BRENNAN CENTER FOR JUSTICE

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Statement of Elizabeth L. Howard
Counsel, Democracy Program
Brennan Center for Justice at NYU School of Law
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"2020 Election Security – Perspectives from Voting System Vendors and Experts"

Chairperson Lofgren, Ranking Member Davis, and members of the Committee, thank you for the opportunity to speak about the critical issue of election security. The Brennan Center for Justice—a nonpartisan law and policy institute that focuses on democracy and justice—appreciates the opportunity to discuss our analysis of the important efforts to secure voting systems across the country, based on the results of our extensive studies and work to ensure our nation's election systems are more secure and reliable. Given the important role that election vendors play in our nation's election security, this hearing is extremely important. This committee's ongoing oversight efforts have positively impacted the security of our election infrastructure, and Congress has more work to do.

For over a decade, I have worked on election administration issues. In my former position as deputy commissioner of elections in Virginia, I coordinated various election security projects, including the decertification of all paperless voting machines in 2017. In my current role, I focus almost exclusively on election security. Representing the Brennan Center, I frequently partner with state and local election officials to assist with the implementation of important election security measures and serve on the Michigan Secretary of State's Election Security Commission and the Pennsylvania Secretary of State's Audit Working Group. I have also co-authored multiple reports on election security and remedial measures and policies that will better enable our election infrastructure, including our voting systems, to withstand attack.

I hope to convey three points in my testimony today:

(1) Election vendors play a critical role in our democracy but have received little federal or congressional oversight;

(2) Despite this lack of oversight, there has been significant progress in improving election security in the past few years – particularly since 2016 – as there has been a greater national focus on the issue; and
(3) There is still more to do to further strengthen our election systems ahead of the 2020 election and beyond. Congress has a critical role to play in that process, including oversight of the vendors that are so important to the security and accuracy of our elections.

I. Election Vendors Play a Critical Role in our Democracy, But Federal Oversight is Lacking

In our current federal election system, private companies perform an extensive array of activities for local election jurisdictions. These election vendors design and manufacture voting machines; build and maintain election websites that help voters determine how to register and where they can vote; print and design ballots; program voting machines before each election; and build and maintain voter registration databases, voting machines, electronic pollbooks used to check in voters at the polls, election night reporting software, and more. To be sure, not every jurisdiction outsources all these functions, but all rely on private vendors for some of this work and many for all of it.

More than 80 percent of voting machines in use today are under the purview of the three private election vendors who are testifying before this committee today.[1] A successful cyberattack against any of these companies could have devastating consequences for elections in vast swaths of the country. But it's not just about voting machines. As described above, beyond voting machines themselves, other technologies that play critical roles in our current election system, like voter registration databases and electronic pollbooks, are also supplied and serviced by these and other private companies.

As outlined in our May 2019 testimony before this committee, the threat of hacking, disruption, or manipulation of our election system is very real.[2] Since 2016, national security and intelligence officials have repeatedly sounded the alarm. In November 2019, the Departments of Defense, Homeland Security, and Justice, together with the Director of National Intelligence, Federal Bureau of Investigation, National Security Agency, and Cybersecurity and Infrastructure Security Agency, issued a joint statement warning, "Russia, China, Iran, and other foreign malicious actors all will seek to interfere in the voting process" in 2020.[3] This comes despite

[1] Kim Zetter, "The Crisis of Election Security," *New York Times Magazine*, Sept. 26, 2018, https://www.nytimes.com/2018/09/26/magazine/election-security-crisis-midterms.html.

[2] Election Security Hearing, Before the Comm. on House Administration, 116th Cong. (2019) (statement of Lawrence Norden).

[3] "Joint Statement from the Department of Justice, DOD, DHS, DNI, FBI, NSA and CISA on Ensuring Security of 2020 Elections," Justice News, U.S Department of Justice, Nov. 5, 2019, https://www.justice.gov/opa/pr/joint-statement-department-justice-dod-dhs-dni-fbi-nsa-and-cisa-ensuring-security-2020.

these agencies' "[increased] level of support to state and local election officials in their efforts to protect elections."[4]

While the threat to our election infrastructure is real, as a bipartisan 2018 U.S. Senate Intelligence Committee report observed, "State local, territorial, tribal, and federal government authorities have very little insight into the cyber security practices of [election] vendors."[5] As the Brennan Center has outlined in a recent report, "A Framework for Election Vendor Oversight," (Appendix A) election vendors are subject to virtually no oversight or transparency requirements by the federal government. As a result, local election officials are left in the dark about the vendors they must work with as they seek to defend American elections from attack.

Election officials are purchasing products, including voting machines, and entering into maintenance and service contracts with these vendors, without even knowing, for example, who are the employees or contractors programming the voting machines? Who is writing any software upgrades? Have they been background checked to see if they are vulnerable to bribery and coercion? Have they received basic training on how to avoid spear-phishing attacks, or not to use public WiFi when transmitting potentially sensitive information? Similarly, election officials have no insight into where these private election vendor employees do their work – are they even located in the United States, or are they engineering machine components while under the jurisdiction of a foreign adversary?

These risks and unanswered questions are not tolerated in other key sectors that impact our national security. Defense contractors, for example, must comply with myriad rules from the handling of classified information to the security of their supply chains.[6] The nuclear power industry is subject to an extensive set of rules governing the fitness and reliability of their personnel.[7] Even colored pencils are subject to more federal regulation than voting systems.[8] To be sure, more than 8,000 state and local election jurisdictions retain primacy in running elections. But only the federal government has the resources to ensure that these local officials have access

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[4] "Joint Statement from the Department of Justice, DOD, DHS, DNI, FBI, NSA and CISA on Ensuring Security of 2020 Elections," DOJ.

[5] *Russian Targeting of Election Infrastructure During the 2016 Election: Summary of Initial Findings and Recommendations*, U.S. Senate Select Committee on Intelligence, May 8, 2018, https://www.intelligence.senate.gov/publications/russia-inquiry.

[6] See, e.g., *National Industrial Security Program, Operation Manual*, U.S Department of Defense, Feb. 2006, §§ 2-200–2-211, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodm/522022M.pdf.

[7] See generally, 10 C.F.R. §§ 26.1–26.825.

[8] Compare, for example, The Labeling of Hazardous Art Materials Act, 15 U.S.C. 1277, and 16 C.F.R. §§ 1500.14, with 11 CFR §§ 9405.1 et seq. Indeed, Chapter II of Title 11 of the Code of Federal Regulations, the principal regulations applicable to the EAC, does not address the certification of voting systems or any potential oversight of election vendors more broadly. Nor does the legislation that established the EAC (the Help America Vote Act of 2002) — which sets some requirements for voting systems used in federal elections, see 52 U.S.C. § 21081 — require the EAC to issue any mandatory regulations on those topics. See, e.g., 52 U.S.C § 20971 (regarding the certification and testing of voting systems), § 20929 ("The Commission shall not have any authority to issue any rule, promulgate any regulation, or take any other action which imposes any requirement on any State or unit of local government . . ."), § 21101 (regarding the EAC's adoption of voluntary guidance).

to the information and expertise they need to effectively ensure that election vendors' security practices are not endangering federal elections.

