bob
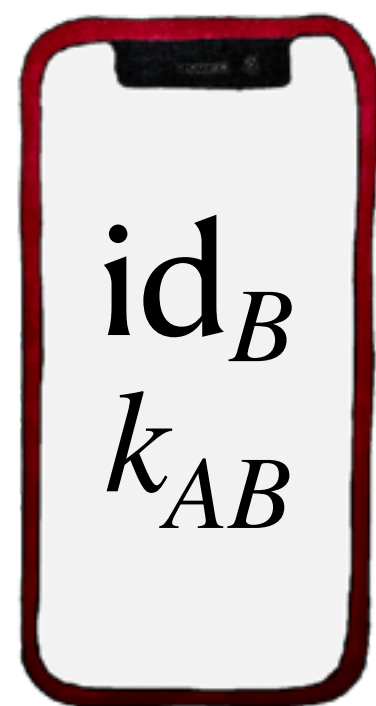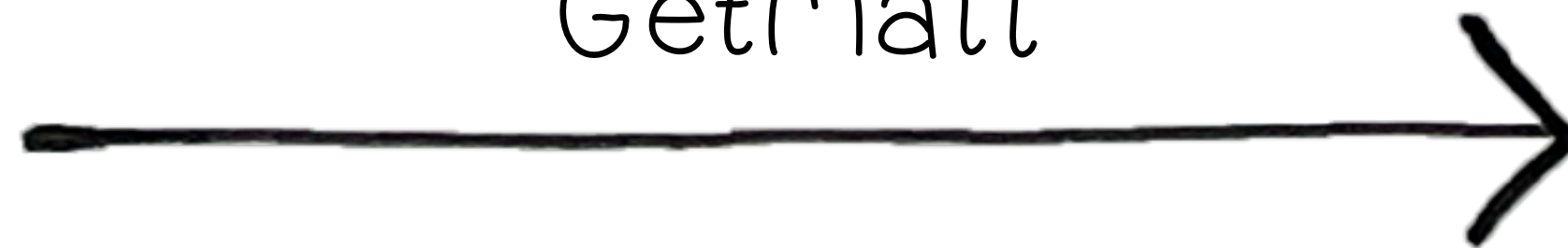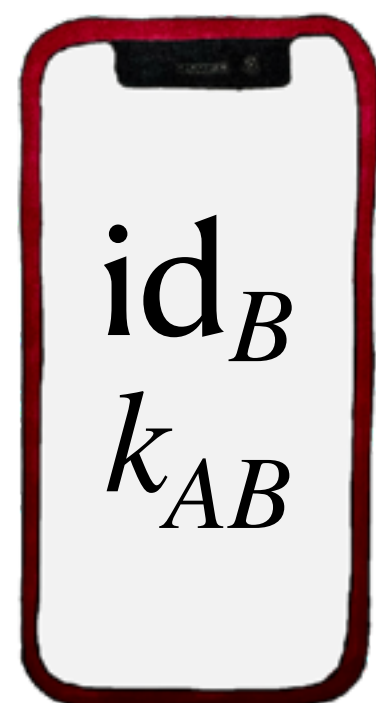
$\mathbf{id}_B$
k_{AB}

GetMail

$[id_C, \mathbf{anno}]_{k_{AB}}$

Shared Encrypted
Mailbox (EMB)
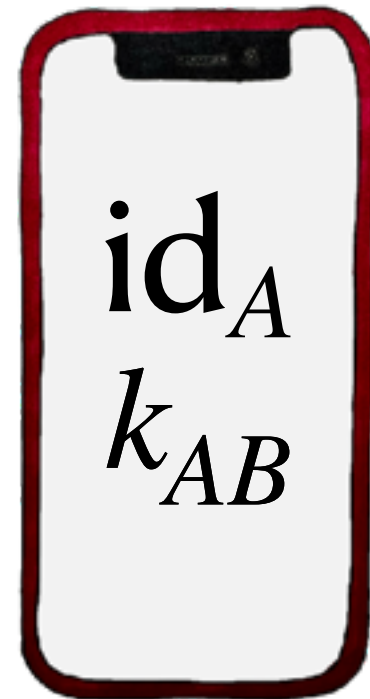
Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Event:
Protest
Organizer:
Eve

Tigro
Server

Shared Encrypted
Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Event:

Protest

Organizer:

