



What Distributed Infrastructure Could Save the Planet?

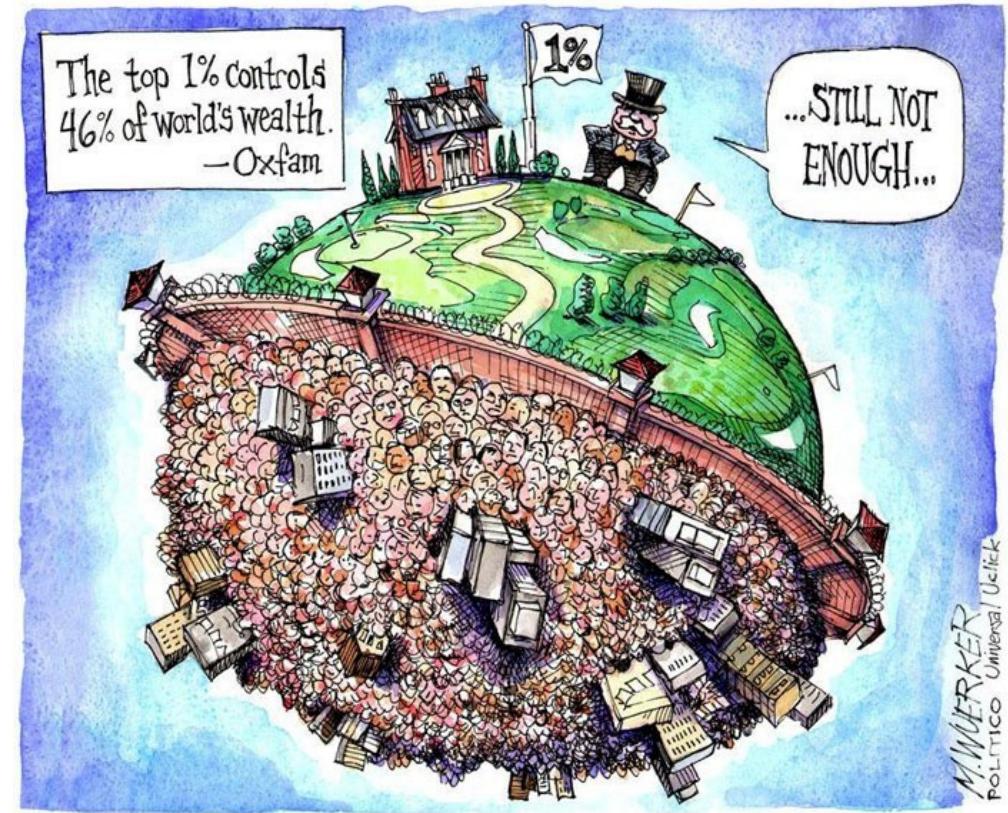
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DICG – December 12, 2023

We're facing hard global problems



Climate
change



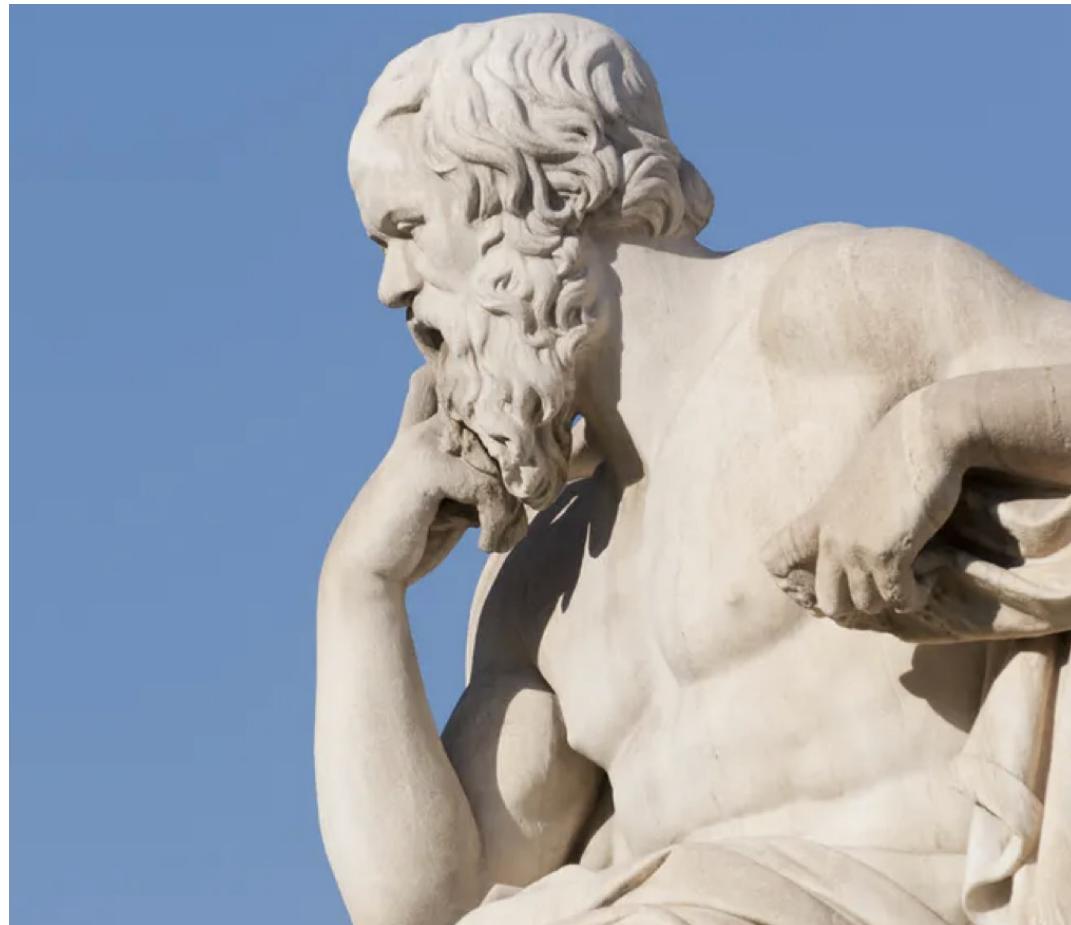
Exploding
inequality

Global problems need global tools



Like distributed infrastructure ... *right?*

Is our distributed infrastructure...



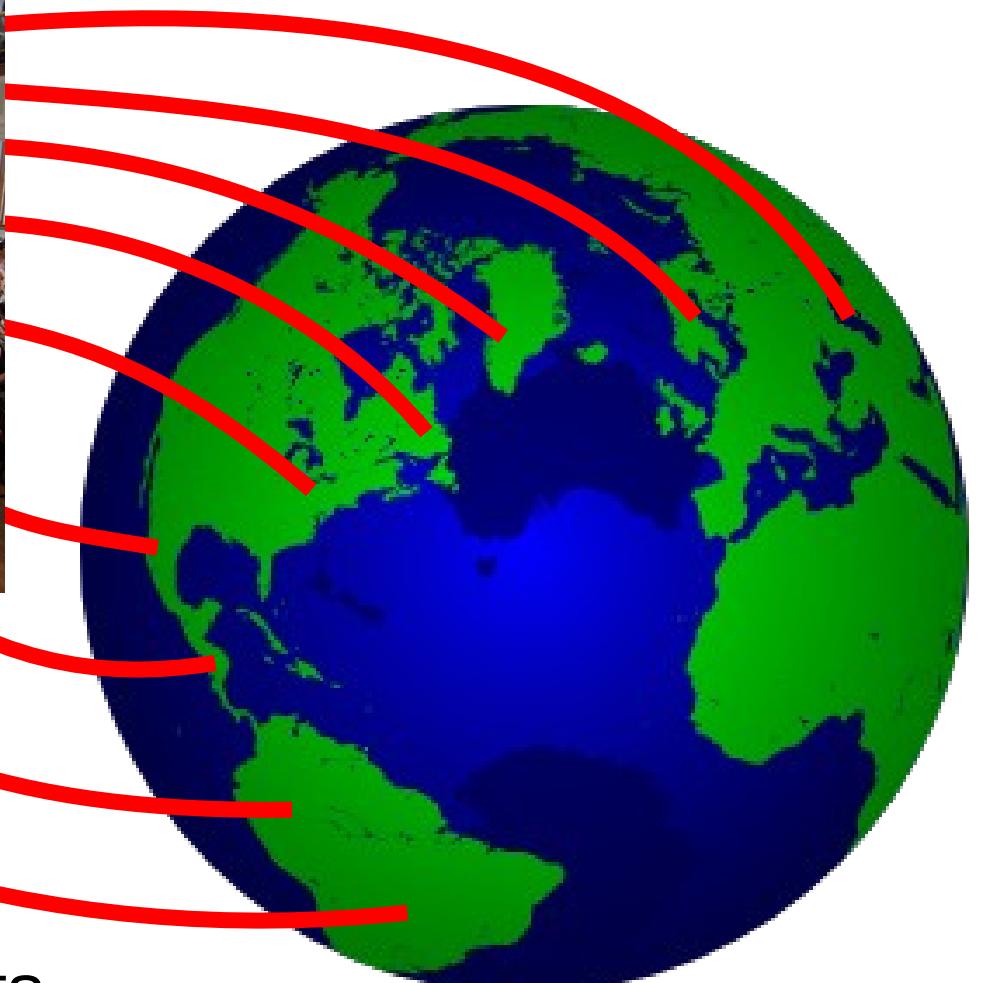
Helping us find
wise solutions?



In everyone's
collective interest?

