VoteBOX

a tamper-evident, verifiable voting system

DANIEL R. SANDLER
DAN S. WALLACH

RICE UNIVERSITY

DRE voting systems

current systems shown to have deep flaws

high-profile malfunctions

vulnerable to attacks

yet, there are benefits

accessibility

feedback

flexibility

user preference

Greene et al. **Is newer always better? The usability of electronic voting machines versus traditional methods.** CHI '08.

building a better electronic voting machine

D. R. Sandler, K. Derr, and D. S. Wallach. **VoteBox: a tamper-evident, verifiable electronic voting system.** In *Proceedings of the 17th USENIX Security Symposium (USENIX Security '08)*.

security properties

minimized software stack

less code to examine → practical audits & certification

fault tolerance

prevent or minimize data loss in case of failure

tamper evidence

proof of failure/attack during & after an election

verifiability

confirm that votes will be cast as intended

techniques
used in VoteBox

1. PRUI: pre-rendered user interfaces
2. Auditorium: replicated secure logs
3. ballot challenge system

PRUI pre-rendered user interfaces

move complexity out of the voting machine TCB

and into a definition file representing the ballot

- ballot artwork & text, pre-rendered into bitmaps
- ballot layout
- navigation & selection state machine

result

	Diebold	Sequoia	VoteBox
KLOC	64 (C++)	124 (C)	14 (Java)

inspired by Pvote

K.-P. Yee, D. Wagner, M. Hearst, and S. M. Bellovin. **Prerendered user interfaces for higher-assurance electronic voting.** In *USENIX/ACCURATE Electronic Voting Technology Workshop (EVT '06).*

a voting machine is a terrible place to keep ballots

a **malicious** voting machine might silently alter its own totals

and even **honest** voting machines can fail, losing votes & audit logs

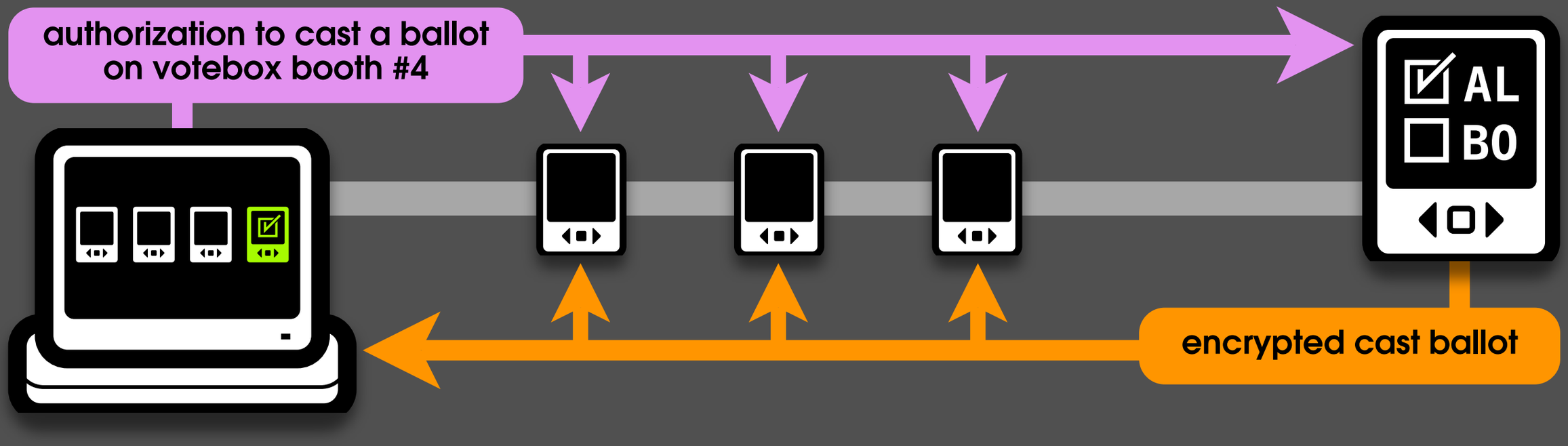
we can't trust voting machines to store critical election data

…not without **redundancy**

AUDITORIUM

Sandler and Wallach. **Casting votes in the Auditorium.** EVT'07.