Eve

oid_E

Tigro Server

Shared Encrypted Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}
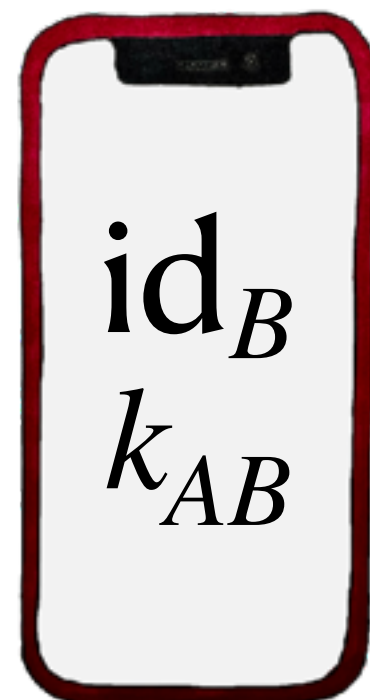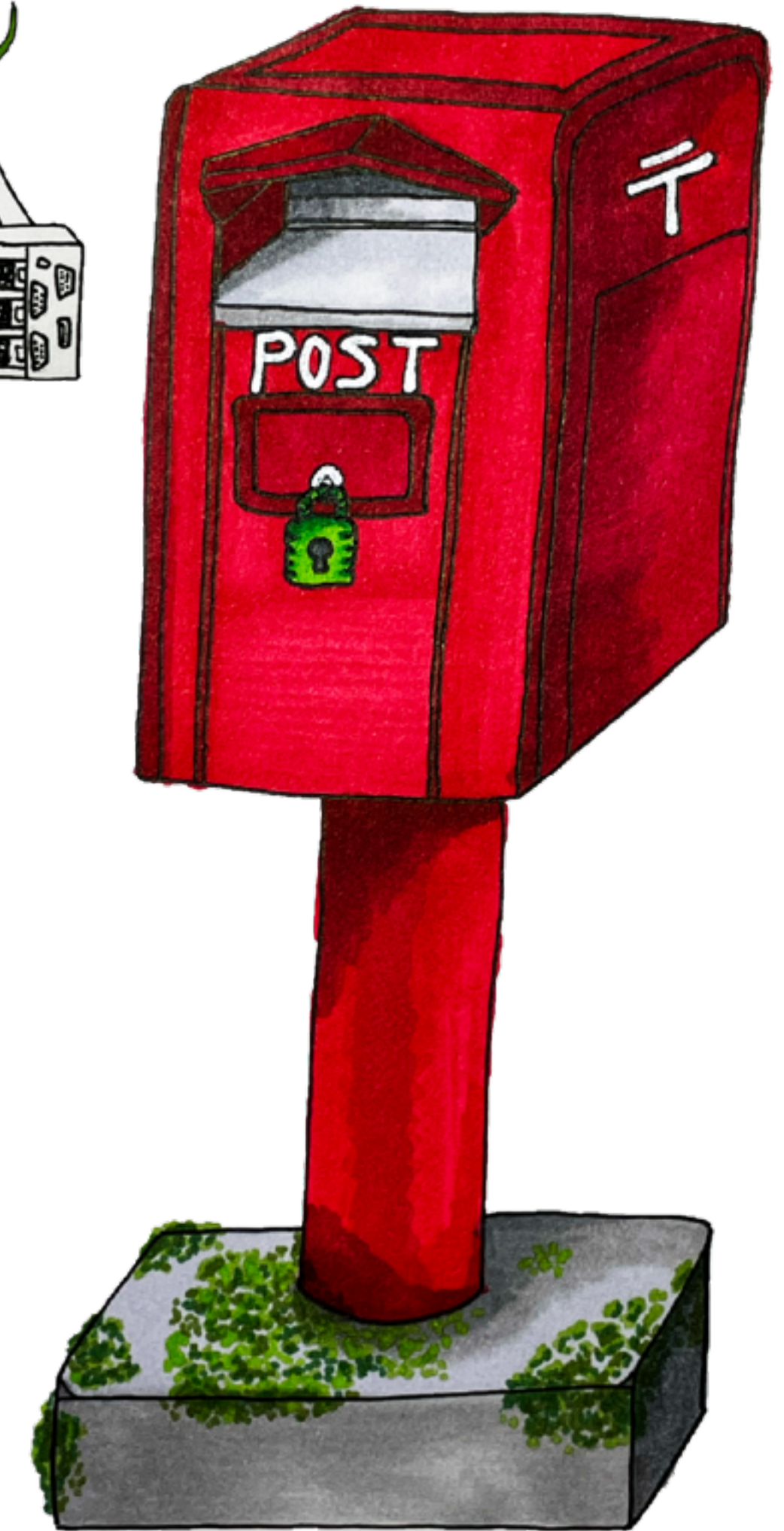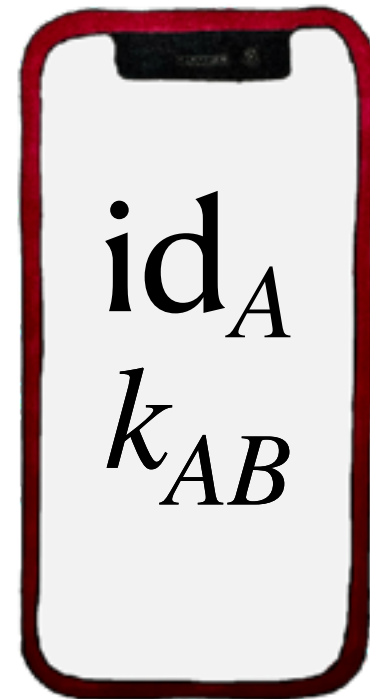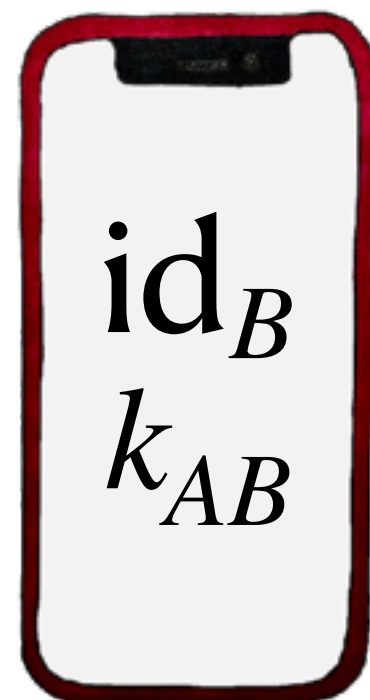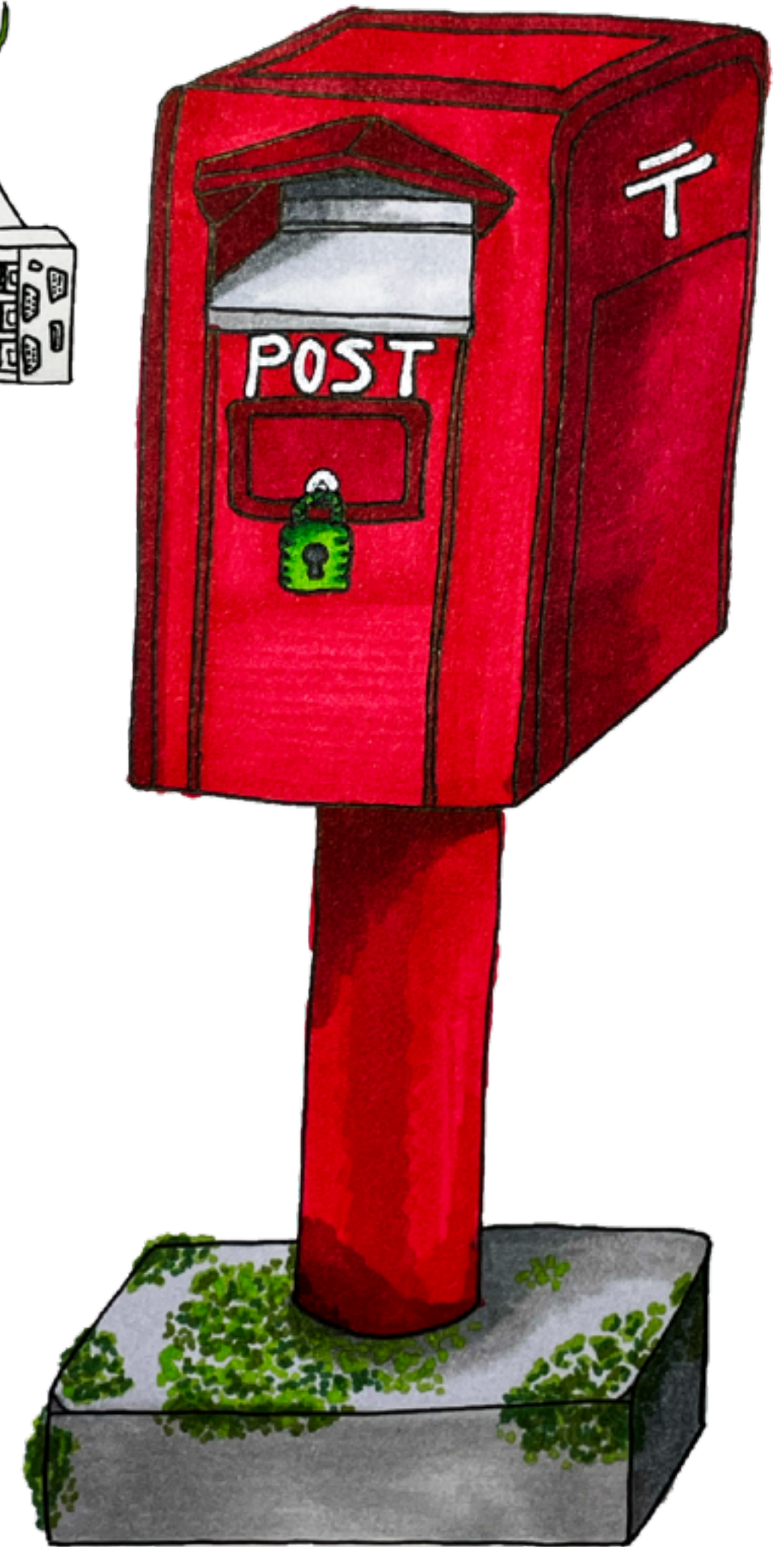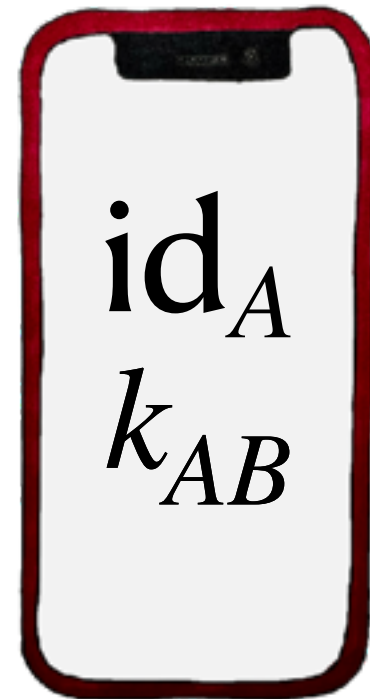
Annotate $\mathbf{oid}_E$: This event is being organized by friends. Hope to see you there.