The world's most urgent need for DI

A coherent, secure, inclusive “global town hall”



→ Decisions,
action plans that
transparently & security
represent everyone's interests

Talk Roadmap

- A need: sane collective decision & action
- A vision: representative global deliberation
- A medium: liquid democracy or variations
- A foundation: proof of personhood
- A challenge: voter coercion, astroturfing
- A program: decentralized infrastructure for all

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Global town hall: requirements

We need a *scalable distributed platform* that gives everyone a voice! ...right?

Like...
Usenet?

(R.I.P.)



What UseNet was (thought to be)

Netizens: On the History and Impact of Usenet

A great historical perspective on how “netizens”
thought UseNet would democratize the world!

Distributed! Decentralized! Democratizing!
Scalable! (huge, deep newsgroup hierarchy)
Delay/disruption tolerant! Everyone has a voice!

But... (oops)

no useful spam control, no effective governance,
no way to identify (real) people for deliberation, ...

Whatever happened to UseNet?

It's still "there" and still "works"! ([Try it!](#))

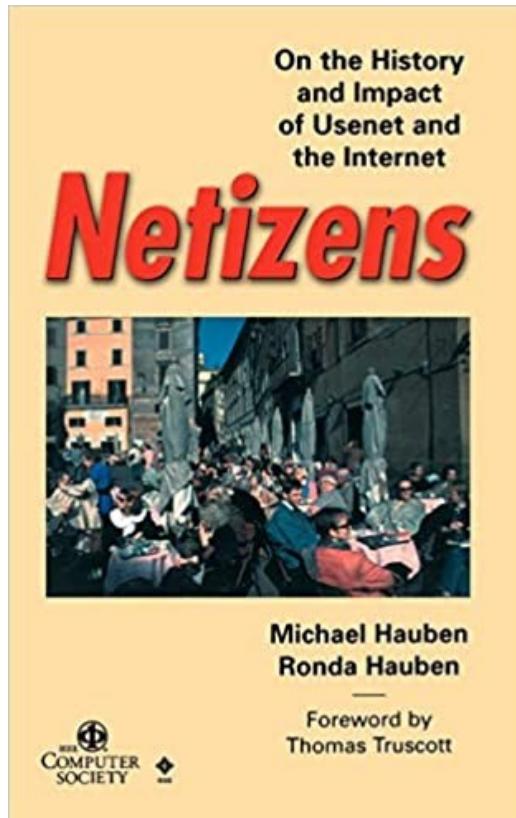
...but nobody's *really* there due to **spam** overrun

The Post-Usenet world fragmented into tribalism

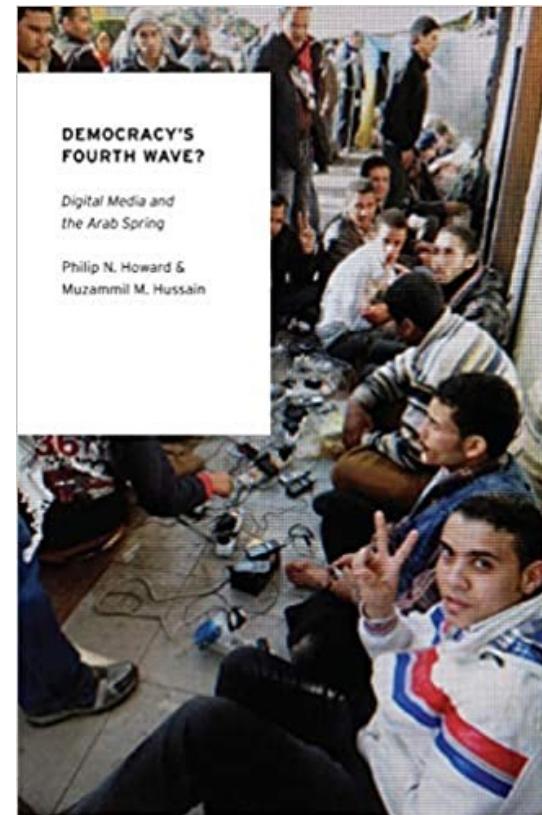
- Private mailing list tribes (MailMan etc.)
- Online platform tribes (Friendster, Facebook, ...)
- Blockchain/Web3 tribes (Bitcoin, Ethereum, ...)
- Emerging: AI/LLM tribes (ChatGPT! ...)

Is the Internet “Democratizing”?

1997



2013



Chapter 18
“The Computer as a
Democratizer”

“Democracy’s Fourth Wave?
Digital Media and the
Arab Spring”

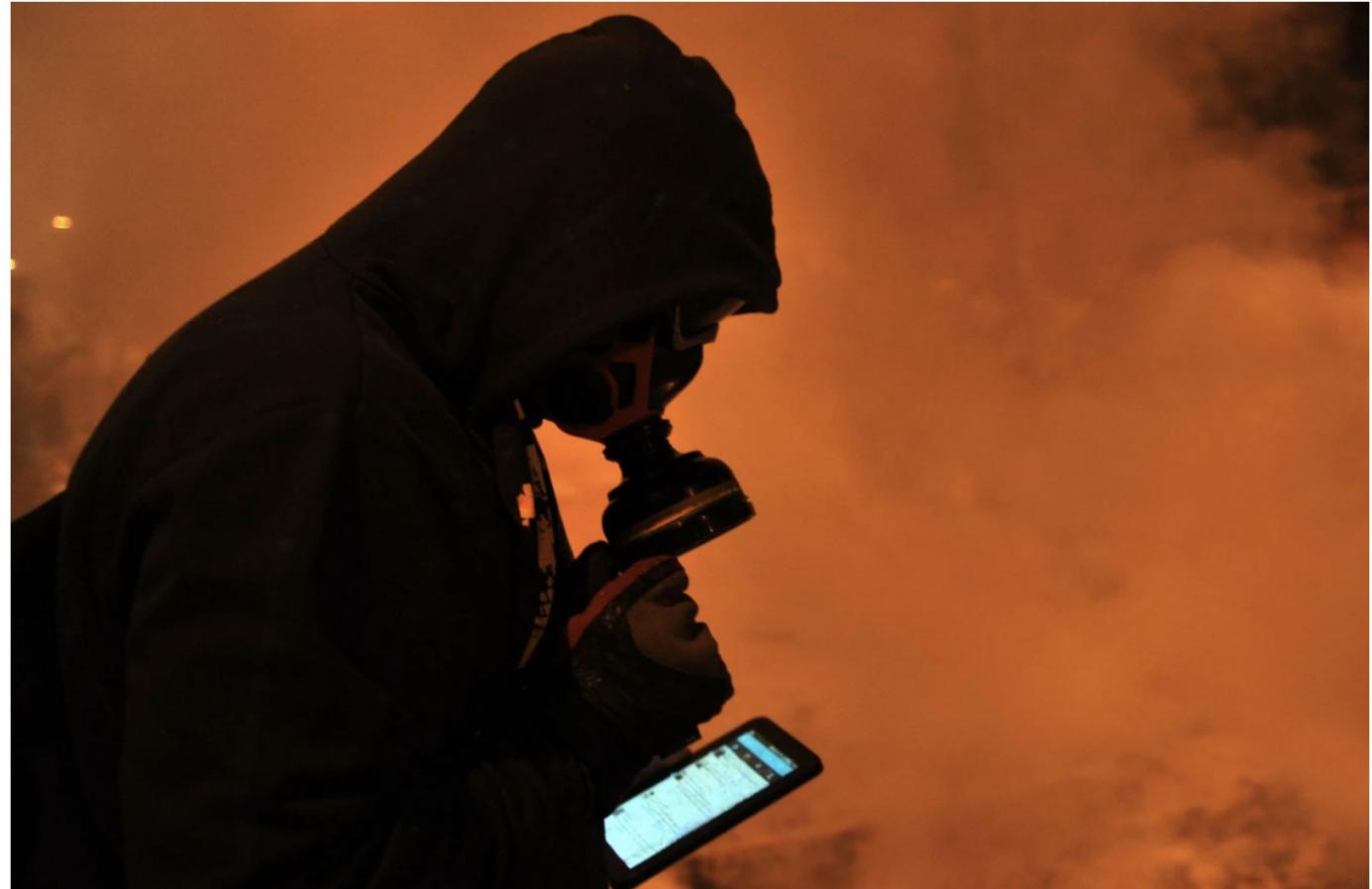
Is the Internet “Democratizing”?

How Social Media Helps Dictators

It's been hailed as "liberation technology." But it has a darker side.

