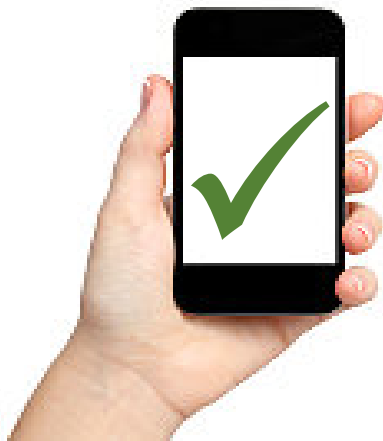


SMARTPHONE VOTING: IMPOSSIBLE OR INEVITABLE?



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Smartphone Voting: Impossible or Inevitable?

Mid-term elections are upon us and with them comes the inevitable observation and question, “Voter turnout is declining, why can’t I vote on my smartphone?” Historically, the argument against any form of non-paper voting has been about security and auditability. Yet, in the financial industry, which requires extreme security, an exciting technology is upending conventional thinking of what is possible. That foundational technologyⁱ is the “blockchain” which has enabled secure, low-cost financial transactions like Bitcoinⁱⁱ.

This paper presents the concept of a Mobile Voting channel: a new way for voters to receive, mark and cast their ballot. This new voting channel responds directly to the challenges of security, convenience and accessibility that have stymied progress in improving voter experience and lowering the cost of elections.

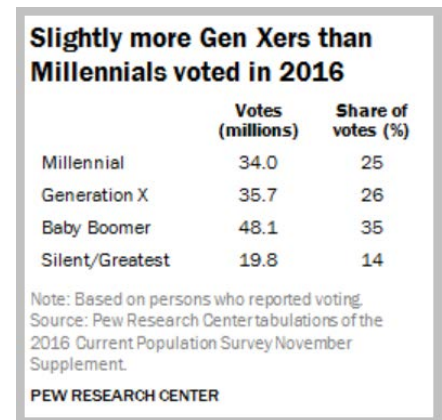
A mobile voting channel, based on the smartphone and secured by the blockchain is fundamentally different than touchscreen or online voting: First, that it is mobile and accessible enables voters to vote privately and independently in the way they live their lives. The smartphone is well-understood by the largest segments of the electorate. It is far less expensive than infrequently used, single purpose voting devices. Coupled with blockchain technology, an immutable, auditable record of every vote is automatically maintained while preserving voter anonymity. It allows the elections industry to leverage the major ongoing corporate investments in smartphones, accessibility, usability and security. Finally, with improved voter convenience, a mobile voting channel offers an antidote to upcoming adverse effects on turnout caused by demographics shifts.

Three forces have converged to create the potential for a new mobile voting channel: rapidly changing demographics, ubiquitous smartphones and the blockchain.

Demographics

An analysis of voter demographics shows that voters in the 18-50 age range will dominate voter turnout in the coming decade. That is concerning if turnout, as expected, will further decline as the Baby Boomers age out and the low-turnout Millennials and Gen Xers begin to cast a larger percentage of the U.S. vote.

As shown in the chart on the right, in 2016, 86% of the U.S. vote was cast by the three largest segments of the voting population: Millennials (ages 18-34 in 2016), Generation X (ages 35-50) and Baby Boomers (ages 51-69). In 2015, Millennials passed the Boomers to become the nation’s largest living generation.



Source: Pew FactTank. July 31, 2017

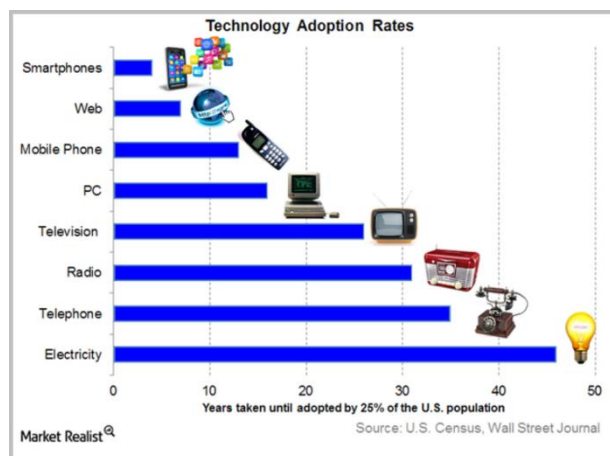
While Boomers now account for the largest percentage of the vote, naturally occurring age-related disabilities (e.g., mobility and eyesight) will create additional challenges for them to vote. Absent innovations in accessibility and convenience, the sheer difficulty of aging Boomers simply getting to the polls will depress turnout for this active segment.