As discussed in our recent paper, there are at least five areas where private election vendor practices deserve greater scrutiny and oversight. The first involves reporting and response to breaches or hacks. It has now been widely reported that Russian actors targeted an election vendor in the lead-up to the 2016 election, as Special Counsel Robert Mueller's report to the attorney general and his indictment of 12 Russian intelligence officers also alleged.[9] But despite recent reporting, the public has more questions than answers about this incident. In fact, the public is not even completely certain of the identity of the election vendor involved, much less when the vendor learned of the attacks, what measures to protect against such an attack were in place, and what steps were taken after discovery of the attack, including whether customers were informed, and if so, how promptly. The private company VR Systems has agreed that it appears to be the subject of this allegation, but has denied that it was in fact hacked.[10] Our uncertainty about the basic facts is instructive: We know very little about the incident because we know very little about the security practices of the vendors that supply voting systems and other election infrastructure in general.

There are no federal laws or regulations requiring private vendors to take any action in the event of a cyberattack, or, second, to even attest that they follow good security practices. Voting machines are subject to voluntary federal certification, but the vendors who supply, maintain, and often program those machines, along with integrated products such as electronic pollbooks, are not.[11] Thus, in 2017, ES&S, the country's leading voting system vendor, left the sensitive personal information of 1.8 million Chicago voters publicly exposed on an Amazon cloud server.[12] That information reportedly included "addresses, birth dates and partial Social Security numbers,"[13] information valuable to hackers. Although ES&S sells federally certified voting systems, that certification process does not speak to vendor practices more generally that can affect the security of voters' personal information.

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[9] United States v. Netyksho et al., No. 1:18CR00215, 2018 WL 3407381, 26 (D.D.C. Jul. 13, 2018); Robert S. Mueller III, *Report on the Investigation into Russian Interference in the 2016 Presidential Election*, U.S. Department of Justice, 2019, 50, https://www.justice.gov/storage/report.pdf.

[10] Mueller, *Report on the Investigation into Russian Interference*, 51; Kim Zetter, "Florida Election Vendor Says It Has Proof It Wasn't Breached by Russians," *Politico*, May 23, 2019, https://www.politico.com/story/2019/05/23/florida-vendor-russia-1469086.

[11] A variety of bills, including the Election Security Assistance Act proposed by Rep. Rodney Davis (R–IL) and the Democratic-sponsored SAFE Act and For the People Act, have called for electronic pollbooks, which are not currently considered voting systems and covered by the program, to be included in its hardware and software testing regime." For the People Act, H.R. 1, 116th Cong. (2019), § 3302; Securing America's Federal Elections Act, H.R. 2722, 116th Cong. (2019), § 204; Election Security Assistance Act, H.R. 3412, 116th Cong. (2019), § 3(a).

[12] Dan O'Sullivan, "The Chicago Way: An Electronic Voting Firm Exposes 1.8M Chicagoans," *Upguard*, Dec. 13, 2018, https://www.upguard.com/breaches/cloud-leak-chicago-voters.

[13] Frank Bajak, "US Election Integrity Depends on Security-Challenged Firms," *Associated Press*, Oct. 29, 2018, https://apnews.com/f6876669cb6b4e4c9850844f8e015b4c.

Third, opaque supply chains further exacerbate the problem. In 2019, an IBM Security Services investigation on behalf of Los Angeles County found that compatibility issues between the county's voter list and an ES&S subsidiary's software contributed to nearly 120,000 voters being left out of printed pollbooks and forced to request provisional ballots.[14] But there is no federal oversight of subsidiaries or contractors who work with election vendors to ensure standards of quality and security are met. The Department of Defense has recently stepped up its enforcement of supply chain integrity and security standards in the defense contracting sphere, in recognition of the risk that supply chains can pose to national security interests.[15] No analogous management of supply chain risk is occurring in the election vendor industry, however, as Congress has not authorized any agency to provide guidelines for these vendors more generally.

Insider attacks are a fourth area in which federal oversight of vendors could play a positive role in election security, as vendors that fail to follow best practices for personnel screening and other safeguards could be exposed to malfeasance from within. If an employee of a major election vendor were vulnerable to bribery or other improper influence, they could severely impact election integrity and public confidence by undertaking malicious acts against their employer.

Finally, the federal government could also improve transparency into vendors' ownership and control structures.[16] Over the last several years, the topic of foreign ownership of election vendors has occasionally made headlines. For instance, in 2018, the FBI informed Maryland officials that a vendor servicing the state, ByteGrid LLC, had been under the control of a Russian oligarch with close ties to President Vladimir Putin.[17] Dominion Voting Systems, the second-largest voting machine vendor in the United States, whose voting machines are used by more than one-third of American voters, has its headquarters in Toronto. But aside from concerns with foreign influence and control, lack of insight into election vendor ownership also prevents the public from scrutinizing potential conflicts of interest. Some unscrupulous officials might award vendor contracts in exchange for gifts or special treatment rather than to those that would best

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[14] "Report Blames Software Error for Los Angeles Voting Problem," *Associated Press*, Aug. 1, 2018, https://apnews.com/95b056ab2eab47febaf721a1d285a045; *Independent Investigation of Election System Anomalies in Los Angeles County on June 5, 2018*, IBM Security Services, Aug. 1, 2018, http://file.lacounty.gov/SDSInter/lac/1042885_FINALExecutiveSummaryAugust12018.pdf; See also Board of Supervisors, *Request for Approval: Amendment Number Eight to Agreement Number 76010 with Data Information Management Systems, LLC for Voter Information Management System Maintenance and Support Services*, County of Los Angeles, 2015, https://www.lavote.net/documents/05052015.pdf (identifying ES&S subsidiary Data Information Management Systems, LLC, as vendor responsible for maintaining and servicing Los Angeles County's voter information management system).

[15] Undersecretary of Defense, *Memorandum Addressing Cybersecurity Oversight as Part of a Contractor's Purchasing System Review*, U.S. Department of Defense, Jan. 21, 2019, https://www.acq.osd.mil/dpap/pdi/cyber/docs/USA000140-19%20TAB%20A%20USD(AS)%20Signed%20Memo.pdf.

[16] The Protect Election Systems from Foreign Control Act, sponsored by former Rep. John Delaney (D-MD), would require vendors to be "solely owned and controlled by a citizen or citizens of the United States" absent a waiver.

[17] Mark Morales, "Maryland Election Contractor Has Ties to Russian Oligarch," *CNN*, Jul. 16, 2018, https://www.cnn.com/2018/07/16/politics/maryland-elections-russia/index.html; Chase Cook and E.B. Furgurson III, "FBI Informs Maryland of Election Software Owned by Russian Firm, No Known Breaches," *Capital Gazette*, Jul. 13, 2018, https://www.capitalgazette.com/news/government/ac-cn-russianelection-0714-story.html.

facilitate free and fair elections. Transparency into ownership and control is required for the public to assess whether officials engaged in procurement and regulation have been improperly influenced.

As we know, election vendors were targeted in 2016 and are likely to be targeted in the future. This hearing represents a continuation of this committee's efforts to bolster election security through oversight of these election vendors. It will be the first congressional hearing at which representatives of the three primary voting systems vendors will appear jointly to publicly answer questions about their ownership, operations and conduct, which impact the security of our democracy. While this hearing is an important step, and other congressional oversight efforts are ongoing,[18] much work remains for Congress to do in 2020 and beyond.