By [Erica Chenoweth](#)

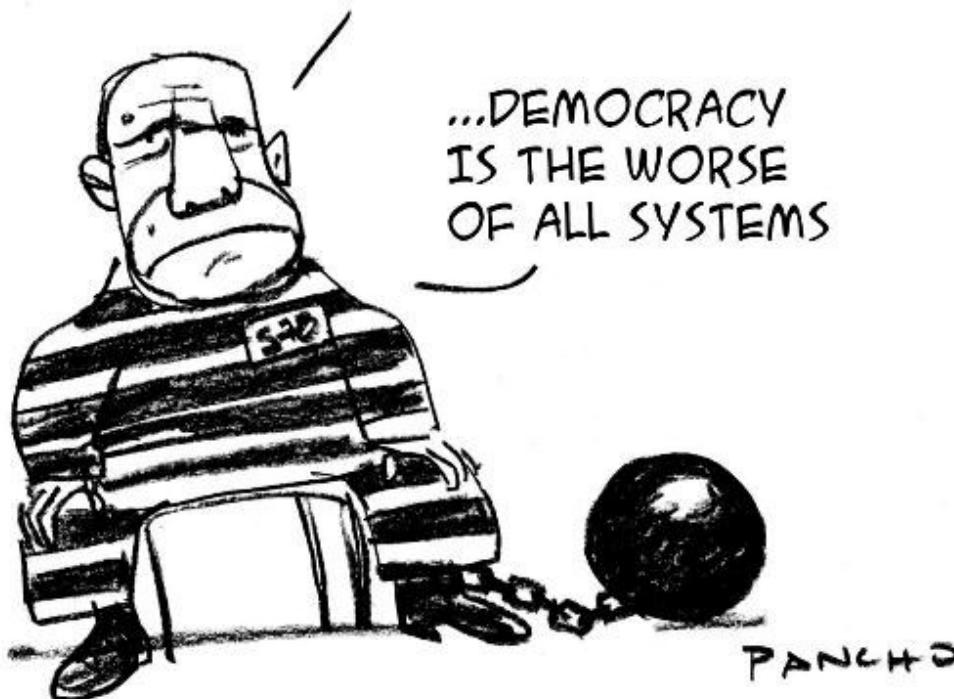
2016



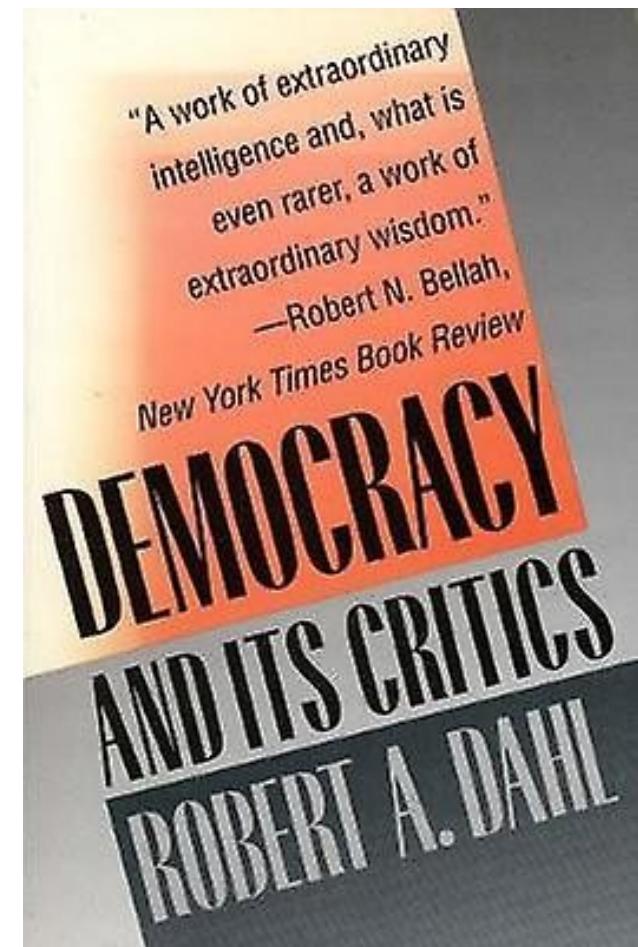
Why democracy...and what *is* it?

Council of Europe,
“Democracy”

ALL FORMER
DICTATORS
WILL TELL YOU...



Robert Dahl,
“Democracy & its critics”



Why democracy...and what *is* it?

Council of Europe,
“Democracy”

Robert Dahl,
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Key criteria:

- Individual autonomy
 - Equality

Key criteria:

- Effective participation
 - Voting equality
- Enlightened understanding
 - Control of the agenda
- Inclusiveness

So is the Internet “Democratizing”?

- Giving “everyone” a voice & a platform



- Equality?
- Enlightened understanding?
- Effective participation?



Global town hall: requirements

The *real* requirements for “democratizing” DI...

- Open to participation by all (of course)
- Accessible *anywhere*, even if poorly-connected
- Coherent global-scale discussion, *deliberation*
- Genuinely self-governed, *not* by “guardians”
- One person one vote, *not* one dollar one vote
- Ensure that participants represent *themselves*

UseNet mostly got the first 2...the others are hard!

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Global Online Self-Governance

Can digital forums and communities self-govern?



Coherent global deliberation: How?

Some deeper “beyond UseNet” problems:

- Even if everyone can *speak* (post, tweet, etc), no one can *pay attention* to everything going on
 - How to address limitations of human attention?
- Complex problems require deep analysis with help of expertise – but *how to choose experts*?
 - How to ensure experts serve *everyone's* interests?

Do we have distributed infrastructure for this?

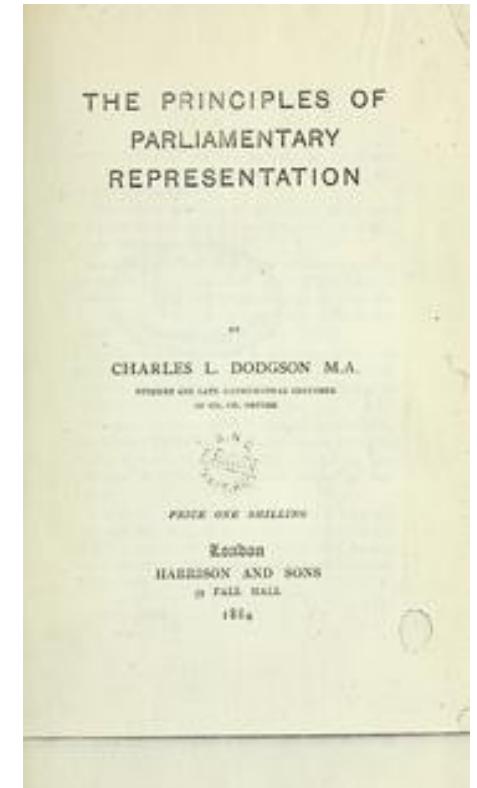
Liquid aka Delegative Democracy

Direct + Representative = Delegative Democracy



Pre-Internet precedents

Lewis Carroll, “Principles of
Parliamentary Representation”
(1884)



James C. Miller,
“Direct and proxy voting
in the legislative process”
(1969)

Internet-based Liquid Democracy

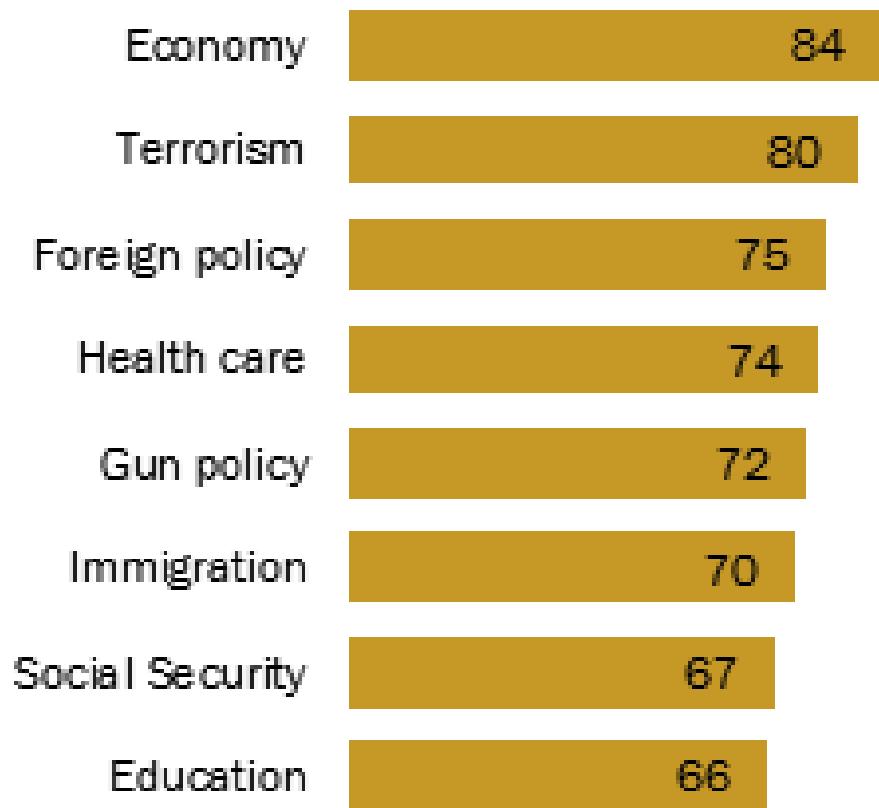
- Bryan Ford, “Delegative Democracy” (2002)
- Dennis Lomax, “Beyond Politics” (2003)
- Joi Ito, “Emergent Democracy” (2003)
- Sayke, “Liquid Democracy” (2003)
- James Green-Armytage,
“Direct Democracy by Delegable Proxy” (2005)
- Mark Rosst, “Structural Deep Democracy” (2005)
- Mikael Nordfors, “Democracy 2.1” (2006)
- ...

Liquid Democracy: Key Intuition

Everyone can't be knowledgeable in **everything**
But **most** people are interested in **something**

So let people
self-specialize

- **Vote directly** on topics you follow closely
- **Delegate** your vote on others



Democracy is Social Anyway

If we trust a friend on a particular issue/election, we may freely follow their advice when voting

- Decision is always individual voter's

Liquid democracy
is just automated
advice following



- Voter can always **override** or **revoke** delegation
- Maximizes **free choice of representatives**

Experiments in Liquid Democracy



PIRATENPARTEI
Deutschland



LiquidFeedback

Widely used for
policy debates within
Pirate Party for
several years

Worked...but raised some concerns

≡ SPIEGEL ONLINE SPIEGEL



Sign in

Liquid Democracy

Web Platform Makes Professor Most Powerful Pirate

A linguistics professor in Bamberg is considered the most powerful member of Germany's burgeoning Pirate Party, even though he holds no office. Martin Haase engages in politics almost exclusively through the Internet using the party's Liquid Feedback software. The platform is flattening the political hierarchy and is unique among German political parties.