Richard Fry at the Pew Research Center said it well, “While the growth in the number of Millennials who are eligible to vote underscores the *potential* electoral clout of today’s young adults, Millennials remain far from the largest generational bloc of *actual* voters. **It is one thing to be eligible to vote and another entirely to cast a ballot.**”ⁱⁱⁱ

Smartphones

The rate of technological diffusion is measured by the length of time a technology takes to be adopted by 25% of the population. At three years, the Smartphone surpasses all other technologies ^{iv}.

Millennials are the first segment of the voting age population to grow up in the age of the Internet, personal computer technology and broadband communications. In 2017, according to the Pew Research Center, 92% of Millennials, 88% of Gen X and 74% of the younger Boomers (ages 51-64) own smartphone ^v.



Widely publicized articles on the FBI's inability to crack the secure enclaves (i.e. trusted containers) on Apple and certain Android smartphones support the assertion that the smartphone is also among the most secure computing platforms ^{vi}. **In short, the ever-improving smartphone is a secure technology platform familiar to most voters.**

The Blockchain

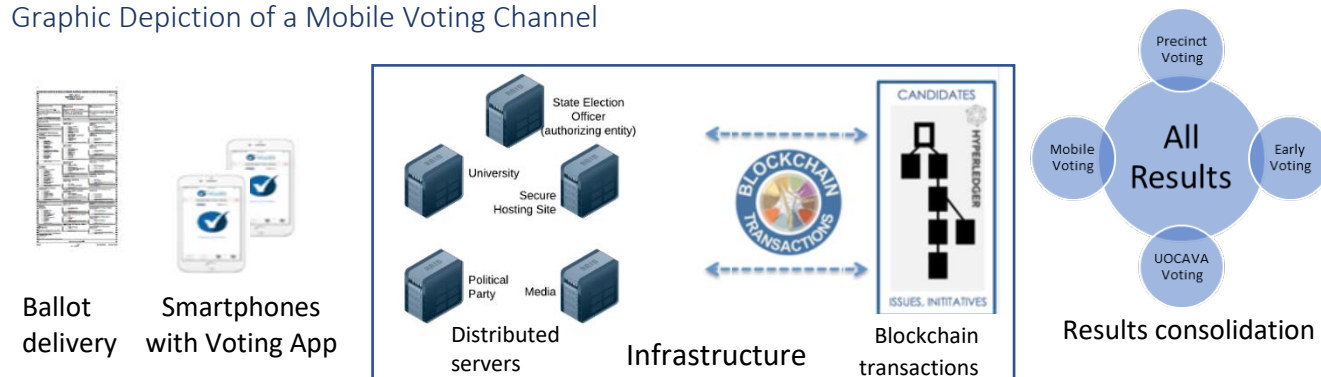
The blockchain is a ledger that runs on distributed servers. Election jurisdictions start the process by crediting each voter with secure tokens that have a one-to-one correspondence to the ovals that voter would have received on a paper ballot. The voter makes selections on an app on their smartphone; overvotes are prevented. Once submitted, the vote is verified and confirmed by the distributed servers. Upon verification, the vote is debited (i.e. subtracted) from the voter's ledger and credited (i.e. added) to the candidate's ledger.

Elements of a mobile voting channel secured by the blockchain

As envisioned in simplified form, a federally / state certified mobile voting channel would consist of:

- **Accessible electronic ballot styles** - created by and securely transmitted by the jurisdiction to the smartphone app of eligible voters at the start of voting.
- **Broadly available devices** - Smartphones, purchased and owned by voters, running a secure, open source and certified Voting App that has been downloaded from a commercial App Store.
- **Infrastructure** – Consists of geographically distributed servers each authorized by a state's Chief Election Officer and running open source software. Servers could, for example, be distributed across universities, political parties, the media and in highly secure hosting facilities like Amazon.
- **Results consolidation** – Mobile voting results would be consolidated with all other voting channels.