II. Important Progress Has Been Made Since 2016

Despite the lack of rigorous oversight, important progress has been made since 2016 toward a more secure election system infrastructure. In January 2017, the Department of Homeland Security (DHS) designated election infrastructure as "critical infrastructure."[19] This designation has resulted in many substantive partnerships and collaborations, such as the Election Infrastructure Subsector Government Coordinating Council (EIS GCC) and the Election Infrastructure Information Sharing and Analysis Center (EI-ISAC), which have significantly improved information sharing practices between federal, state and local officials. Separately, the Election Assistance Commission (EAC), now with a quorum, continues its work on the updated Voluntary Voting System Guidelines (VVSG), though progress remains slow.

Most importantly, despite the lack of oversight of voting system vendors, significant progress has been made on replacing antiquated machines, particularly paperless machines, as well as in implementing robust audits after elections take place but before official results are certified. To address critical vulnerabilities in our current voting system infrastructure, cybersecurity and national security experts have long recommended these steps,[20] which will positively impact the voter confidence of tens of millions of voters who will cast ballots in the 2020 election using a variety of different machines. In fact, the Senate Select Committee on Intelligence's recent

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[18] See e.g., "Warren, Klobuchar, Wyden, and Pocan Investigate Vulnerabilities and Shortcomings of Election Technology Industry with Ties to Private Equity," Oversight Letters. Elizabeth Warren, Dec. 10, 2019, https://www.warren.senate.gov/oversight/letters/warren-klobuchar-wyden-and-pocan-investigate-vulnerabilities-and-shortcomings-of-election-technology-industry-with-ties-to-private-equity; MD. CODE ANN., Election Law §§ 2-109 (2019) (Maryland law requiring ownership disclosure).

[19] "Statement by Secretary Jeh Johnson on the Designation of Election Infrastructure as a Critical Infrastructure Subsector," Office of the Press Secretary, U.S. Department of Homeland Security, Jan. 6, 2017, https://www.dhs.gov/news/2017/01/06/statement-secretary-johnson-designation-election-infrastructure-critical

[20] See e.g., Lawrence Norden, *The Machinery of Democracy: Voting System Security, Accessibility, Usability, and Cost*, Brennan Center for Justice, 2006, https://www.brennancenter.org/publication/machinery-democracy; Lawrence Norden, Aaron Burstein, Margaret Chen, and Joseph Lorenzo Hall, *Post-Election Audits: Restoring Trust in Elections*, Brennan Center for Justice, 2007, https://www.brennancenter.org/publication/post-election-audits-restoring-trust-elections-executive-summary; *Securing the Vote: Protecting American Democracy*, The National Academies of Sciences, Engineering, and Medicine, 2018, https://www.nap.edu/read/25120/chapter/1.

bipartisan report on the Russian government's attack on America's election infrastructure echoed these recommendations and pointedly noted that there was an *urgent* need to secure the nation's voting systems.[21]

State and local election officials around the country have made important progress in implementing these recommendations since 2016. This progress is largely due to the new and acute awareness of the threat that hostile actors pose to the integrity of our elections, coupled with $380 million that Congress began to provide in 2018 to help states bolster their election security. As a result of substantive improvements, our voting systems are more secure today in much of the country.

A. Replacement of Antiquated and Paperless Voting Equipment

Replacing antiquated voting equipment, particularly paperless machines, is a critical step in strengthening our voting systems. Without a paper record of voters' intentions, malicious and accidental errors in machine-tabulated votes cannot be audited and corrected. I know how important this is and, in my former role as deputy commissioner of elections in Virginia, I coordinated the decertification and successful replacement of all paperless voting machines less than 60 days prior to our 2017 gubernatorial election. Since the Virginia decertification, the National Academies of Sciences Engineers and Medicine,[22] bipartisan Senate Select Committee on Intelligence[23] and other experts have identified replacement of paperless voting systems as a crucial priority in protecting our election system infrastructure.

In good news, the antiquated voting systems, including paperless machines, have been almost entirely replaced in battleground states. Michigan replaced its aging paper-based voting equipment statewide after the 2016 election; Ohio approved $114.5 million to replace aging voting machines ahead of the 2020 presidential election; Georgia and Pennsylvania are finalizing their scheduled 2020 replacement efforts;[24] and significant replacement has occurred at the local level in Florida and is ongoing in North Carolina.[25]

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[22] *Securing the Vote, NASED,5.*

[23] *Report of the Select Committee on Intelligence United States Senate on Russian Active Measures Campaigns and Interference in the 2016 U.S. Election Volume 1: Russian Efforts Against Election Infrastructure with Additional Views*, U.S. Senate Select Committee on Intelligence, Jul. 15, 2019, https://www.intelligence.senate.gov/sites/default/files/documents/Report_Volume1.pdf.

[24] Jonathan Lai, "Every Pa. county will have new voting machines — with paper trails — in 2020," *Inquirer*, Jan. 1, 2020, https://www.inquirer.com/politics/pennsylvania/pa-new-voting-machines-for-2020-with-paper-trails-20200101.html; Stephen Fowler, "Georgia Completes Pilot Of New Paper Ballot-Based Voting Machines," *GPB News*, Nov. 6, 2019, https://www.gpbnews.org/post/georgia-completes-pilot-new-paper-ballot-based-voting-machines.

[25] Rachel Looker, "State law on voting machines sticky for counties," *National Association of Counties*, Apr. 26, 2019, https://www.naco.org/articles/state-law-voting-machines-sticky-counties; See e.g., Taft Wireback, "North Carolina County Spends $2M Switching to Paper Ballots," *Government Technology*, Nov. 22, 2019, https://www.govtech.com/security/North-Carolina-County-Spends-2M-Switching-to-Paper-Ballots.html; Red Berky, "New voting machines pass the test in Mecklenburg County," *WCNC*, Nov. 7, 2019,

However, state and local election officials still have much work to do. We estimate that as many as 12 percent of voters (approximately 16 million voters) will vote on paperless equipment in November 2020.[26] This compares to 20 percent of voters (27.5 million) in 2016.[27]

While almost all states and jurisdictions are purchasing new paper-based systems, at least one voting system vendor continues to sell new paperless voting machines. Two Texas counties have spent roughly $2.5 million in the past two years on new paperless machines.[28] Upon learning of the significant security concerns associated with paperless machines – after purchasing them – one Texas election official stated, "Whoever's doing all the research, it seems like we should have been in on it a little sooner. Honestly, it's very disturbing."[29] The truly disturbing issue here is that we can be certain the vendor was well aware of the security concerns, but apparently failed to divulge this information to the election official buyer.

My experience with the decertification of paperless voting machines in Virginia also serves as an example of the crucial role—positive and negative—that vendors could play in assisting local election officials as they seek to make further improvements to election security in 2020.

At the beginning of 2017, paperless voting machines were in use on a patchwork basis in roughly 25% of the commonwealth. Mindful of the critical infrastructure designation made in January of that year,[30] and the increasingly concerning revelations about Russia's efforts to interfere with

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https://www.wcnc.com/article/news/politics/elections/new-voting-machines-pass-the-test-in-mecklenburg-county/275-3d1221e9-7d4d-4599-a89a-53cf8b7e7b30; The number of jurisdictions using paperless DREs has shrunk drastically in Florida, from 24 jurisdictions in 2016, to only three by November 2019. These three remaining counties are currently working to replace their paperless systems before the 2020 elections. See Eric Geller, Beatrice Jin, Jordyn Hermani and Michael B. Farrell, "The scramble to secure America's voting machines," *Politico*, Aug. 2, 2019, https://www.politico.com/interactives/2019/election-security-americas-voting-machines/index.html.