By *Sven Becker* ▾



Promising recent academic work

- **Liquid Democracy: Potentials, Problems, and Perspectives** [Blum & Zuber 2016] provides normative foundation in political theory
- **The Fluid Mechanics of Liquid Democracy** [Gölz et al 2021] on voting power concentration
- **Liquid Democracy in Practice: An Empirical Analysis of its Epistemic Performance** [Revel et al 2022] tests it for “finding expertise”
- **Liquid Democracy Workshop** [UZH 2022]

Global deliberation at scale

Liquid democracy is:

- (Still) promising for scalable deliberation
- (Still) an incomplete work in progress

A few (of many) lingering issues:

- How (and whether) to avoid vote concentration?
- How to create, (self-)govern large topic space?
- How to avoid tribalism, incentivize consensus?

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Who gets how much influence?

Wealth-centric

- One dollar, one vote



[Kera]

Person-centric

- One person, one vote



[Verity Weekly]

Who gets how much influence?

Wealth-centric

- Stock corporations
- Loyalty programs
- Online gaming
- CAPTCHA solving
- Proof-of-work
- Proof-of-stake
- Proof-of-X for most X

Person-centric

- Democratic states
- Elected parliaments
- Membership clubs
- Committees
- Town hall meetings
- Direct democracy
- Liquid democracy

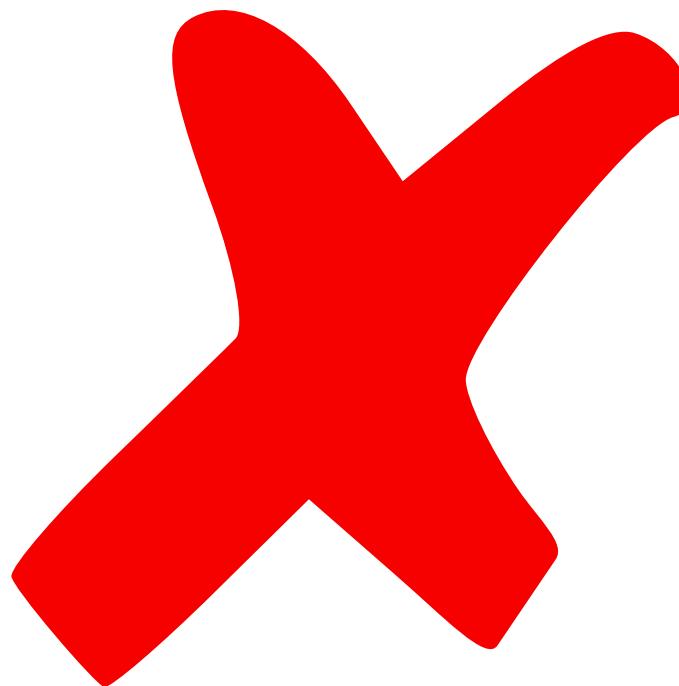
Contrasting Influence Foundations

Wealth-centric



Largely Solved

Person-centric



Largely Unsolved

Which could help save the planet?

Wealth-centric

Been there,
done that...

it's the status quo!

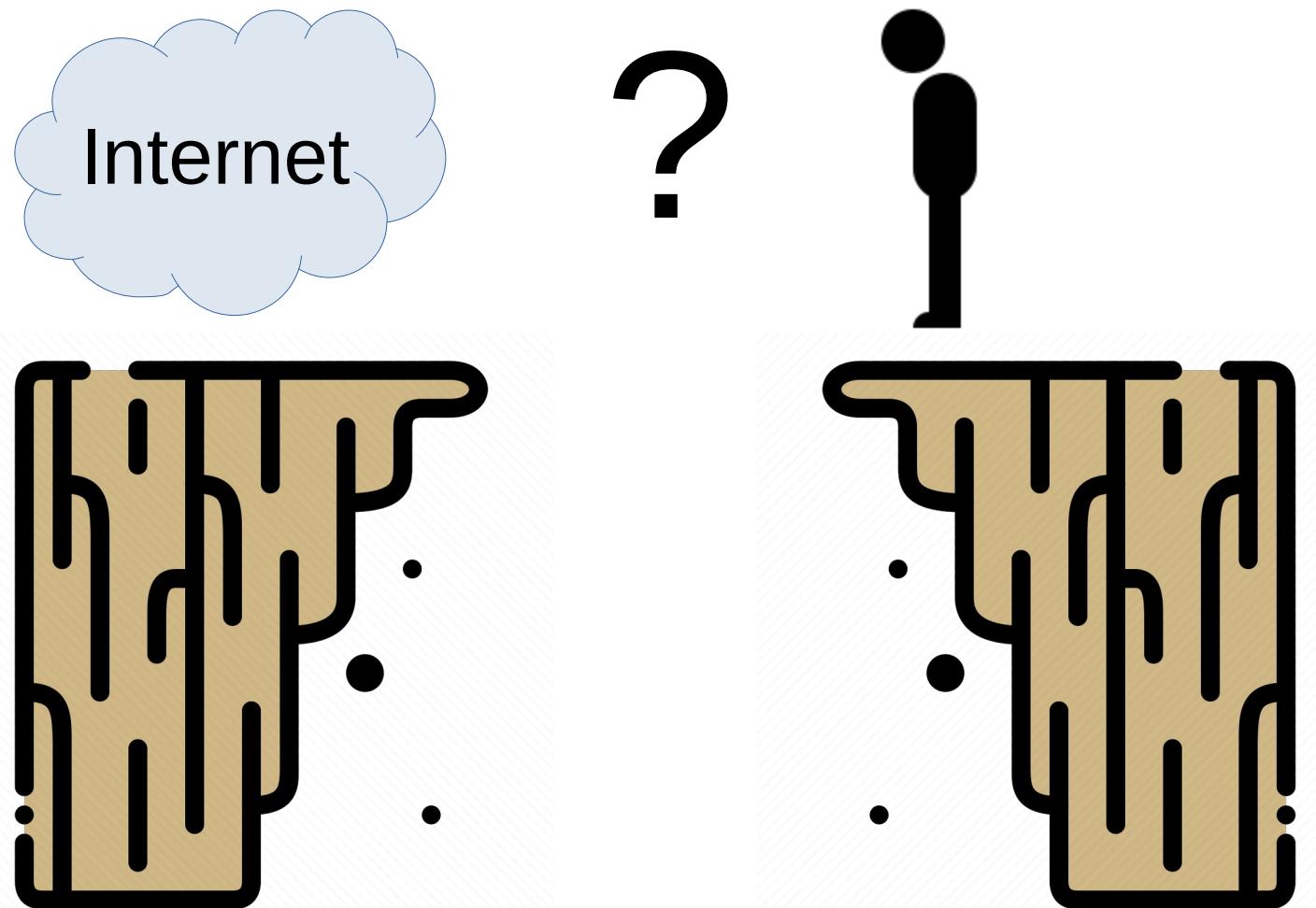
Person-centric

No guarantee
of success, but...

No other plausible
option to get
global buy-in

A Fundamental Problem

Today's Internet doesn't know what a “person” is



People aren't digital, only profiles are



[Pixabay, The Moscow Times]

Fakery is exploding, especially w/ AI



[Ian Sample, The Guardian]

Brief problem statement

- How to “identify” **real (human) persons...**
 - For online messaging, participation, deliberation
 - Ensuring accountability, “one person one vote”
- ...without actually “identifying” them?
 - Protect participant privacy, anonymity, freedom
 - Avoid requiring real ID cards or trackable proxies
- Achieve “**proof of personhood**” not “identity”?

Preprint: <https://bford.info/pub/soc/personhood/>

Identity and Personhood in Digital Democracy: Evaluating Inclusion, Equality, Security, and Privacy in Pseudonym Parties and Other Proofs of Personhood

Bryan Ford
Swiss Federal Institute of Technology in Lausanne (EPFL)

November 4, 2020

Key desirable (required?) goals

Can we achieve Proof of Personhood that is:

- **Inclusive:** open to all *real people*, not to bots
- **Equitable:** all *people* get equal power, benefits
- **Secure:** correct operation, verifiable by *people*
- **Privacy:** protects rights & freedoms of *people*

“We must act to ensure that technology is designed and developed to serve humankind, and not the other way around”

- Tim Cook, Oct 24, 2018

Personhood Online: Approaches

- **Documented Identity:** e.g., government-issued
 - Privacy-invasive, IDs not hard to fake or buy
- **Biometric Identity:** India, UNHCR, Worldcoin
 - Huge privacy issues, false positives+negatives
- **Trust Networks:** PGP “Web of Trust” model
 - Unusable in practice, doesn’t address Sybil attacks
- **Physical Presence:** in-person participation
 - Requires no ID, trust, connections: just a *body*
 - Proposed in **Pseudonym Parties** [SocialNets ‘08]

A few Proof of Personhood efforts

- Pseudonym Parties [Ford, 2008]
- Proof-of-Personhood [Borge et al, 2017]
- Encointer [Brenzikofe, 2018]
- BrightID [Sanders, 2018]
- Duniter [2018]
- Idena [2019]
- HumanityDAO [Rich, 2019]
- Pseudonym Pairs [Nygren, 2019]
- DFINITY Virtual People Parties [Williams, 2021]
- Worldcoin [Worldcoin, 2023]

PoP based on physical presence

- Ford/Strauss, “**An Offline Foundation for Online Accountable Pseudonyms**” [2008]
 - In-person *pseudonym parties* to create PoP tokens