Bob

id_B
k_{AB}

Tigro Server

POST

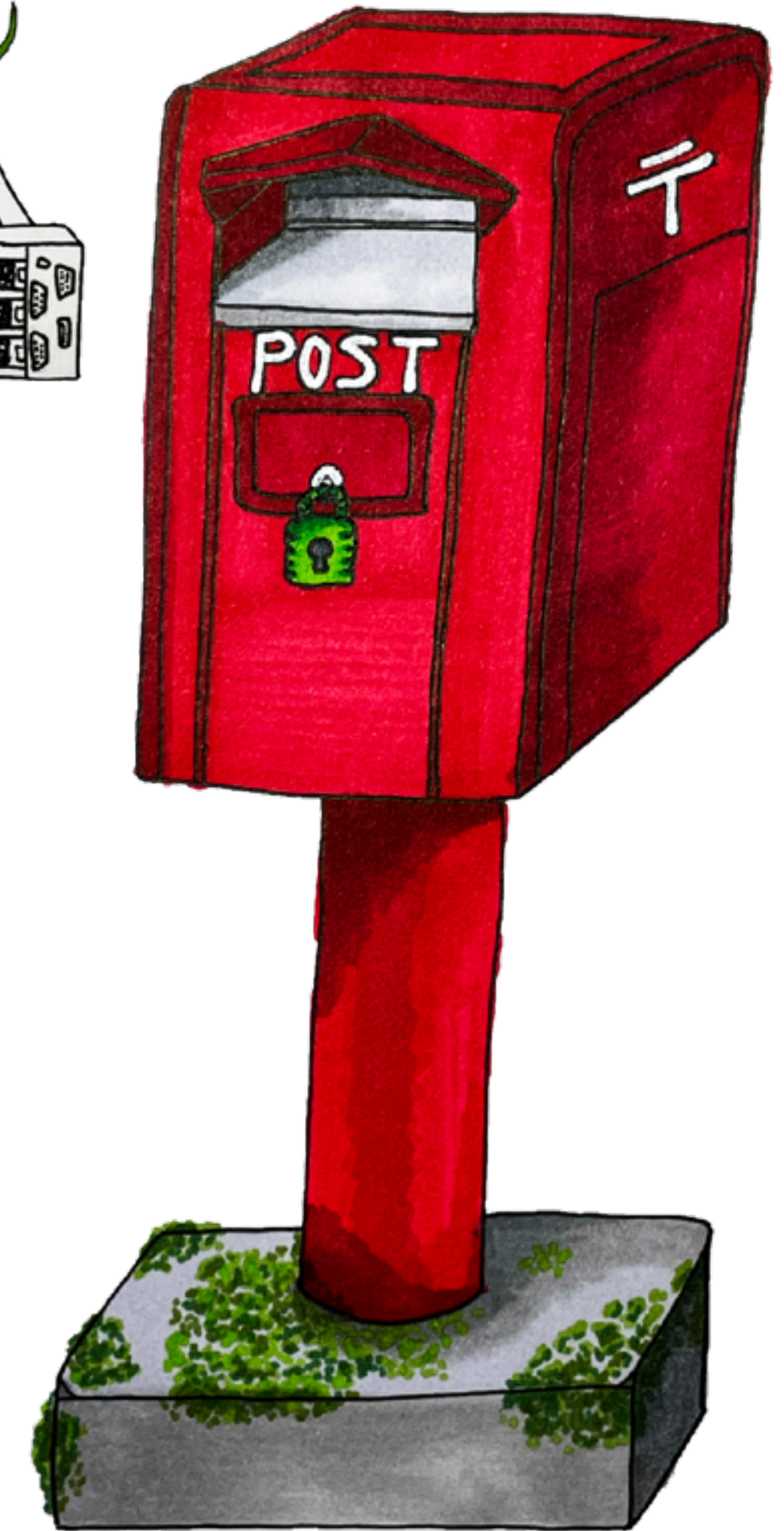Shared Encrypted Mailbox (EMB)

Annotation System

Alice

$\mathbf{id}_A$
k_{AB}

Bob

$\mathbf{id}_B$
k_{AB}
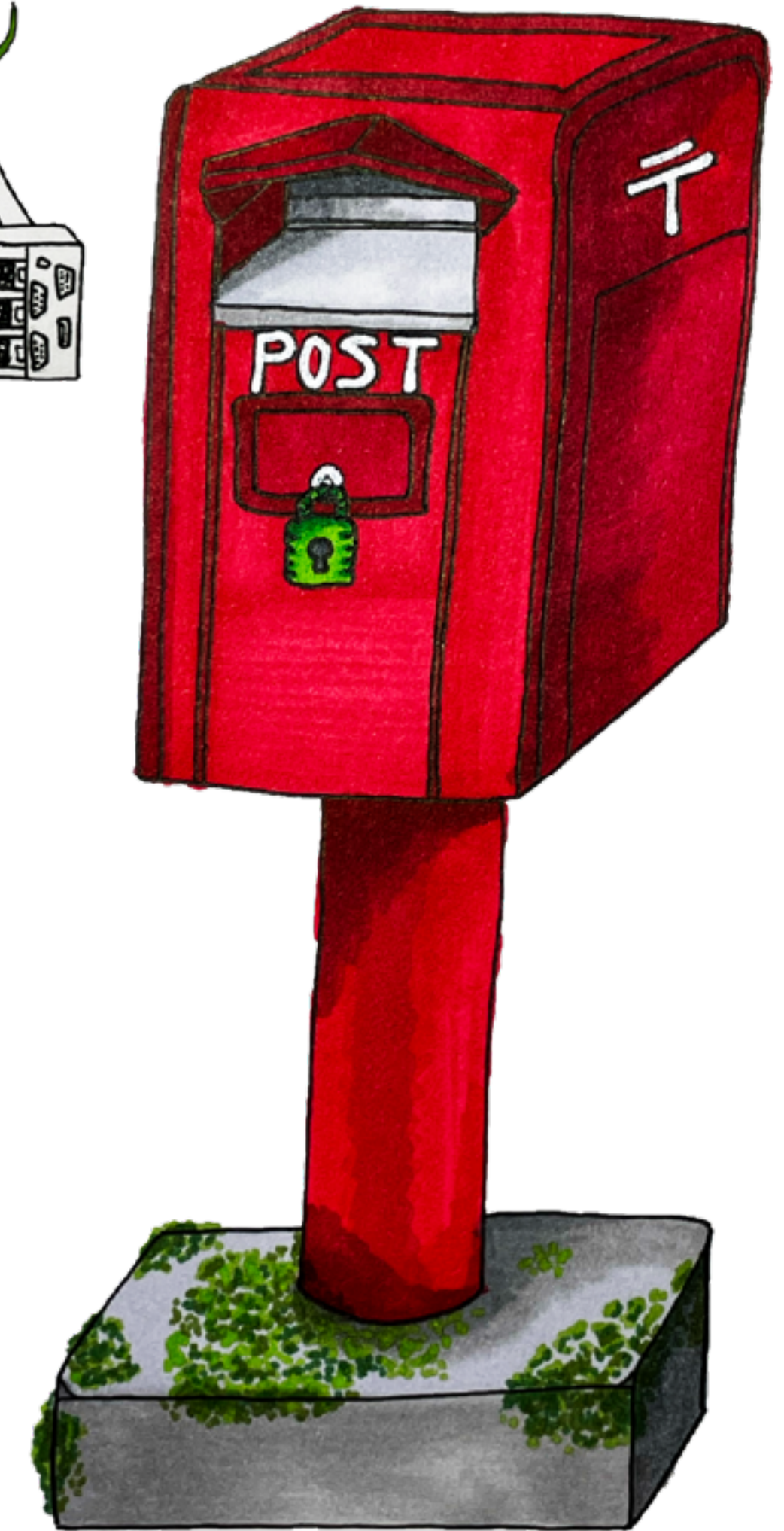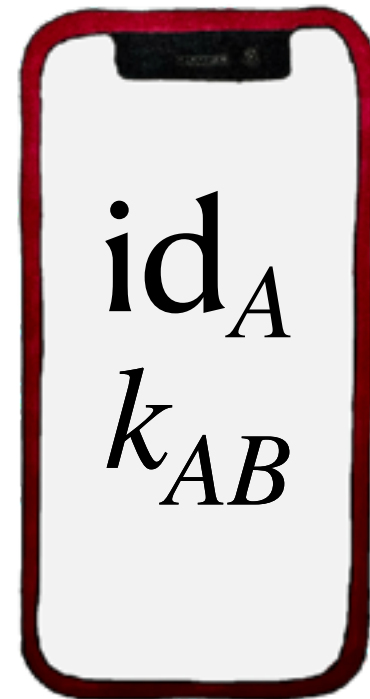
Annotate $\mathbf{oid}_E$: No one I know can confirm the identity of Eve. Proceed with caution.
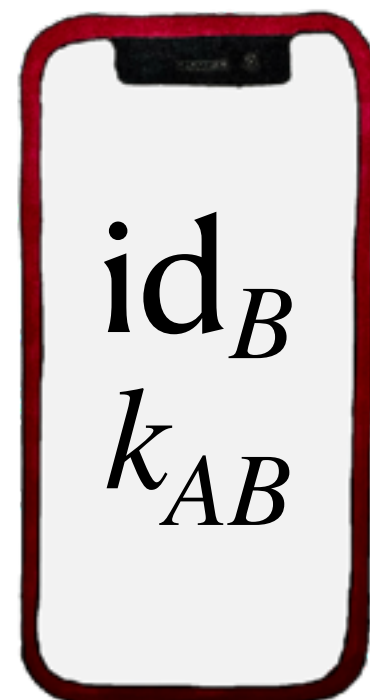
Tigro Server