the AUDITORIUM polling place network



connects all voting machines (+ supervisor console)

all election events are digitally **signed**, **broadcast** to other machines, and recorded in **tamper-evident logs**

result: tamper-evidence and recoverable data

“cast as intended”

the biggest challenge for DREs

how can the voter trust that a VoteBox

captured the voter’s choices faithfully,

encrypted the ballot correctly,

and stored and broadcast it in the Auditorium?

if the voter’s intent is lost, no amount of procedure or post facto auditing can recover it

ballot challenge

at the end of the voting session:

1. force the machine to **commit** to the contents of the ballot it is about to cast
   - irrevocable
   - contents not revealed
2. the voter chooses either:
   - **cast** the ballot, or
   - **challenge** the machine to reveal the contents of the commitment

(challengers should enlist pollworker assistance)

we owe this technique to Benaloh

J. Benaloh. **Ballot casting assurance via voter-initiated poll station auditing.** In *Proceedings of the 2nd USENIX/ACCURATE Electronic Voting Technology Workshop (EVT '07)*.

the commitment is an encrypted ballot

in Benaloh 07, it was printed under glass

the machine cannot un-print it in case of audit

to challenge: break glass & decrypt

in VoteBox, Auditorium is the "printer"

commitments broadcast & logged everywhere

we can send these commitments offsite via one-way link

allows third-party **challenge centers** to supervise and help confirm challenges

conclusion:
why VoteBox?

lots of research on **individual pieces** of the e-voting problem

VoteBox uniquely integrates these techniques into a **single system**

it also introduces **Auditorium** and a new **ballot challenge** scheme

offering **security properties** not found in today's commercial systems

NB: some or all of our techniques could be added to those systems

thanks

undergraduates who have worked on VoteBox

Kyle Derr, Emily Fortuna, George Mastrogiannis, Kevin Montrose, Corey Shaw, Ted Torous