An Offline Foundation for Online Accountable Pseudonyms

Bryan Ford

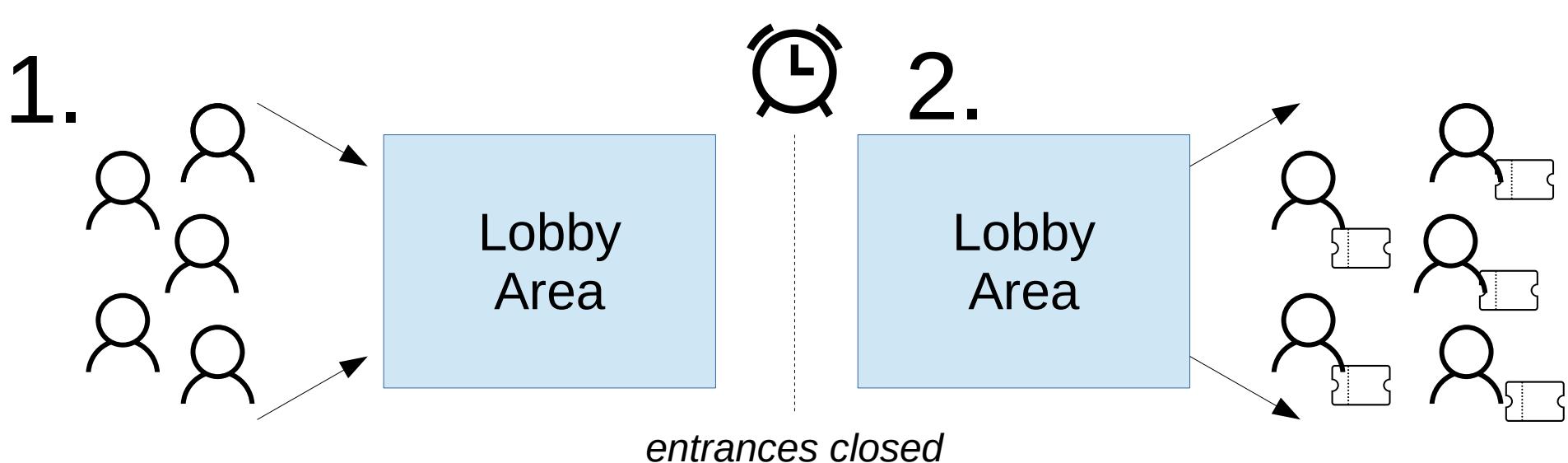
Massachusetts Institute of Technology

Jacob Strauss

PoP based on physical presence

Principle: real people have only one body each

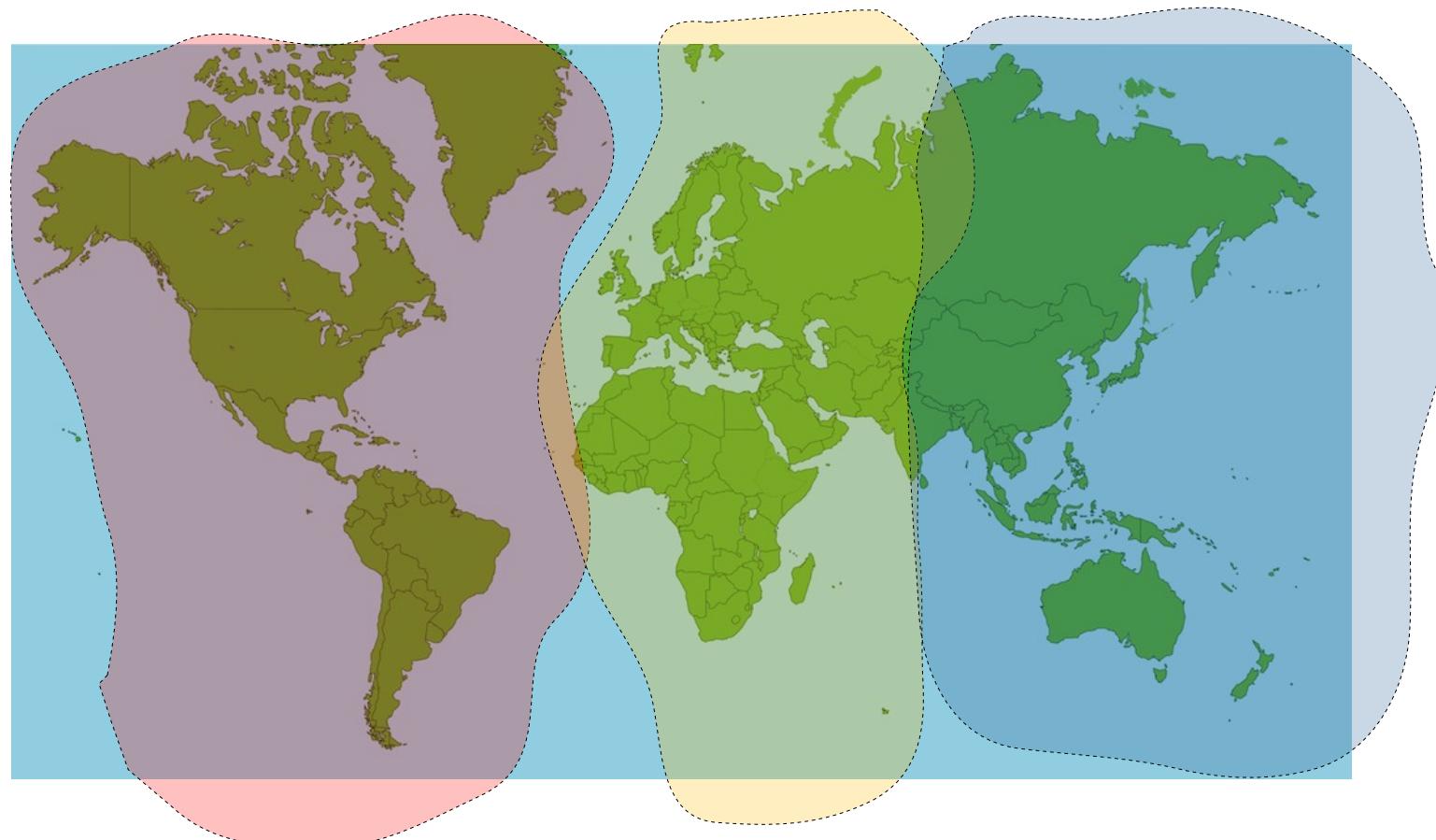
- Attendees gather in “lobby” area by a deadline
- At deadline entrances close, *no one else gets in*
- Each attendee gets one token while leaving



Scalable via *simultaneous* events

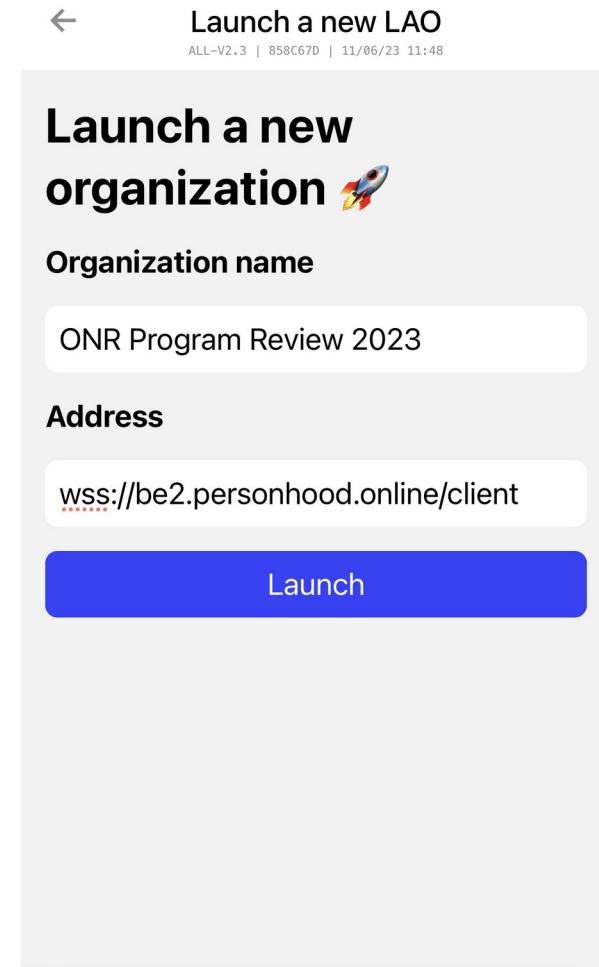
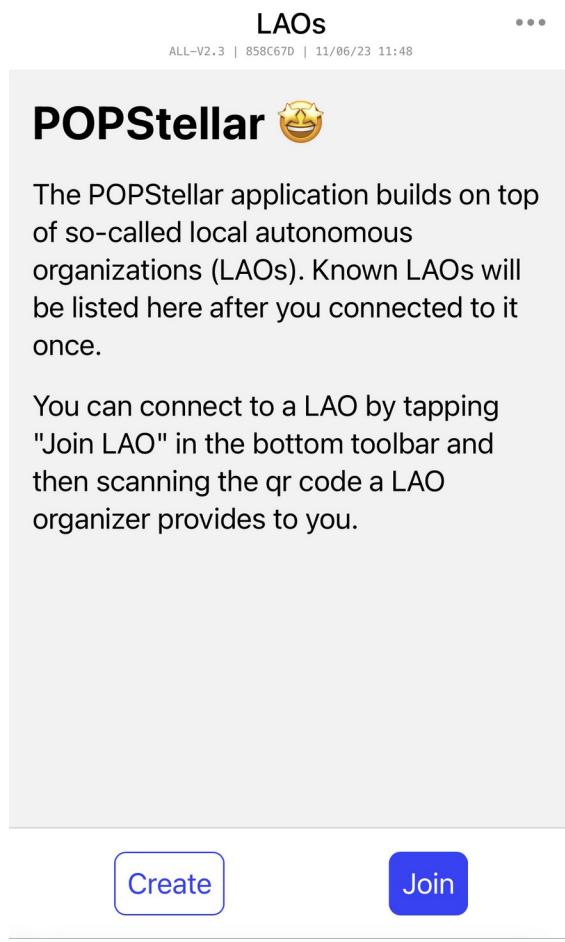
Potentially at many grassroots-organized events