Shared Encrypted Mailbox (EMB)
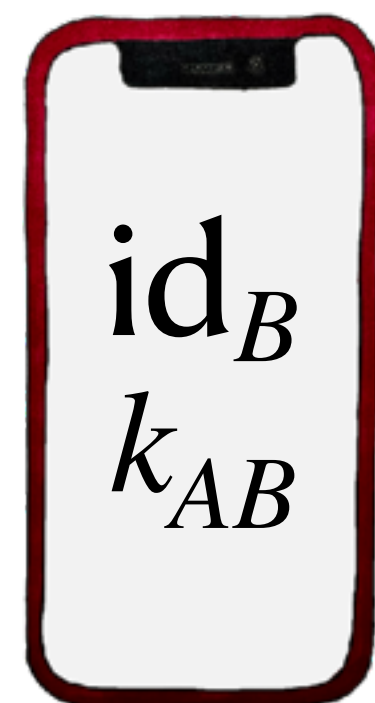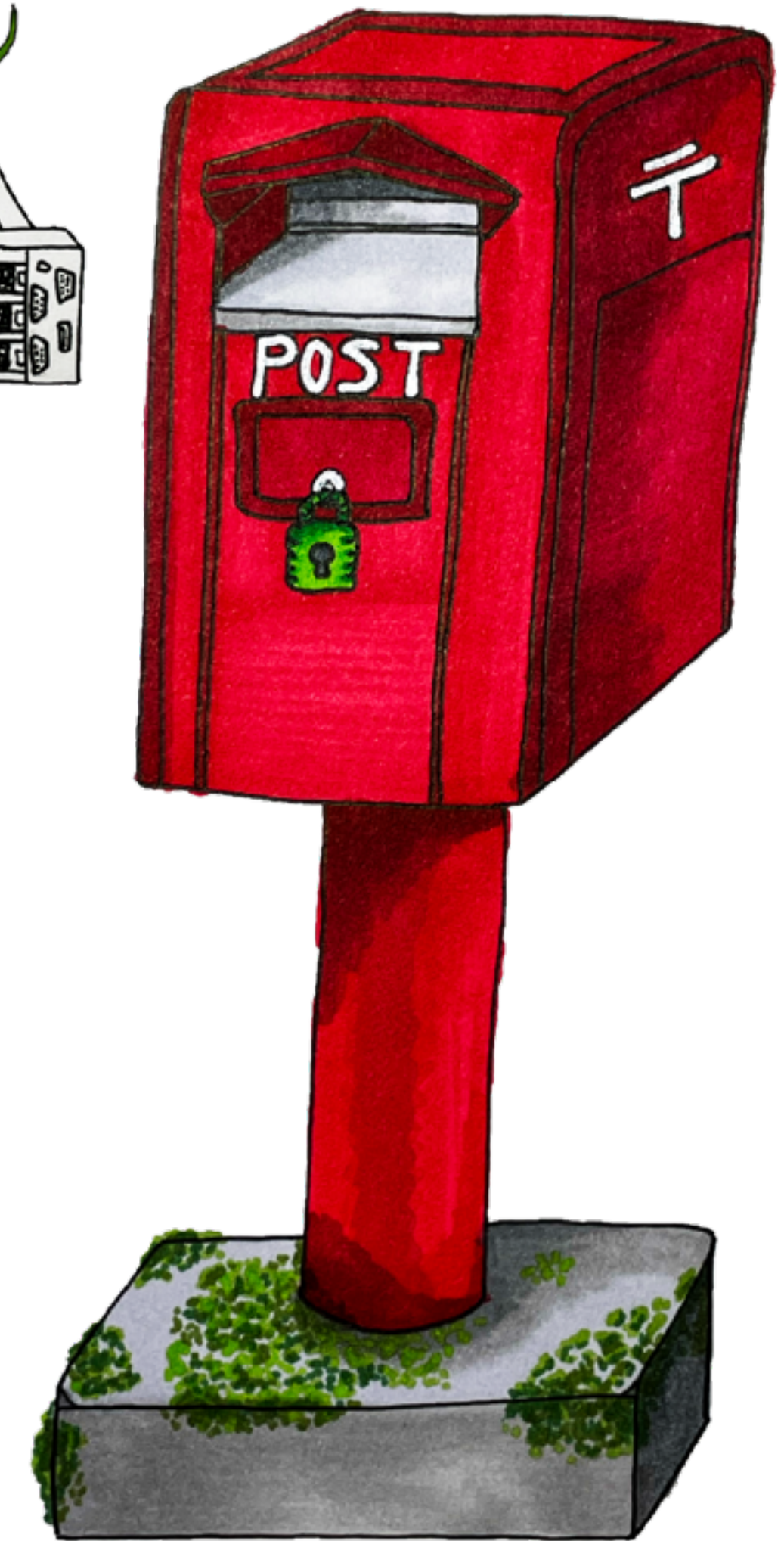
Annotation System