Graphic Depiction of a Mobile Voting Channel



A graphic explanation of how a Mobile Voting channel could work

Setup: initialization, registration, blank ballot delivery

Initialization



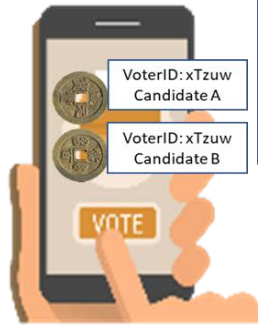
Voter Mary Smith downloads the Voting App from the App Store to her smartphone

Registration



Mary registers herself to the jurisdiction entering her name and address, authenticates herself by scanning the barcode on her driver's license and authenticates herself to the smartphone with her fingerprint.

Ballot Delivery



Official Ballot
Vote for 1

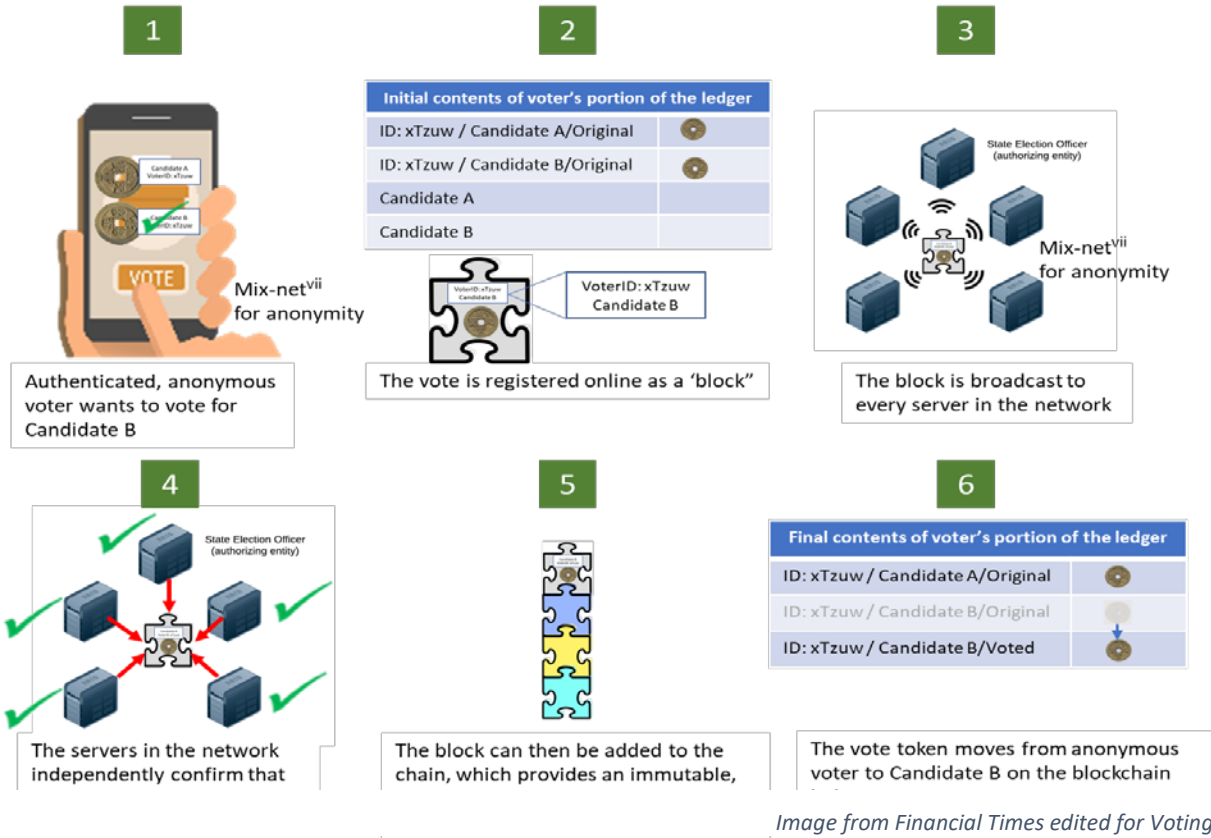
Candidate A

Candidate B

By comparison, voters receiving paper ballots mark ovals for their selection.