- Even globally, in a few “timezone federations”



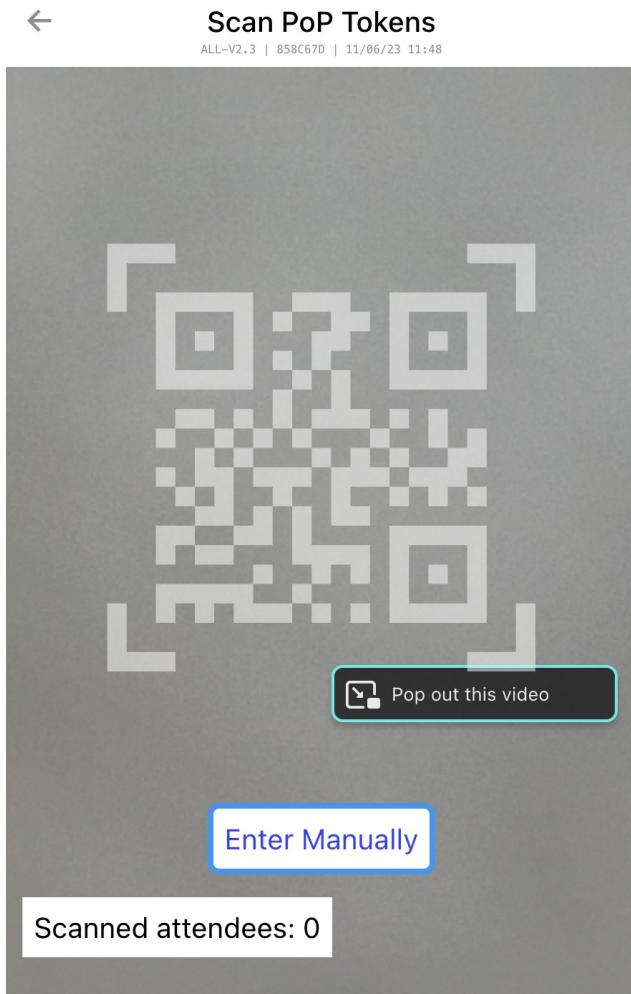
Local Autonomous Organizations

Any person or group may create an ad-hoc LAO

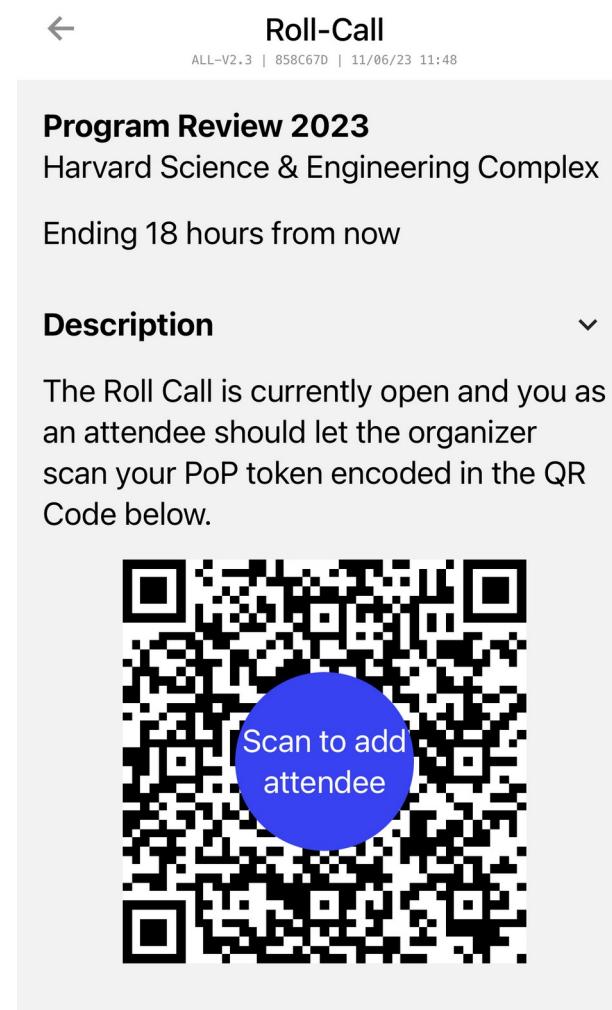


Organizer scans attendees' tokens

Organizer:



Participant:



Anti-tracking PoP tokens

Roll-calls are already privacy-preserving

- Yield PoP tokens with no identifying information

But PoP tokens could still be tracked, correlated

- Pseudonymity is not the same as anonymity!

Goal: blinded untraceable *usage* of PoP tokens

- Pseudonym-friendly but accountable!

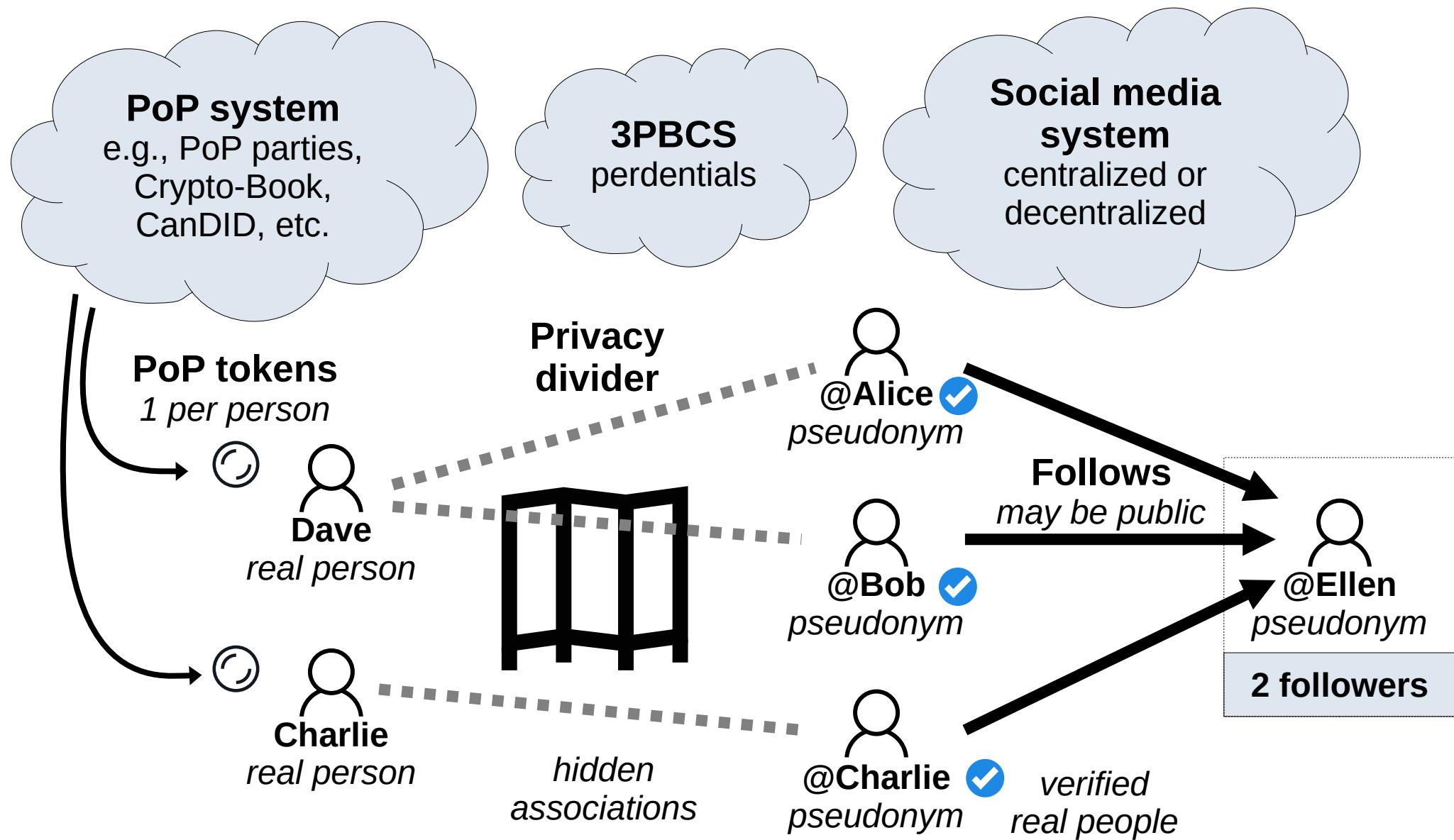
3PBCS: a privacy-preserving personhood-based credential system

3PBCS creates **perdentials**: credentials usable to

- Reveal & prove **properties** about the bearer
 - e.g., age > 18, have Ph.D. from U, usual SSI stuff
- Create **pseudonyms** with “real person” status 
 - *Sybils allowed!* professional, personal, hobby...  
- Allow **counts/quotas** with 1-per-person weight
 - Followers, likes, etc. count only *unique real people*

Builds on *any* PoP scheme + Coconut credentials

Perdentials: an illustrative scenario



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PoP for deliberation, governance

Can PoP enable online robust self-governance?