Alice

id_A
k_{AB}
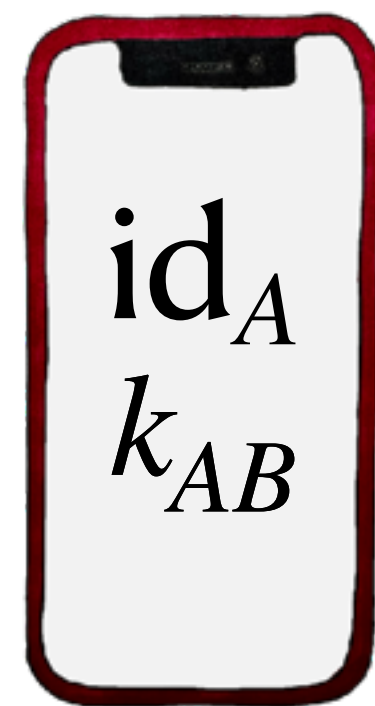
Bob

id_B
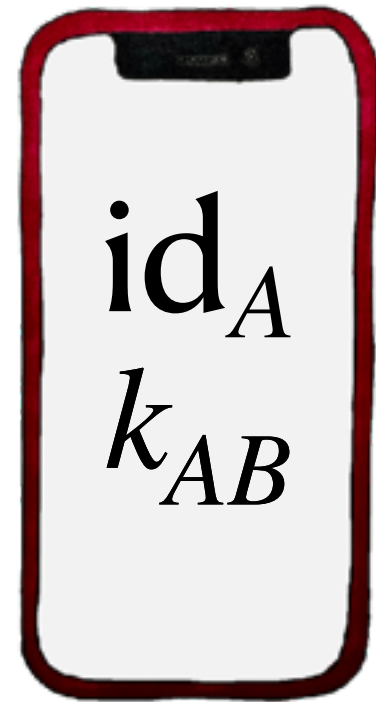k_{AB}

SendMail
$[oid_E, anno]_{k_{AB}}$

Tigro
Server

Shared Encrypted
Mailbox (EMB)

Annotation System
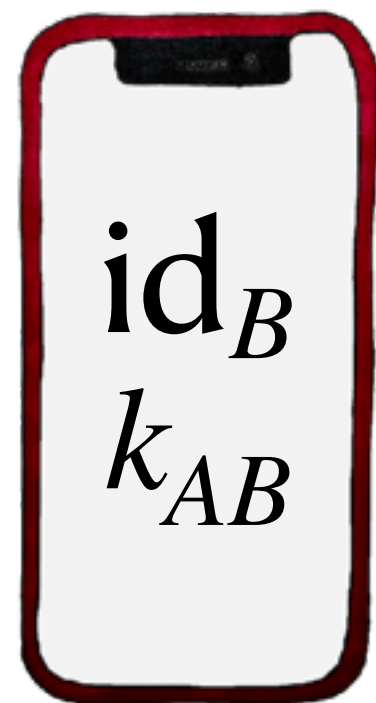

Alice

id_A
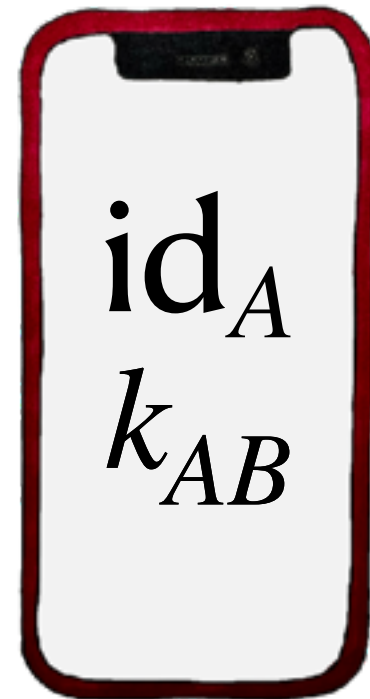k_{AB}

Bob

id_B
k_{AB}

Tigro Server

$[\mathrm{oid}_E, \mathbf{anno}]_{k_{AB}}$

Shared Encrypted Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Event:
Protest
Organizer:
Eve
oid_E

Tigro
Server

$[oid_E, anno]_{k_{AB}}$

Shared Encrypted
Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Event:
Protest
Organizer:
Eve
$\textbf{oid}_E$

GetMail

Tigro
Server

$[\textbf{oid}_E, \textbf{anno}]_{k_{AB}}$

Shared Encrypted
Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob

id_B
k_{AB}

Event:
Protest
Organizer:
Eve
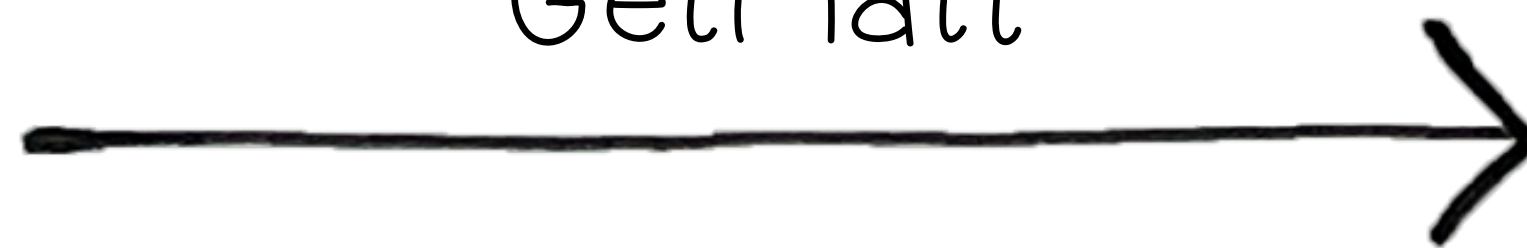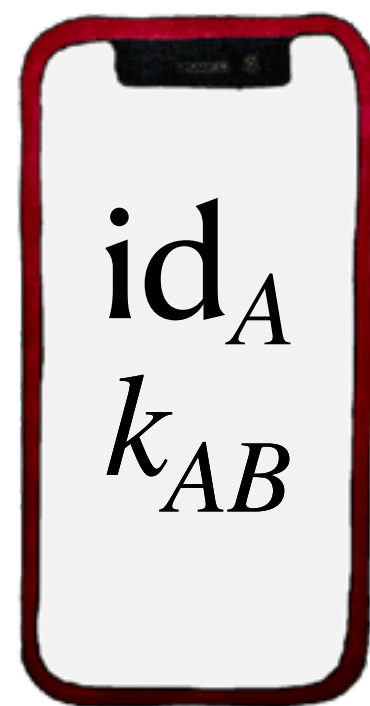$\mathbf{oid}_E$

GetMail

$[\mathbf{oid}_E, \mathbf{anno}]_{k_{AB}}$

Tigro
Server

$[\mathbf{oid}_E, \mathbf{anno}]_{k_{AB}}$

Shared Encrypted
Mailbox (EMB)