[26] At least some voters in the following eight states will cast their ballot on a paperless voting machine: Indiana, Kansas, Kentucky, Louisiana, New Jersey, Mississippi, Texas, and Tennessee.

[27] Andrea Córdova McCadney, Lawrence Norden, and Elizabeth Howard, "Voting Machine Security: Where We Stand 6 Months Before the New Hampshire Primary," *Brennan Center for Justice*, Aug. 13, 2019, https://www.brennancenter.org/our-work/analysis-opinion/voting-machine-security-where-we-stand-few-months-new-hampshire-primary.

[28] "Texas must retire paperless voting systems to prevent hacking," *Houston Chronicle*, Apr. 9, 2019, https://www.houstonchronicle.com/opinion/editorials/article/Texas-must-retire-paperless-voting-systems-to-12816376.php ("In one case, a Texas county that tried to do the right thing was hamstrung by poor state leadership. San Jacinto County recently spent a cool $383,000 on a new paperless voting system because no one in Austin or Washington warned against it."); Greg Gordon, "14 states' voting machines are highly vulnerable. How'd that happen?," *McClatchy Washington Bureau*, Apr. 4, 2019, https://www.mcclatchydc.com/news/nation-world/national/article207851784.html ("Vicki Shelly, the election administrator in San Jacinto County, Tex., north of Houston, said she received no alert from Washington or state officials before the county spent $383,000 on its new paperless touch-screen voting system made by Hart InterCivic.").

[29] Gordon, "14 states' voting machines are highly vulnerable. How'd that happen?".

[30] Statement by Secretary Jeh Johnson on the Designation of Election Infrastructure as a Critical Infrastructure Subsector," Office of the Press Secretary, U.S. Department of Homeland Security, January 6, 2017, https://www.dhs.gov/news/2017/01/06/statement-secretary-johnson-designation-election-infrastructure-critical.

elections,[31] multiple paperless jurisdictions voluntarily made plans to transition to paper-based voting systems. Election officials in localities without transition plans, which were generally poor and rural, were aware of the security concerns associated with paperless machines, but a lack of resources prevented them from replacing their equipment.

As pressure mounted on DHS over the summer to notify election officials in the "21 states" that they had publicly stated were targets of Russian hackers but refused to identify, DEFCon, one of the longest running and largest annual underground hacking conferences,[32] hosted its inaugural Voting Machine Hacking Village ("Village") exhibit.[33] The Village offered "white hat" hackers access to various models of voting equipment, procured by the event organizers through a variety of methods, that were in use across the country, including in Virginia.[34]

We had serious – and immediate – concerns when news stories published in early August reported that all of the paperless voting machines at DEFCon had been hacked, many "within minutes," and one article even included a password for paperless machines still in use in multiple Virginia jurisdictions.[35] We immediately partnered with the state IT agency, VITA, to conduct security reviews of the paperless machines used in Virginia as we were now facing a drastically different threat environment than just two years earlier.

Shortly thereafter, on September 7, less than 60 days prior to the General Election, we decertified all paperless voting machines. Despite the less-than-ideal timeframe, the transition was successful in all affected jurisdictions, largely due to the tireless efforts of local election officials.

The voting machine vendors, and their in-state representatives, were not helpful during the lead up to the decertification (one vendor even refused to provide a requested voting machine for testing purposes). However, once the decertification decision was made, the vendors were integral partners in the effort to ensure a smooth transition; they rapidly and successfully deployed new paper-based voting systems across the commonwealth. Vendor cooperation and openness will make all the difference as more local election officials seek to use the $425 million Congress has allocated to improve election security and public confidence in the months ahead.

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[31] Mueller, *Report On The Investigation Into Russian Interference* (characterizing the Russian government's interferences as a "sweeping and systematic" effort to undermine faith in our democracy); *Russian Active Measures Campaigns and Interference in the 2016 U.S. Election Volume 1*, SSCI.

[32] "Frequently asked questions about DEF CON," *Def Con*, https://www.defcon.org/html/links/dc-faq/dc-faq.html.

[33] Matt Blaze, et al., *Report on Cyber Vulnerabilities in U.S. Election Equipment, Databases, and Infrastructure*, DEFCON 25 Voting Machine Hacking Village, Sept. 2017, https://www.defcon.org/images/defcon-25/DEF%20CON%2025%20voting%20village%20report.pdf.

[34] Ibid.

[35] Sean Steinberg, "Hackers Eviscerate Election Tech Security…Who's Surprised?" *Who What Why*, Aug. 1, 2017, https://whowhatwhy.org/2017/08/01/hackers-eviscerate-election-tech-security-whos-surprised/.

B. Implementation of Robust Post-Election Audits

Paper-based voting machines improve election security because they create a paper record that voters can verify for accuracy before casting their ballot. Election officials can review these hard copy paper records during an audit after the election. However, these paper records will be of "limited security value"[36] unless they are used to check and confirm aggregate electronic tallies containing the ultimate election night results.

Traditional post-election audits, which generally require manual inspection of paper ballots cast in randomly selected precincts or on randomly selected voting machines, can provide assurance that individual voting machines accurately tabulated votes. Multiple states have employed these audits for over a decade. In 2020, including four new states since 2016,[37] 24 states and the District of Columbia will have voter verifiable paper records for all votes cast and require post-election audits of those paper records before certifying election results.[38] In total, these 24 states and the District of Columbia make up 295 electoral votes. The remaining 26 states, totaling 243 electoral votes, do not currently require post-election audits of all votes prior to certifying election results. However, there is nothing stopping most of these remaining states from conducting these audits if they have the resources and will to do so.

Risk-limiting audits (RLAs) are a comparatively new procedure and offer two important improvements to traditional post-election audits. RLAs use statistical methods and a manual

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[36] Norden, *The Machinery of Democracy*.

[37] These four states are Rhode Island, Iowa, Georgia, and Pennsylvania. See 17 R.I. Gen Laws §17-19-37.4 (2017); 2017 Iowa Acts 256; H.B. 316, 2019 Leg., Reg, Sess. (Ga. 2019). Pennsylvania, which requires traditional post-election audits before certification in jurisdictions with paper-based equipment, is expected to have replaced all its remaining paperless equipment by the 2020 elections. See Jonathan Lai, "Every Pa. county will have new voting machines — with paper trails — in 2020," Inquirer, Jan. 1, 2020, https://www.inquirer.com/politics/pennsylvania/pa-new-voting-machines-for-2020-with-paper-trails-20200101.html.