- Adds missing “one-person-one-vote” foundation

But...

**Whose interests
do participants
represent?**



The Coercion, Vote-Buying Problem

How can we know people vote their **true intent** if we can't secure the environment they vote in?



The Coercion, Vote-Buying Problem

Both **Postal** and **Internet** voting are vulnerable!

Election Fraud in North

*Carolina Leads to New Charges
for Republican Operative*

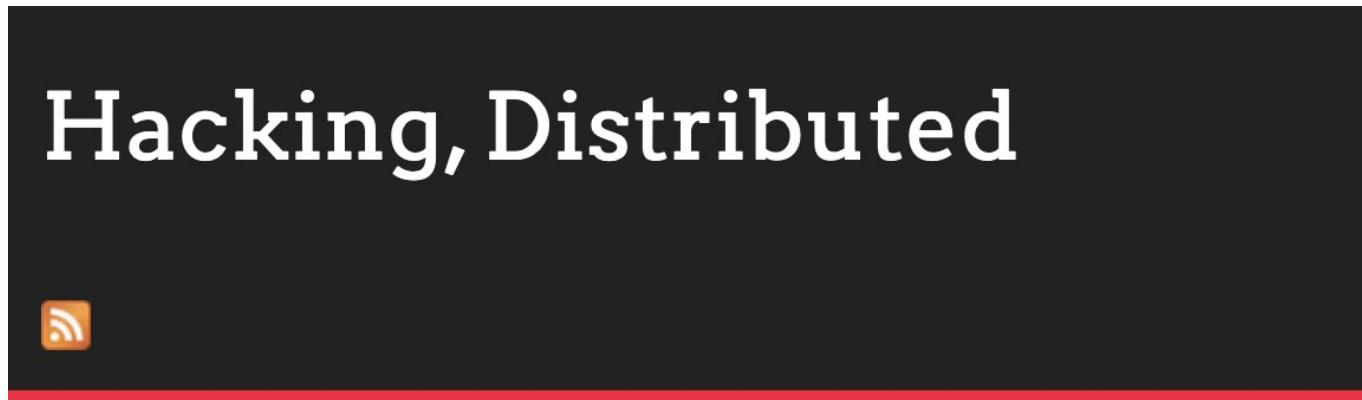
The New York Times

July 30, 2019



The Coercion, Vote-Buying Problem

“Blockchain” could makes the problem worse!



On-Chain Vote Buying and the Rise of Dark DAOs

on-chain voting voting e-voting trusted hardware identity selling ethereum

July 02, 2018 at 03:22 PM

[Philip Daian](#), [Tyler Kell](#), [Ian Miers](#), and [Ari Juels](#)

The “fake credentials” solution [JCJ]

At **registration** time:

- Give all voters *real* and *fake* voting credentials



At **voting** time:

- Real and fake credentials both *appear* to work
- Only real credentials cast votes that *count*

The central challenge

When, where, how do voters get credentials?

- Without being coerced at or after registration?

Online registration or PoP

- Unclear there's *any* plausible solution that doesn't make unrealistic/magical assumptions

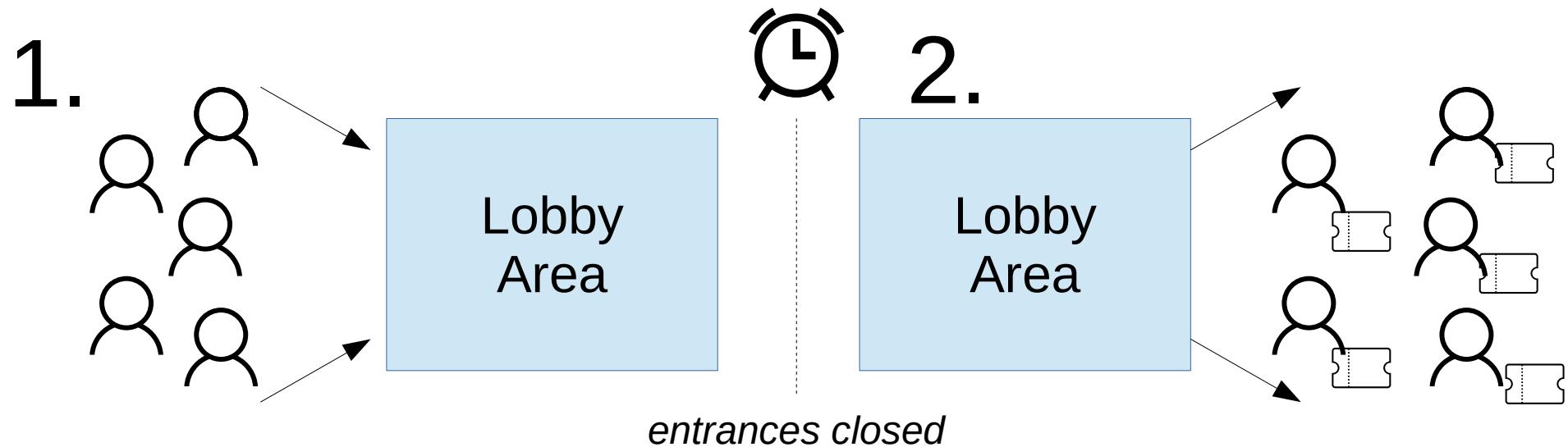
In-person registration or PoP

- We can leverage physical security (again)!

PoP based on physical presence

In-person attendees get short-term *tickets*

- Not (yet) long-term PoP credentials



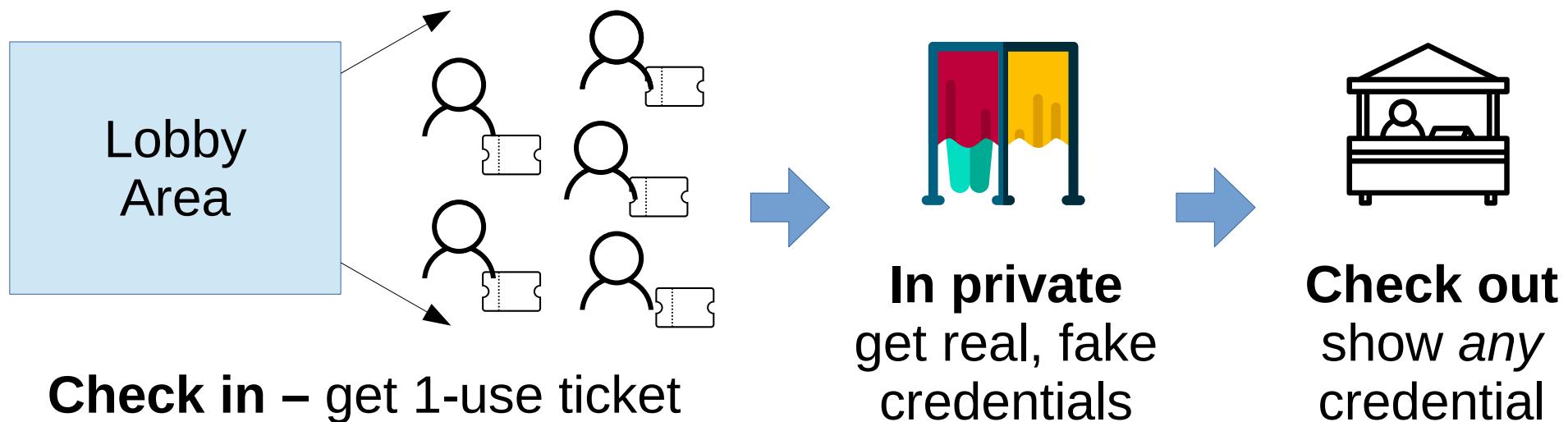
PoP based on physical presence

In-person attendees get short-term *tickets*

- Not (yet) long-term PoP credentials

Use tickets in a supervised *privacy booth* nearby

- Create long-term real and fake PoP credentials



Key technical & behavioral problems

The coercion problem is still far from “easy”

- What happens in the privacy booth?
- How much must voters trust what’s in it?
- How do they “know” which credential is real?
- How to ensure a coercer *can’t* learn this?
- Can voters “hide” real credential from coercer?
- Can voters understand and use the process?
- Can and will voters lie to a coercer? ...