designers of the VoteBox ballot

Mike Byrne, Sarah Everett, Kristen Greene

others who have offered ideas and criticism

Ben Adida, Josh Benaloh, Peter Neumann, Chris Piekert, Brent Waters

NSF/ACCURATE

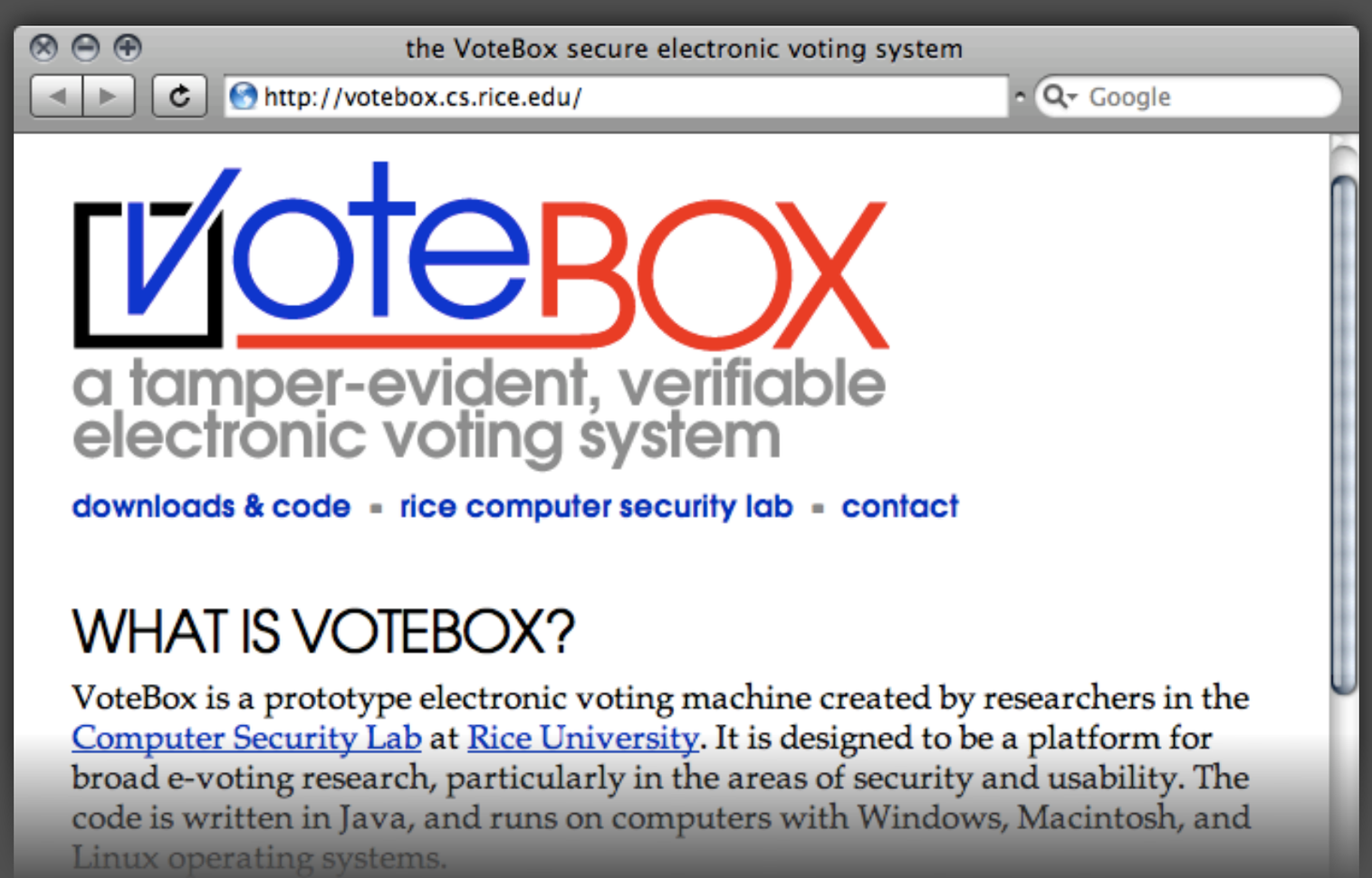
votebox.cs.rice.edu

SOURCE CODE

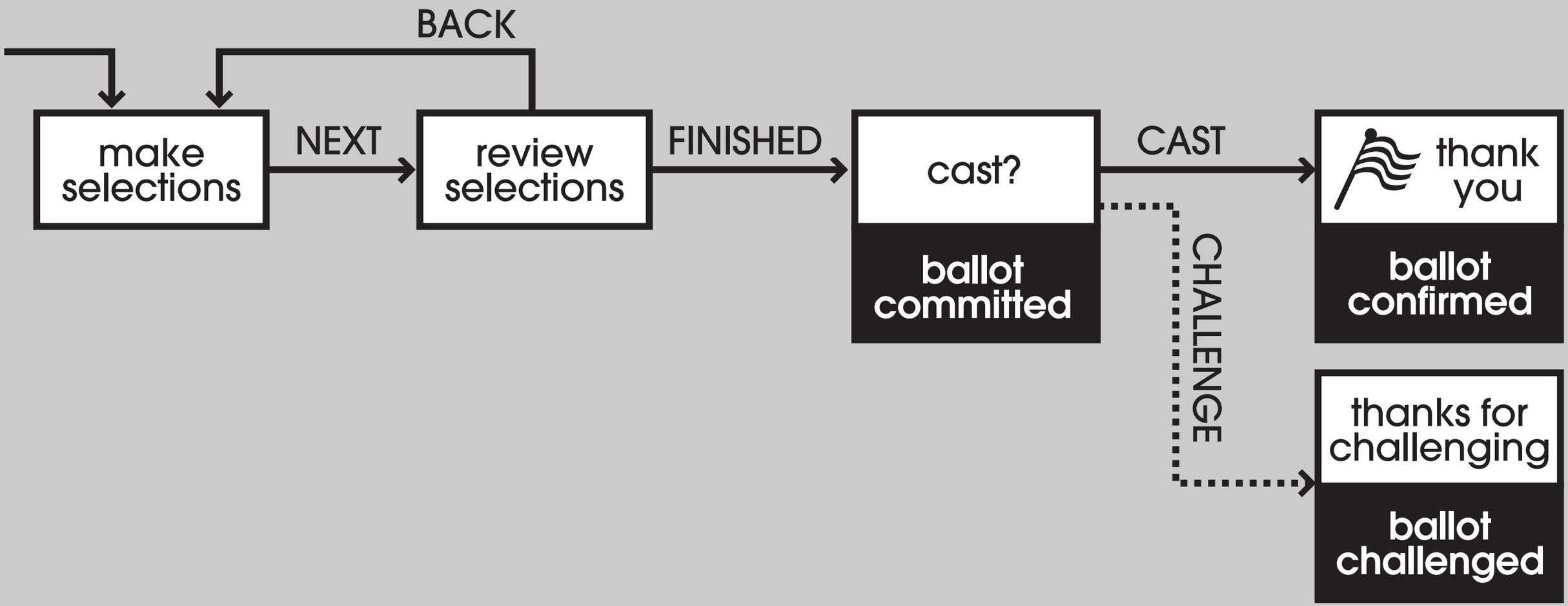
— booths, supervisor console, ballot creator
— core tech: Auditorium, etc.