[38] For the purposes of this report, the Brennan Center only counted jurisdictions that (1) mandate post-election audits of (2) voter-verified paper records (3) before the certification of election results. These twenty-four states are Alaska, Arizona, California, Colorado, Connecticut, Georgia, Hawaii, Illinois, Iowa, Massachusetts, Minnesota, Missouri, Montana, Nevada, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, Rhode Island, Utah, Washington, and West Virginia. Although Ohio conducts post-election audits after certification, the Election Board must amend its certification if the audit results in a change of the vote totals reported in the official canvass. Post-election audits in Illinois and Iowa are not legally binding on election results, while statutes in California, Colorado, Connecticut, Hawaii, Nevada and Utah offer no guidance on whether audits are binding. Other states, which only require post-election audits for jurisdictions that use paper-based equipment (Kansas, Kentucky, Tennessee and Texas) were not included in the list since they still have some jurisdictions using paperless equipment. New Jersey's post-election statute is dependent on the implementation of new voting systems that produce voter verifiable paper records (which have not yet been purchased); *See* "POST-ELECTION AUDITS," National Conference of State Legislatures, last modified November 25, 2019, accessed Jan 6, 2020, http://www.ncsl.org/research/elections-and-campaigns/post-election-audits635926066.aspx; "State Audit Laws Searchable Database," Verified Voting, accessed July 2, 2019, https://www.verifiedvoting.org/state-audit-laws/; Danielle Root, Liz Kennedy, Michael Sozan, and Jerry Parshall, *Election Security in All 50 States: Defending America's Elections*, Center for American Progress, Feb. 12, 2018, https://www.americanprogress.org/issues/democracy/reports/2018/02/12/446336/election-security-50-states/.

review of paper ballots to check the accuracy of reported election outcomes.[39] They are generally more efficient than traditional audits, typically requiring a review of a smaller number of ballots during the audit process. And the statistical modeling used is designed to detect potential inaccuracies in overall election outcomes, as opposed to problems with individual machines. RLAs can provide assurance that the reported winner did, in fact, win the election,[40] instead of a traditional audit, which only assures officials that machines are working correctly. Because of these features, the Brennan Center and many other experts have urged broad adoption of RLAs.

States have embraced RLAs at a rapid rate: Colorado was the first state to implement RLAs in 2017.[41] In the following two years, officials in 15 states began experimenting with the procedure in some fashion.[42]

Currently, Colorado and Rhode Island require RLAs before results are legally certified; Nevada will do the same starting in 2022.[43] (Local election officials in Virginia are also required to use the procedure, but only once every five years and only after certification of election results.)[44] Washington and Ohio allow election officials to select RLAs from a set of post-election audit options; California enacted a similar law last year that will apply for most of 2020.[45]

The Brennan Center has long supported both a complete, nationwide transition to paper ballot voting machines and the implementation of risk-limiting audits to ensure security and confidence in electoral results. While the time for the remaining states to replace their antiquated and paperless voting systems prior to the 2020 election is running down, the recent $425 million provided by Congress just last month to bolster election security may enable additional states to transition in the near future and will enable additional states to, at minimum, experiment with robust, statistically sound post-election audits. As they do so, vendors should be forthright and

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39 Elizabeth Howard, *A Review of Robust Post-Election Audits*, Brennan Center for Justice, 2019, https://www.brennancenter.org/our-work/research-reports/review-robust-post-election-audits.

40 Assuming the reported winner did, in fact, win the election. If the reported winner did not, in fact, win the election, the RLA will detect there is a potential problem with some pre-determined probability, such as 95 percent. See Jerome Lovato, *Risk-Limiting Audits – Practical Application*, U.S. Election Assistance Commission, Jun. 25, 2018, https://www.eac.gov/assets/1/6/Risk-Limiting_Audits_-_Practical_Application_Jerome_Lovato.pdf; Howard, *A Review of Robust Post-Election Audits*.

41 Ann Marie Awad, "Colorado Launches First in the Nation Post-Election Audits," *NPR*, Nov. 22, 2017, https://www.npr.org/2017/11/22/566039611/colorado-launches-first-in-the-nation-post-election-audits.

42 These 15 states are Alabama, California, Georgia, Indiana, Michigan, Missouri, New Jersey, Ohio, Oregon, Pennsylvania, Rhode Island, Texas, Virginia and Washington.

43 Colo. Rev. Stat. Ann. § 1-7-515; 17 R.I. Gen. Laws Ann. § 17-19-37.4(b); The Nevada law requires the state to pilot RLAs during the 2020 election. S.B. 123, 2019 Leg., Reg. Sess. (Nev. 2019).

44 Va. Code Ann. § 24.2-671.1.

45 Wash. Rev. Code Ann. §29A.60.185; *Ohio Election Official Manual*, Ohio Secretary of State, Aug. 1, 2018, https://www.sos.state.oh.us/globalassets/elections/directives/2017/dir2017-10_eom.pdf/; The California law authorizes RLAs starting with the March 3, 2020 primary and automatically sunsets at the end of 2020. See Cal. Elec. Code § 15367.

accurate about the security risks inherent in the voting systems they are selling, which may include paperless auditing functionality, and refrain from selling paperless voting machines altogether.

As the months pass, though, it will be harder to replace systems before voters will cast their vote for president. Our focus must shift to further securing the voting systems in place.

III. Congress Has a Critical Role to Play in What is Required to Secure our Elections in 2020 and Beyond

While state and local election officials can take many important steps to strengthen our infrastructure, without congressional action these efforts will result in a patchwork of voting system vulnerabilities across the country. Only Congress can establish a national regulatory framework for election security to safeguard our election infrastructure and Americans' confidence in our electoral system. While this unprecedented hearing is an important step, Congress has much work to do to further protect our election infrastructure in 2020 and beyond.

A. Congress Should Conduct Meaningful Oversight Over Federal Funding for Election Security in 2020

First, it is critical that Congress provide meaningful direction and oversight over how the $805 million that Congress has allocated over the last two years to bolster state election security is used. Ongoing oversight efforts by this committee and others have had a substantive and positive impact on voting system security across the nation. As the committee continues these efforts throughout 2020, it should pay particular attention to the measures that state and local election officials can implement to make our voting networks more resilient before 2020.

While no voting system is 100% secure, election officials should strive to deploy resilient voting systems. Such systems have the "ability… to withstand a major disruption… and to recover within an acceptable time."[46] Regardless of the type of voting technologies used, election officials can implement several commonsense and affordable measures that will make their voting system more resilient and minimize voting delays or interruptions in the event of a voting system failure due to any reason, including error or intentional attack.[47]

Our recent report, *Preparing for Cyberattacks and Technical Failures: A Guide for Election Officials*,[48] (Appendix B) identifies commonsense steps that state and local election officials can

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[46] "What is System Resilience," Dictionary, IGI Global, accessed Jan. 6, 2020, https://www.igi-global.com/dictionary/cyber-threats-to-critical-infrastructure-protection/51260.

[47] Edgardo Cortés, Gowri Ramachandran, Liz Howard, and Lawrence Norden, *Preparing for Cyberattacks and Technical Failures: A Guide for Election Officials*, Brennan Center for Justice, 2019, https://www.brennancenter.org/sites/default/files/2019-12/2019_12_ContingencyPlanning.pdf.

[48] Ibid.

take before an election to minimize voting interruptions or delays on Election Day. Although it is not possible to build a voting system that is 100 percent secure against technology failures and cyberattacks, simple and effective resiliency plans nonetheless ensure that eligible voters are able to exercise their right to vote and have their votes accurately counted. With a "giant turnout" predicted for 2020,[49] using a portion of the federal grants soon to be disbursed to state and local election officials to fund these projects is just commonsense.