In-person Coercion Resistance

TRIP: Trust-limited Coercion-Resistant In-Person Voter Registration

- <https://arxiv.org/abs/2202.06692>

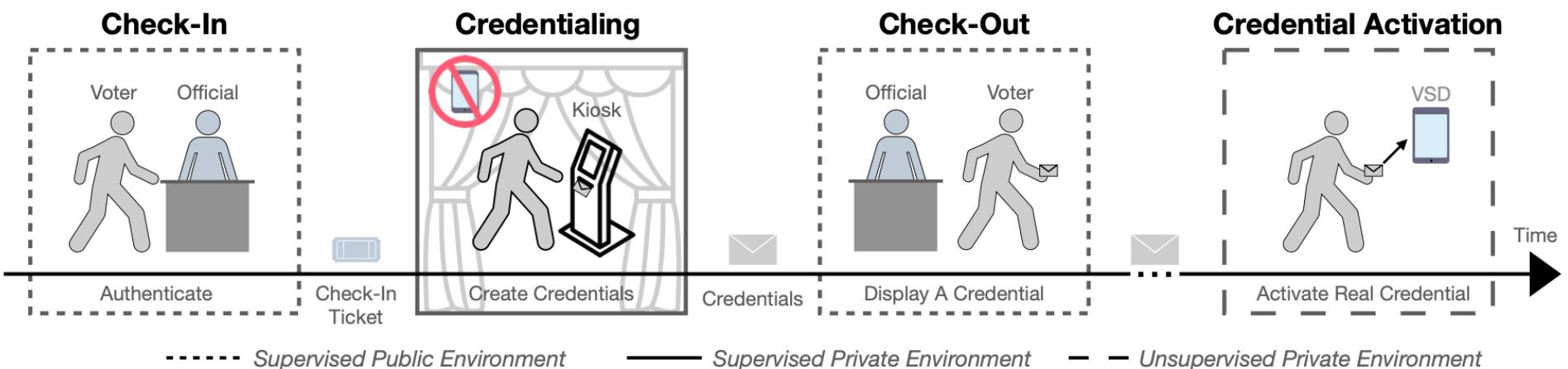
E-Vote Your Conscience: Perceptions of Coercion and Vote Buying, and the Usability of Fake Credentials in Online Voting

- *Coming soon, shareable on request*

TRIP workflow overview

Attendees use digital kiosk in privacy booth to print real & fake *paper credentials*

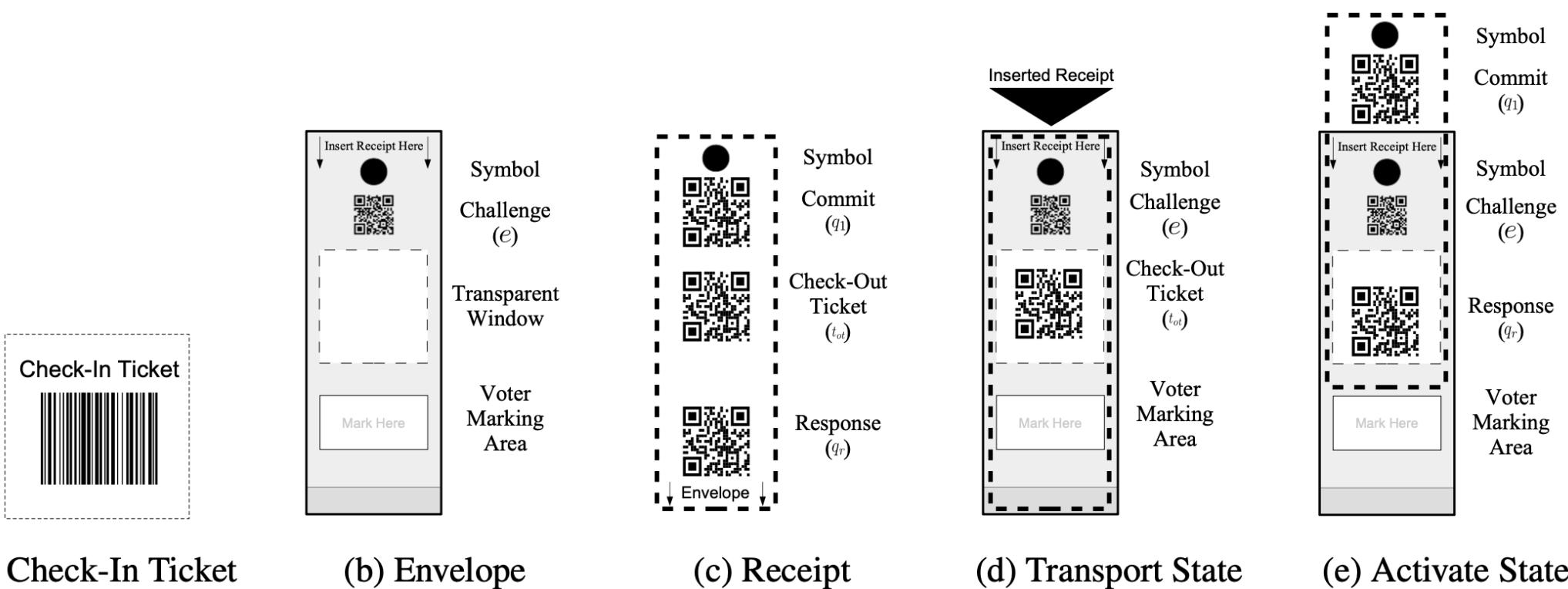
- Cheap, easy to hide from a coercer
- Attendees *not* under coercion need not trust the kiosk



TRIP paper credential design

Kiosk prints three QR codes on a receipt printer

- *Printing sequence* determines real versus fake
- Voter observes but can't prove it later



User studies on TRIP

- Preliminary user study in early 2022
 - 41 EPFL PhD student participants (15 female)
 - System Usability Scale (SUS) score of 64.3
 - Industry average is in 60-70 range
 - 40 created a fake credential (7 created two)
 - 6 made minor process mistakes
 - Learned from mistakes, suggestions in next phase
- Study was approved by EPFL's ethics board

User studies on TRIP

- Larger, more diverse study in fall 2022
- Study was approved by EPFL's ethics board
 - 150 participants recruited in park in greater Boston
 - Broad spectrum in age, gender, ethnicity, education
 - Used A/B testing to compare 5 variants of TRIP
 - Incorporated introductory videos to “educate” users
 - Used exit surveys to study a variety of questions
- Study was approved by EPFL's ethics board

Prototype kiosk setup for full study



User study – summary of lessons

- Is the problem of voter coercion important?
 - 26% reported experience by someone they know
 - Most likely scenario: ballot selfies; source: family
- Is the TRIP kiosk usable by ordinary people?
 - SUS usability score of 70.4 → 58th percentile
- Can voters successfully use TRIP?
 - 83-95% success rate depending on metric
- Will users detect & report a malicious kiosk?
 - 30% without, 57% with, “security education”

Next steps, goals, questions

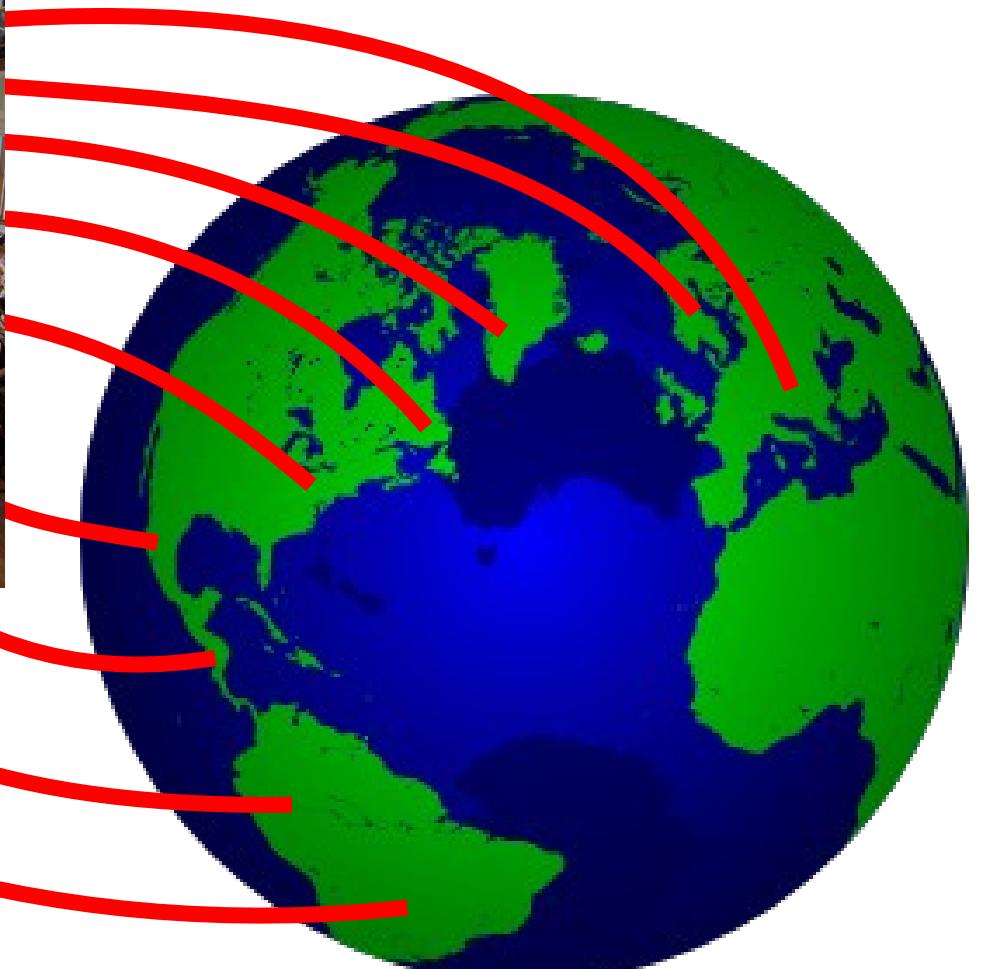
- Real series of presence-based events
 - Tentative: hybrid online/in-person seminar series
 - Participate online or at one of several/many sites
 - Only in-person participants get “voting rights”
- User studies of proof-of-presence processes
 - Including coercion resistance as an option
- What participatory forum(s) to build on top?
 - Simple polls; social media; deliberative debate?
- What will make PoP compelling, sustainable?

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Is a true “global town hall” feasible?

For robust discussion of important global issues



→ Decisions,
action plans that
transparently & securely
represent everyone's interests

Towards a true global town hall

If **climate change** is world's most urgent problem,
collective action is most urgent meta-problem.

- Must get *everyone* “at the table” on equal basis
- Hard choices require transparency for buy-in

I believe we *can* create distributed infrastructure
to solve the meta-problem (then the problem)....

- Start by recognizing *how hard* meta-problem is
- We have promising pieces, but need a *system*