Annotation System

Alice

id_A
k_{AB}

Bob
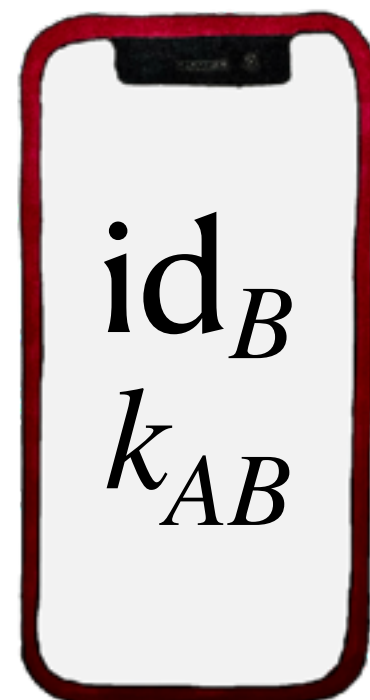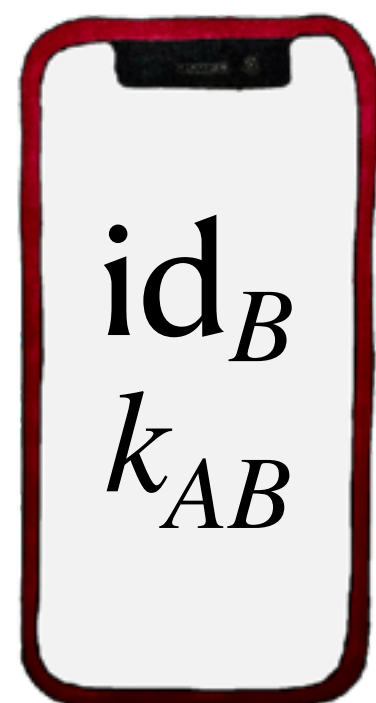
id_B
k_{AB}

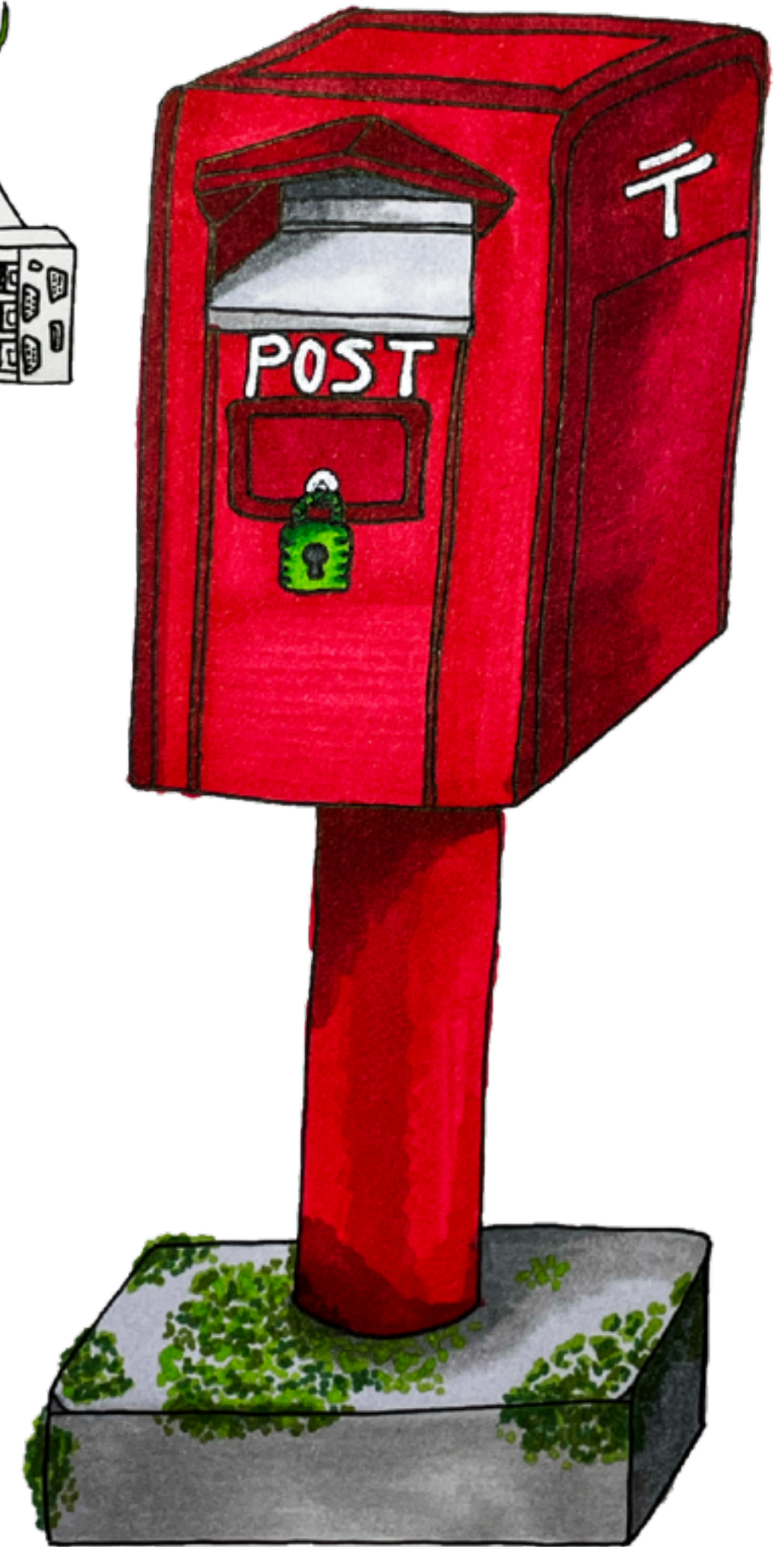Alice and Bob can digitally & confidentially <u>share trust assessments</u> of any person, place, or thing.

Tigro Server

Shared Encrypted Mailbox (EMB)

Trust Metrics Over Social Networks

Trust Metrics Over Social Networks
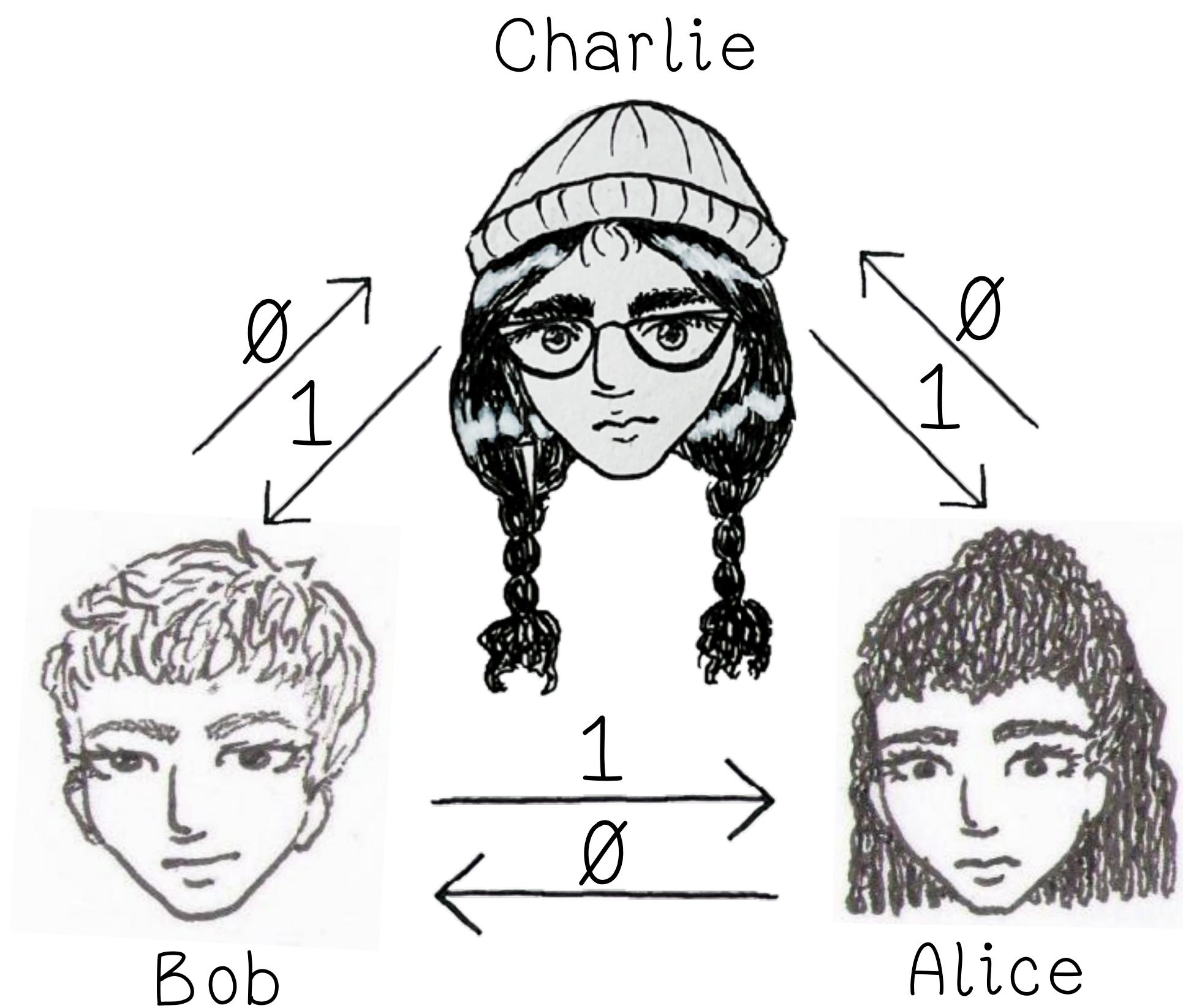
Charlie