These measures may vary based on the type of voting system in use and are outlined in our report.[50] For example, jurisdictions relying primarily on direct recording electronic (DRE) voting machines or ballot marking devices (BMDs) should order sufficient paper ballots—generally 35% of registered voters in November 2020—to ensure voting can continue with minimal delay for 2-3 hours of peak voting if voting machines go down on Election Day.[51] Further, while supplies are very important, properly training poll workers on when and how to use these materials is essential.[52]

For jurisdictions primarily relying on voting systems with paper ballots marked by hand, we recommend that election officials print sufficient ballots for 100% of registered voters, and even more in jurisdictions employing election day registration. Many election officials using paper ballots decide how many ballots to print on the basis of prior or predicted election turnout.[53] This approach can result in ballot shortages or outages and leave jurisdictions unprepared for unexpected voter surges.[54] This happened across the country during the 2018 midterm elections[55] when turnout reached historic levels, and many experts predict record-breaking turnout in 2020.[56]

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[49] Alexi McCammond, "The Democrats' 100-year flood," *Axios*, May 22, 2019, https://www.axios.com/2020-presidential-election-turnout-predictions-democrats-143cced4-cda7-4665-9fc3-911387416119.html (" 'The safest prediction in politics is for a giant turnout in 2020,' said Larry Sabato of the University of Virginia. 'Nobody's going to believe the polls after 2016, and everyone will assume a tight race.' ").

[50] Cortés, et al., *Preparing for Cyberattacks and Technical Failures*.

[51] Ibid.

[52] Ibid.

[53] Ibid.

[54] Ibid.

[55] See e.g "Monroe County receives voting extension after some polling locations run out of ballots," *Fox 59*, Nov. 6, 2018, https://fox59.com/2018/11/06/monroe-county-requests-voting-extension-after-some-polling-locations-run-out-of-ballots/; Erin Roby and Mike Valerio, "4 voting locations in Prince George's Co. run out of paper ballots," *WUSA 9*, Nov. 6, 2018, https://www.wusa9.com/article/news/politics/elections/4-voting-locations-in-prince-georges-co-run-out-of-paper-ballots/65-611861358; "High turnout has Missouri polling places running out of ballots," *FOX 2*, Nov. 6, 2019, https://fox2now.com/2018/11/06/high-turnout-has-missouri-polling-places-running-out-of-ballots/.

[56] Alexi McCammond, "The Democrats' 100-year flood," *Axios*, May 22, 2019, https://www.axios.com/2020-presidential-election-turnout-predictions-democrats-143cced4-cda7-4665-9fc3-911387416119.html (" 'The safest prediction in politics is for a giant turnout in 2020,' said Larry Sabato of the University of Virginia. 'Nobody's going to believe the polls after 2016, and everyone will assume a tight race.' ").

B. The Federal Government Should Enact Comprehensive Election Security Reform to Protect Elections in 2020 and Beyond, and this should include greater oversight of election system vendors

Next, Congress must enact comprehensive election security reform. This comprehensive reform will require consistent funding for election security, as proposed in bills such as the For the People Act and the SAFE Act.[57] It will also require substantive vendor oversight.

Currently, there are no federal laws or regulations requiring private vendors to take any action in the event of a cyberattack, or even to attest that they follow good security practices.[58] Voting systems are subject to voluntary federal certification, but the vendors who supply, maintain, and often program those machines, along with integrated products such as electronic pollbooks, are not. Thus, although a vendor may sell federally certified voting systems, that certification process does not speak to vendor practices more generally that can affect, for example, the security of voters' personal information.

The Brennan Center recommends that Congress adopt a comprehensive system of election vendor oversight by authorizing the EAC's Technical Guidelines Development Committee (TGDC) to issue best practices for election vendors and certify ongoing compliance with those practices.[59] These best practices should address, among other things, the five areas discussed above: (1) cybersecurity best practices; (2) background checks and other security measures for personnel; (3) transparent ownership; (4) processes for reporting cyber incidents; and (5) supply chain integrity.

The certification program should include election vendors and a broader set of elections systems. We believe that voluntary certification will provide vendors with sufficient incentives to comply with best practices while respecting the historic role of states in overseeing their own elections.

Until Congress is able to act, the EAC could significantly improve election officials' insight into voting system vendors' practices by requiring, through its registration process, that voting system vendors provide key information relevant to the five areas discussed above. Enhancing the registration process will better enable election officials to mitigate risks facing our election infrastructure and provide much needed transparency to the voting equipment sales and

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[57] For the People Act, H.R. 1, 116th Cong. (2019), § 298D; Securing America's Federal Elections Act, H.R. 2722, 116th Cong. (2019), § 297D.

[58] The Secure Elections Act, S. 2261, 115th Cong. (2017), which had bipartisan support for much of 2018, would have required vendors to notify the relevant election agencies when suspected cyber-incidents occur; in a similar vein, the Election Vendor Security Act, H.R. 6435, 115th Cong. (2018), requires vendors to "report any known or suspected security incidents involving election systems . . . not later than 10 days after the vendor first knows or suspects that the incident occurred.".

[59] The Election Vendor Security Act, sponsored by Rep. Jamie Raskin (D-MD), proposes that state and local election administrators be banned from using any vendor for federal elections that does not meet some minimum standards. H.R.6435, 115th Cong. (2018).

marketing process. While this would not reach vendors who market election infrastructure such as e-pollbooks, but do not sell voting systems, it would be a significant step in the right direction.

congressional reform and agency action can ensure that in the long and short term, our elections are free, fair and secure.

C. The Federal Government Should Provide Consistent and Reliable Election Security Funding

Finally, a lack of financial resources presents the most significant obstacle to election security improvements in local jurisdictions. Congress took an important first step in 2018 by allocating $380 million to states for election security activities, and recently committed an additional $425 million. But these one-time investments are not enough to address the significant problems facing election systems, nor to provide long-term stability for future elections. Senator Warner, Vice Chair of the Senate Intelligence Committee, observed last week, "additional money is no substitute for a permanent funding mechanism for securing and maintaining elections systems." As the Congressional Task Force on Election Security found and numerous national security and election officials have said, "Election security is national security."[60] There is an ongoing need for federal funding to help protect our election infrastructure from foreign threats.

Because the threats to our elections evolve over time, effective election security requires an ongoing commitment of resources, as opposed to a one-time expenditure. Companies in the private sector have departments and budgets dedicated to security generally, and often to cybersecurity specifically, precisely for this reason. Congress should provide a steady stream of funding for the periodic replacement of outdated voting systems, upgrading of databases and other election infrastructure, and the purchasing of ongoing technical and security support for all these systems.

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[60] See e.g., "Secretary Kirstjen M. Nielsen Remarks to the National Election Security Summit: As Prepared for Delivery," *Homeland Security*, Sept. 10, 2018, https://www.dhs.gov/news/2018/09/10/secretary-kirstjen-m-nielsen-remarks-national-election-security-summit ("[E]lection security is national security."); "Department of Homeland Security and Georgia Secretary of State Respond to Misleading News Reports About Georgia Elections," *Georgia Secretary of State*, Jul. 16, 2019, https://sos.ga.gov/index.php/general/department_of_homeland_security_and_georgia_secretary_of_state_respond_to_misleading_news_reports_about_georgia_elections ; *Congressional Task Force on Election Security*, House Committee on Homeland Security, 2018, https://homeland.house.gov/imo/media/doc/TFESReport.pdf; Stephen Montemayor, "Bid to get Minnesota federal election security money picks up early in session," *Star Tribune*, Jan. 7, 2019, http://www.startribune.com/bid-to-get-minnesota-federal-election-security-money-picks-up-early-in-session/504511722/; Francis X. Taylor, "Firewalling democracy: Federal inaction on a national security priority," *Hill*, Jan. 31, 2018, https://thehill.com/opinion/national-security/371251-firewalling-democracy-federal-inaction-on-a-national-security; Open Hearing on "Cyber-securing the Vote: Ensuring the Integrity of the U.S. Election System," Before the House Comm. on Oversight and Government Reform, 115th Cong. (2018) (statement of Maggie Toulouse Oliver, New Mexico Secretary of State), https://www.nass.org/sites/default/files/7.24.18-HouseOGR-2018Elections-MTO.pdf.