At election time, Mary's App receives cryptographically secure vote tokens from her jurisdiction which are then anonymized by the App to preserve voter privacy. There are as many tokens delivered as there would be ovals on the voter's paper ballot style. The App prevents overvotes.

How a blockchain works for voting

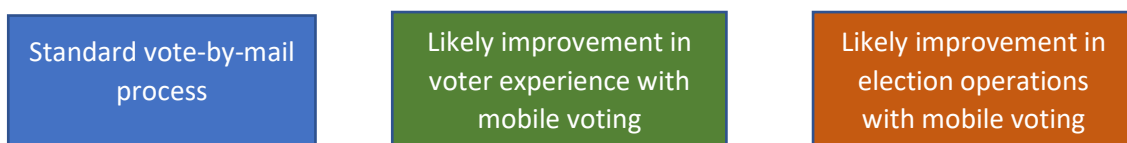


Overview of the Vote-by-Mail Process

The graphic below illustrates the steps involved in vote-by-mail, the closest analog to what voting on a smartphone would look like. This chart shows where improvements in election operations and voter experience can be made with a smartphone-based, mobile voting channel.



Legend:



Conclusion

This paper has presented three arguments in support of a mobile voting channel:

1. **Inexorable Demographics** - Rapid changes in the U.S. voting population that are clearly visible today will, in a few short years, place severe strains on our electoral systems. We will see further declines in voter turnout and increased demand for both innovations in accessibility and greater convenience for all voters.
2. **Existing Infrastructure** - The smartphone is an existing technological platform combined with a scaled-out, secure application distribution system – the App Store. Smartphones are now owned by nearly all voters in the top three segments of the voting population: Millennials, Generation X and Baby Boomers. Highly secure and ubiquitous, the smartphone will allow voters to vote privately^{vii} and independently in the way they live their lives.
3. **A promising solution to security** - The thorniest problems to date have been (a) ensuring that an authenticated voter can cast anonymous votes from a secure platform and (b) ensuring resiliency and platform availability even under the threat of public ISP network disruption. While more testing is needed, the smartphone paired with the blockchain are candidate technologies to address those problems.

The title of this paper poses the question of voting on a smartphone: Is it impossible or inevitable? We believe the answer is, “Neither. Smartphone voting is possible; it is just not inevitable.” Additional technical work to be done includes rigorous, independent “red team” testing, pilots and education^{viii}. However, whether the solution we have described, or something close to it, gains traction in governmental elections is still unknown.

What is clear is that a mobile voting channel is no longer an academic exercise. Leaders in election software and blockchain technology for the smartphone are working together on this solution now.

Endnotes – references checked as of Jan. 29, 2018

ⁱ See: Harvard Business Review article on blockchain as foundational infrastructure. <https://hbr.org/2017/01/the-truth-about-blockchain>

ⁱⁱ From NIST, a complete, unbiased description of blockchain technology: <https://csrc.nist.gov/CSRC/media/Publications/nistir/8202/draft/documents/nistir8202-draft.pdf>

ⁱⁱⁱ See: <http://www.pewresearch.org/fact-tank/2016/05/16/millennials-match-baby-boomers-as-largest-generation-in-u-s-electorate-but-will-they-vote/>

^{iv} See: <https://finance.yahoo.com/news/tech-adoption-rates-reached-dizzying-143221586.html>

^v See: Fact sheet on adoption rates of smartphones <http://www.pewinternet.org/fact-sheet/mobile/>

^{vi} See: Discussion on the inherent security of smartphones <http://theconversation.com/fbi-tries-to-crack-another-smartphone-5-essential-reads-87141>

^{vii} A description of the method to produce an anonymized vote token, called a “mix-net” is beyond the scope of this paper. This short video describes work with mix-nets in Europe, including its use in voting at 2:03,

<https://ec.europa.eu/digital-single-market/en/news/what-mix-net-find-out-about-technology-core-panoramix-project>

^{viii} See: Excellent tutorial on Blockchain <https://www.youtube.com/watch?v=Lx9zgZCMqXE>