Ø
1

Ø
1

Bob

1
Ø

Alice

Tentative Hypothesis:

Over a grounded social network graph, the Hyperlink-Induced Topic Search (HITS) algorithm can meaningfully measure a person's:

Trust Metrics Over Social Networks

Charlie

Ø

1

Ø

1

Bob

1

Ø

Alice

Tentative Hypothesis:

Over a grounded social network graph, the Hyperlink-Induced Topic Search (HITS) algorithm can meaningfully measure a person's:

– Connectivity (physical proximity) to trusted organizers (Hub Measure)

Trust Metrics Over Social Networks

<u>Tentative Hypothesis:</u>

Over a grounded social network graph, the Hyperlink-Induced Topic Search (HITS) algorithm can meaningfully measure a person's:

– Connectivity (physical proximity) to trusted organizers (Hub Measure)

– Leadership role in relation to others (Authority Measure)
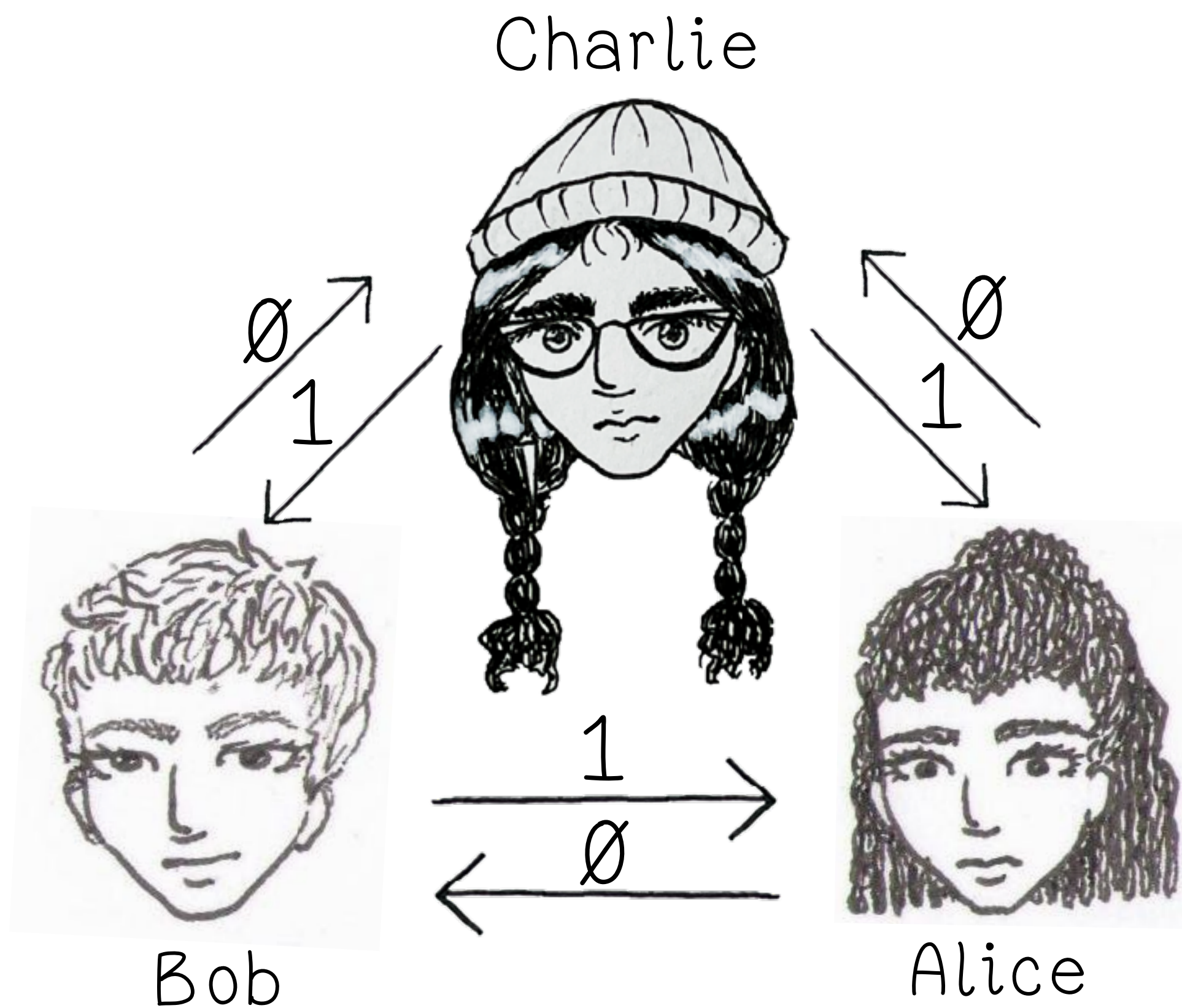
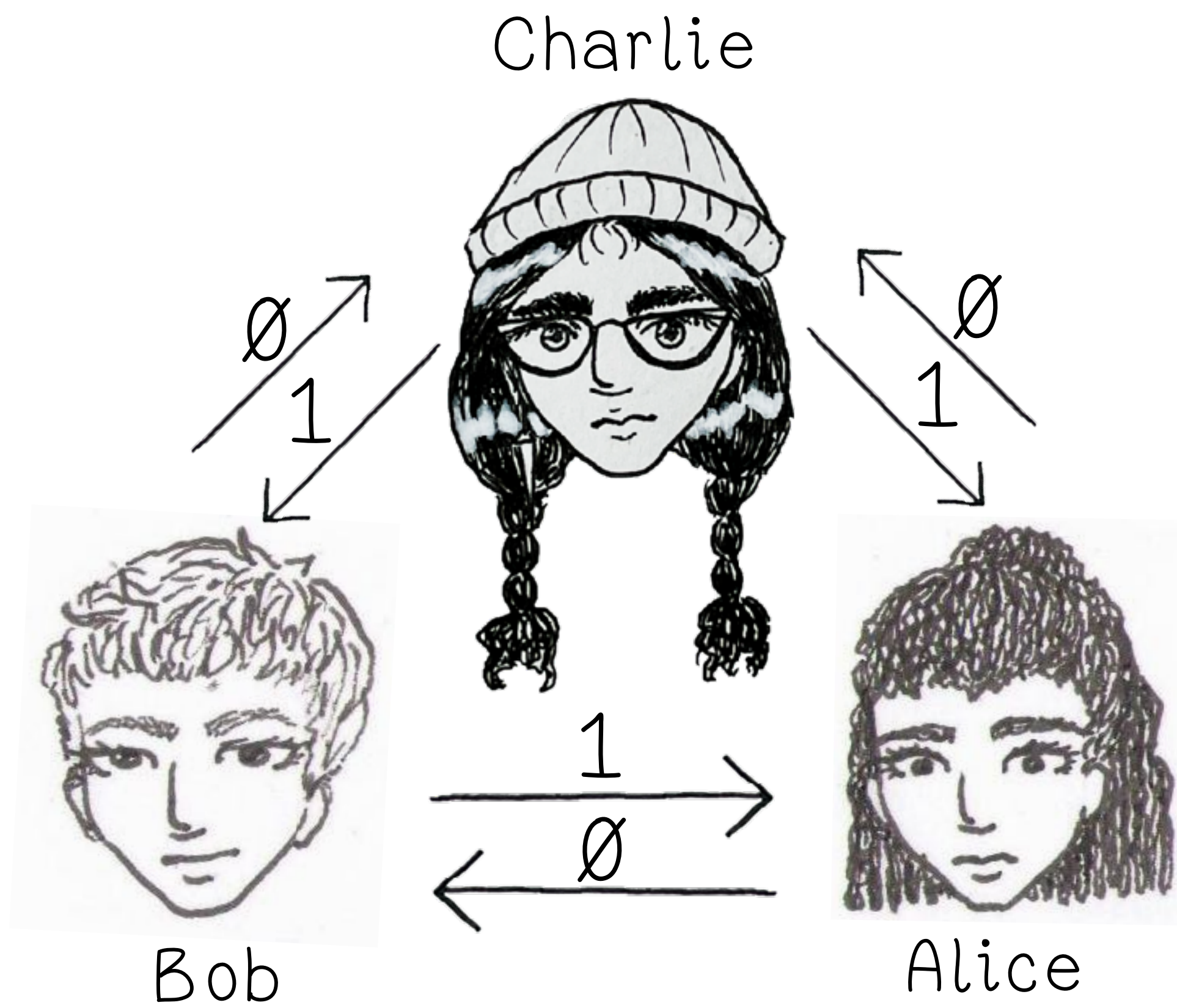# Trust Metrics Over Social Networks
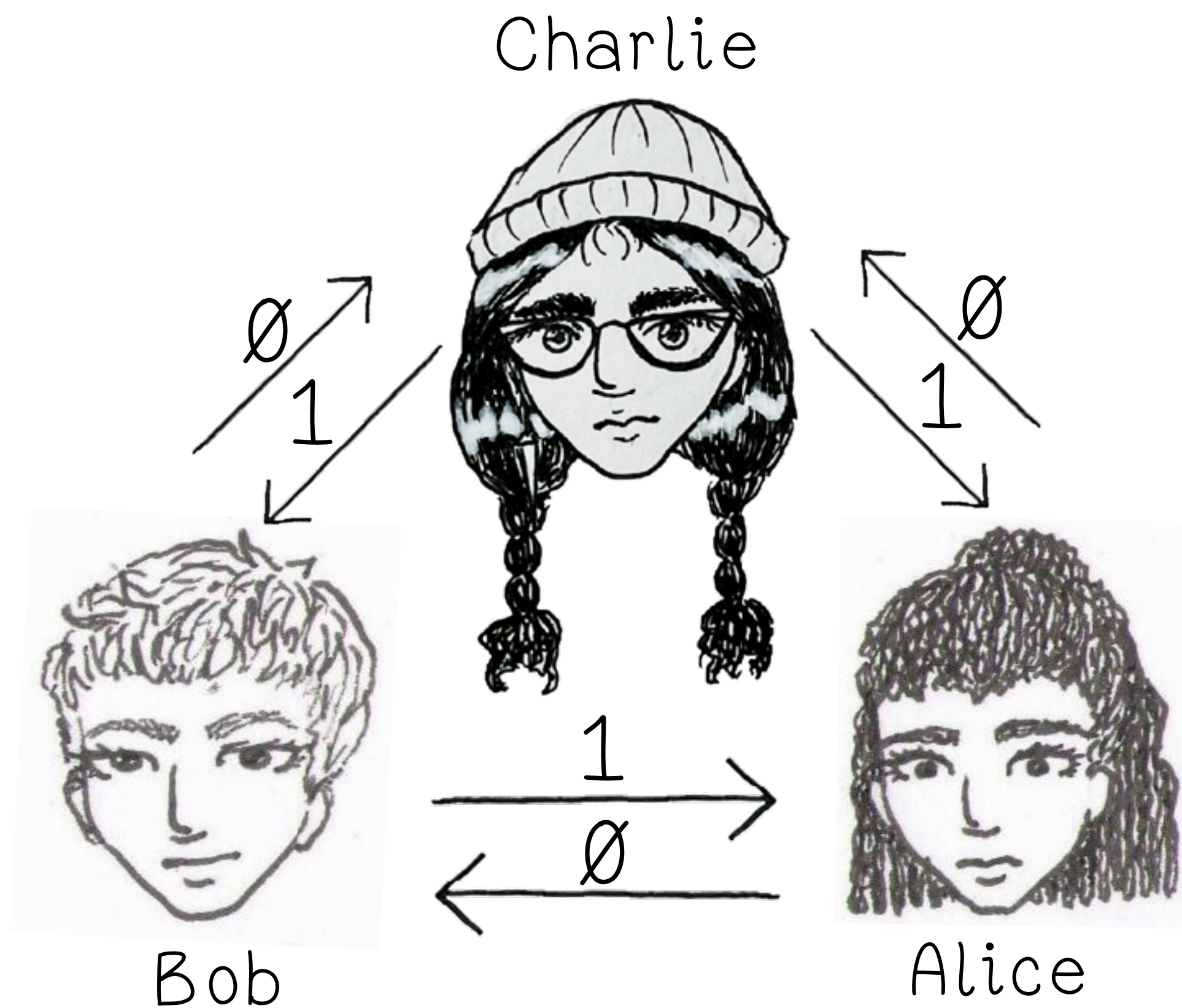
Charlie

Bob

Alice

Ø
1

Ø
1

1
Ø

Tentative Hypothesis:

Over a grounded social network graph, the Hyperlink-Induced Topic Search (HITS) algorithm can meaningfully measure a person's:

– Connectivity (physical proximity) to trusted organizers (Hub Measure)

– Leadership role in relation to others (Authority Measure)

Disclaimers: Quantifiable metrics are still functions of qualitative metrics; Edge weights are up for debate (eg. could replace Ø/1 with a survey); Digitizing this data (even in encrypted form) may be too risky.

tigro Long-Term Goals

Phase 0: Finish analysis of the cryptographic protocols

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Phase 1: Prototype protocols and conduct user studies*

– Implementation: toward multi-platform design & security

– User studies: capturing the right notion of trust & UI/UX

tigro Long-Term Goals

Phase 0: Finish analysis of the cryptographic protocols

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Phase 2: Build out applications, more user studies*

- Implementation: context-dependent applications & security
- User studies: assess relevance of specific designs & UI/UX

tigro Long-Term Goals

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What kind of world do we want to build with our work?

Thank you for listening!

Interested in getting involved in the tigro project? Please find me! Or, email leah_rosenbloom@brown.edu

Resources

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9. Leah Rosenbloom. Toward secure social networks for activists. In *Moving technology ethics at the forefront of society, organisations and governments*, pages 491–502. ETHICOMP, 2021.
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