The Brennan Center has estimated the nationwide five-year cost for four of the highest priority election security projects to be approximately $2.2 billion.[61] This total includes estimated costs for: 1) providing additional state and local election cybersecurity assistance, 2) upgrading or replacing statewide voter registration systems, 3) replacing aging and paperless voting machines, and 4) implementing rigorous post-election audits.

Conclusion

Despite the lack of vendor oversight, important progress has been made since 2016 to make our voting system infrastructure more secure. Congress has an important role to play and can take immediate steps to support state and local election officials as they work with vendors to replace, audit, and improve the resiliency of their systems in 2020 and beyond.

[61] Lawrence Norden and Edgardo Cortés, "What Does Election Security Cost?," *Brennan Center for Justice,* Aug. 15, 2019, https://www.brennancenter.org/our-work/analysis-opinion/what-does-election-security-cost.

Appendix A

POLICY REPORT

BRENNAN CENTER FOR JUSTICE

A Framework for Election Vendor Oversight

Safeguarding America's Election Systems

By Lawrence Norden, Christopher R. Deluzio, and Gowri Ramachandran PUBLISHED NOVEMBER 12, 2019

Brennan Center for Justice at New York University School of Law

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Executive Summary

More than 80 percent of voting systems in use today are under the purview of three vendors.[1] A successful cyberattack against any of these companies could have devastating consequences for elections in vast swaths of the country. Other systems that are essential for free and fair elections, such as voter registration databases and electronic pollbooks, are also supplied and serviced by private companies.

Yet these vendors, unlike those in other sectors that the federal government has designated as critical infrastructure, receive little or no federal review. This leaves American elections vulnerable to attack. To address this, the Brennan Center for Justice proposes a new framework for oversight that includes the following:

- **Independent oversight.** A new federal certification program should be empowered to issue standards and enforce vendors' compliance. The Election Assistance Commission (EAC) is the most logical agency to take on the role. Unfortunately, from its founding, the EAC has had a history of controversy and inaction in carrying out its core mission. In this paper, we assume that the EAC would be charged with overseeing the new program, and we make a number of recommendations for strengthening the agency so that it could take on these additional responsibilities. Whichever agency takes on this role must be structured to be independent of partisan political manipulation, fully staffed with leaders who recognize the importance of vendor oversight, and supported by enough competent professionals and experts to do the job.
- **Issuance of vendor best practices.** Congress should reconstitute the EAC's Technical Guidelines Development Committee (TGDC) to include members with more cybersecurity expertise and empower it to issue best practices for election vendors. (The TGDC already recommends technical guidelines for voting systems.) At the very least, these best practices should encourage election vendors to attest that their conduct meets certain standards concerning cybersecurity, personnel, disclosure of ownership and foreign control, incident reporting, and supply chain integrity. Given the EAC's past failures to act on the TGDC's recommendations in a timely manner, we recommend providing a deadline for action. If the EAC does not meet that deadline, the guidelines should automatically go into effect.
- **Vendor certification.** To provide vendors a sufficient incentive to comply with best practices, Congress should expand the EAC's existing voluntary certification and registration power to include election vendors and their various products. This expanded authority would complement, and not replace, the current voluntary federal certification of voting systems, on which ballots are cast and counted. Certification should be administered by the EAC's existing Testing and Certification Division, which would require additional personnel.
- **Ongoing review.** In its expanded oversight role, the EAC should task its Testing and Certification Division with assessing vendors' ongoing compliance with certification standards. The division should continually monitor vendors' quality and configuration management practices, manufacturing and software development processes, and security postures through site visits, penetration testing, and cybersecurity audits performed by certified independent third parties. All certified vendors should be required to report any changes to the information provided during initial certification, as well as any cybersecurity incidents, to the EAC and all other relevant agencies.
- **Enforcement of guidelines.** There must be a clear protocol for addressing violations of federal guidelines by election vendors.

Congressional authorization is needed for some but not all elements of our proposal. The EAC does not currently have the statutory authority to certify most election vendors, including those that sell and service some of the most critical infrastructure, such as voter registration databases, electronic pollbooks, and election night reporting systems. For this reason, Congress must act in order for the EAC or other federal agency to adopt the full set of recommendations in this report.[2] Regardless, the EAC could, without any additional legislation, issue voluntary guidance for election vendors and take many of the steps recommended in this paper as they relate to voting system vendors. Specifically, it is our legal judgment that the EAC may require, through its registration process, that voting system vendors provide key information relevant to cybersecurity best practices, personnel policies, and foreign control. Furthermore, the EAC may deny or suspend registration based on noncompliance with standards and criteria that it publishes.

Ultimately, the best course of action would be for Congress to create a uniform framework for election vendors that adopts each of the elements discussed in this paper. In the short run, however, we urge the EAC to take the steps it can now to more thoroughly assess voting system vendors.

Introduction

The unprecedented attacks on America's elections in 2016, and repeated warnings by the country's intelligence agencies of future foreign interference, have raised the profile of election security in a way few could have imagined just a few years ago. The response has largely focused on improving the testing of voting machines before they are purchased and on training state and local election officials to institute best practices to prevent, detect, and recover from cyberattacks.

Yet private vendors, not election officials, build and maintain much of our election infrastructure. They create election websites that help voters determine how to register and where to vote; print and design ballots; configure voting machines; and build and maintain voter registration databases, voting machines, and electronic pollbooks. Not every jurisdiction outsources all of these functions, but all rely on vendors for some of this work and many for nearly all of it. Understandably, many local governments under fiscal pressure would rather contract out these functions than increase their election office staff, especially considering the cyclical nature of election-related work.

There is almost no federal regulation of the vendors that design and maintain the systems that allow us to determine who can vote, how they vote, or how their votes are counted and reported. While voting systems are subject to some functional requirements under a voluntary federal testing and certification regime, the vendors themselves are largely free from federal oversight.

This is not the case in other sectors that the federal government has designated as critical infrastructure. Vendors in the defense sector, for example, face substantial oversight and must comply with various requirements, including rules governing the handling of classified information and supply chain integrity. The federal government regulates colored pencils, which are subject to mandatory standards promulgated by the Consumer Product Safety Commission, more stringently than it does America's election infrastructure.[3]

There is a growing bipartisan appreciation that federal action is needed to address the risks that vendors might introduce into election infrastructure. Rep. Zoe Lofgren (D–CA), who chairs the Committee on House Administration, has said that a significant election-related "vulnerability comes from election technology vendors . . . who have little financial incentive to prioritize election security and are not subject to regulations requiring them to use cyber security best practices."[4] Alabama's Republican secretary of state, John Merrill, has called for the EAC to undertake "a centralized effort to evaluate the effectiveness of election equipment, whether it be for voter administration purposes, electronic poll books," or the like.[5]

While state and local governments retain primacy in running elections, only the federal government has the resources and constitutional responsibility to ensure that the more than 8,000 local election jurisdictions have access to information and expertise to safeguard federal elections from insecure vendor practices.[6] The ability of a foreign power to exploit the vulnerabilities of a vendor in a single county in Pennsylvania could have extraordinary repercussions for the country.