RESEARCH PAPERS

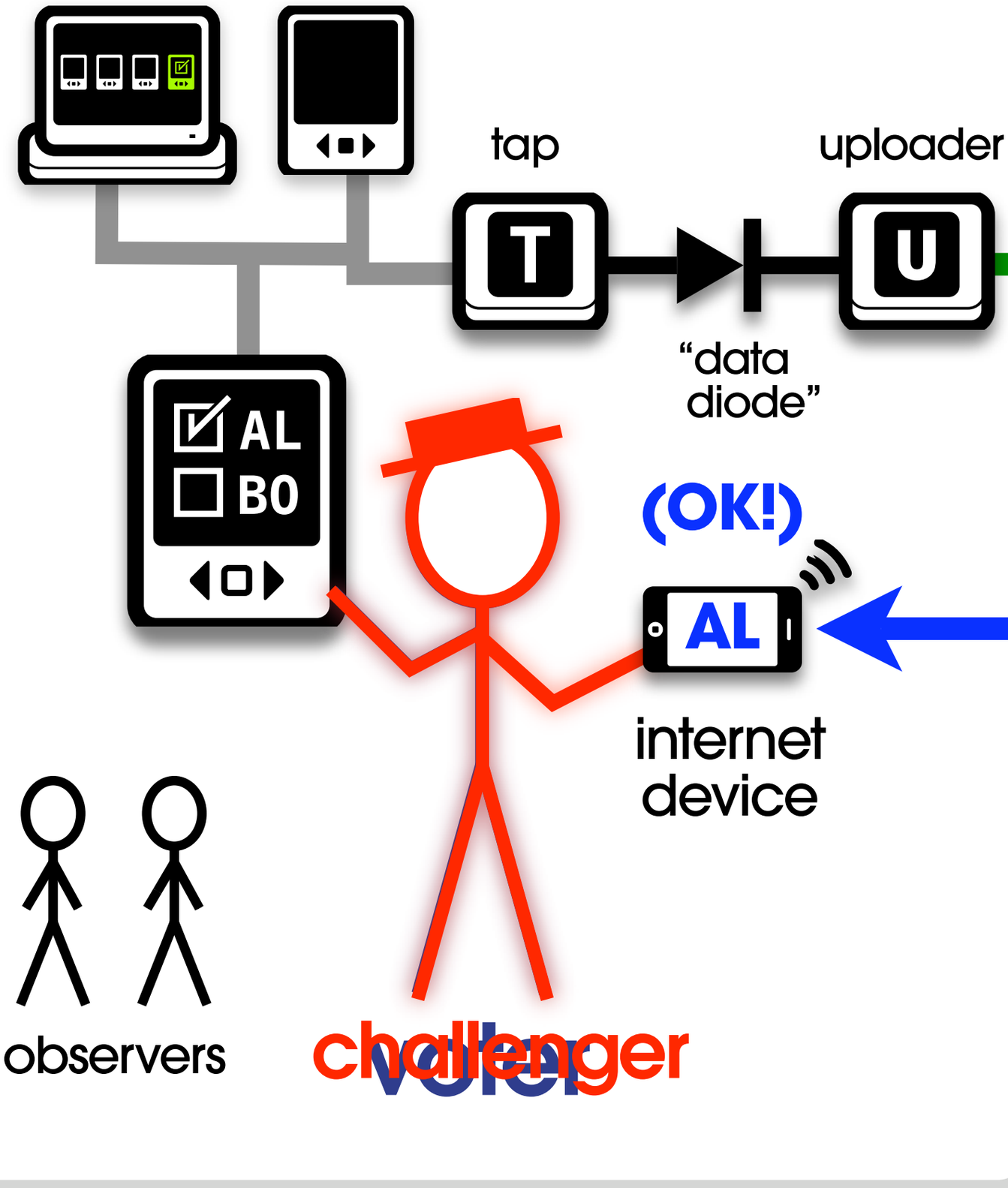
OPERATING INSTRUCTIONS



ballot challenge **voter flowchart**



polling place



INTERNET

challenge center