Given the lack of federal oversight, the relatively small number of vendors with significant market share,[7] and

Vendor Involvement in Elections

>> Voter Registration Database
Voter registration information is housed in statewide databases that in many jurisdictions are created or maintained by a vendor.

>> Ballot Programming
Prior to every election, voting machines must be programmed with a memory card or USB stick to display the ballot or read and count votes. Vendors often provide the software.

>> Electronic Pollbooks
On Election Day, poll workers in most jurisdictions check voters in using electronic pollbooks, which are usually provided by a vendor.

>> Voting Systems
Jurisdictions use a variety of voting machines, all provided by vendors.

>> Election Night Reporting
On election night, the general public can view election results through reporting websites that are often provided by vendors.

>> Postelection Audits
After an election, vendors and their equipment play a role in checking that the equipment and procedures used to count votes worked properly and that the election yielded the correct results.

their "severe underinvestment in cybersecurity,"[8] the Brennan Center proposes that the federal government take on a more substantial oversight role. Under our proposal, the EAC would extend its existing certification regime from voting systems to include all vendors that manufacture or service key parts of the nation's election infrastructure. The commission would also continuously monitor vendors, with the power to revoke certification. (The EAC currently has that power but only uses it to oversee the systems themselves.)

Definition of Election Vendor

This paper refers to "election vendors" when discussing those entities that provide election services to jurisdictions throughout the United States. A 2017 University of Pennsylvania report on the election technology industry described these entities as those "that design, manufacture, integrate, and support voting machines and the associated technological infrastructure."[9] While the report focused largely on voting systems, quantifying the sector's annual revenue at $300 million,[10] the election vendors referred to also include those that do not participate in the voting systems market but provide other election-related goods and services. For the purposes of this paper, "vendor" is defined to include any private individual or business that manufactures, sells, programs, or maintains machines that assist in the casting or tallying of votes, voter registration databases, electronic pollbooks, or election night reporting systems.

Vendors Present Points of Attack into Election Infrastructure

Private vendors' central role in American elections makes them prime targets for adversaries. Yet it is impossible to assess the precise level of risk associated with vendors — or how that risk impacts election security. As a 2018 U.S. Senate Intelligence Committee report observed, "State local, territorial, tribal, and federal government authorities have very little insight into the cyber security practices of [election] vendors."[11]

This limited visibility into vendors includes

- vendor cybersecurity practices (how vendors protect their own information technology infrastructure and data);
- foreign ownership of vendors (whether foreign nationals, or agents of foreign governments, own companies performing critical election functions);
- personnel policies and procedures (whether background checks and other procedures are in place to safeguard against inside attacks);
- cybersecurity incident response (how vendors alert relevant authorities of attacks); and
- supply chains (where parts, software patches, and installations come from; how are they transported; and how they are kept secure).

Revelations that Russian actors targeted an election vendor in the lead-up to the 2016 election provide a useful example of how little insight there is into vendor security.

Special Counsel Robert Mueller's report to the attorney general and indictment of 12 Russian intelligence officers both included allegations that these officers hacked a private U.S. elections systems vendor. The vendor is believed to operate in at least eight states, including the battleground states of North Carolina, Virginia, and Florida.[12]

According to the special counsel, hackers gained access to the vendor's computers and used an email account designed to look like the vendor's to send spearphishing emails to Florida election officials.[13] Per the indictment, "the spearphishing emails contained malware that the Conspirators embedded into Word documents bearing [the vendor's] logo."[14] According to Florida Governor Ron DeSantis, the hackers breached the election systems of two Florida counties.[15]

We still don't know all the facts. Even in the rare instance that the public learns of a vendor hack — as it did through the special counsel's investigation — many questions remain unanswered. When and how did the vendor learn of these attacks? What preventive measures were in place? What steps did the vendor take after discovering it was targeted to ensure that it was not infiltrated? Did it immediately inform its customers? The public generally never learns the answers to these questions, and there are no federal laws or regulations requiring private vendors to take any action in the event of a cyberattack.

Similarly, *Vice* recently reported that election night reporting systems sold by Election Systems and Software (ES&S), the country's leading election vendor, had been exposed to the public internet, potentially for years on end. (ES&S denied the substance and significance of the report.) Although ES&S voting machines are certified by the EAC, its transmission configuration is not.[16]

The lack of visibility into vendors and their cybersecurity can also contribute to an inability to detect poor practices that might affect vendor performance until it is too late. In 2017, ES&S left the sensitive personal information of 1.8 million Chicago voters publicly exposed on an Amazon cloud server.[17] That information reportedly

included "addresses, birth dates and partial Social Security numbers,"[18] information valuable to hackers.

Opaque supply chains further exacerbate the problem. Earlier this year, an IBM Security Services investigation on behalf of Los Angeles County found that compatibility issues between the voter list and an ES&S subsidiary's software contributed to nearly 120,000 voters being left out of printed pollbooks and forced to request provisional ballots.[19]

Although the EAC can conduct manufacturing site visits through its Quality Monitoring Program,[20] this program extends only to voting systems that are submitted for voluntary certification and does not cover the full menu of vendor products and services. There is no federal scrutiny of supply chains for components sourced for noncertified products and services, for example, despite the finding of the Department of Homeland Security (DHS) that "contractors, sub-contractors, and suppliers at all tiers of the supply chain are under constant attack."[21]

The recent ban on certain technologies made by the Chinese company Huawei is a stark illustration of the growing recognition of supply chain risk.[22] Vendors' use of local or regional partners or subcontractors adds to the lack of visibility. For instance, Unisyn Voting Solution, a digital scan voting system manufacturer whose systems have been certified by the EAC, identifies a range of partners in several states on its website.[23] Neither Unisyn nor these partners are currently subject to the kind of oversight we recommend.

Election officials often depend on vendors whose practices are opaque. Yet these companies — unlike those in other critical infrastructure sectors, such as defense, nuclear, dams, and energy — face almost no federal oversight of their security systems. There are no requirements that vendors report breaches, screen employees' backgrounds, patch security flaws, report foreign ownership or control, or ensure the physical security of sensitive software and hardware.

> The ability of a foreign power to exploit the vulnerabilities of a vendor in **a single county in Pennsylvania** could have extraordinary repercussions.

Independent Federal Oversight

This paper assumes that the Election Assistance Commission would be the agency charged with overseeing election vendors. There are many reasons why the EAC is the most logical choice for this role. One among them is that the EAC already certifies voting equipment and issues voluntary guidance. Because it is structured as an independent agency with bipartisan membership, it faces less risk of undue political meddling in the technical work of overseeing election vendors than a traditional executive agency would. Its structure could also help avoid dramatic shifts in oversight approaches with a change of presidential administrations.[24]

Unfortunately, the EAC has been plagued by controversy for years. Its leaders have waded into contentious issues, such as voter identification and proof of citizenship, that have little relation to the agency's core responsibilities.[25] It has missed deadlines for completing critical functions, such as adopting voting system guidelines.[26] And there are concerns that it has not taken election security seriously enough,[27] as well as "complaints of infighting, high [staff] turnover and cratering morale."[28]

If the EAC were chosen for this role, Congress would need to take a number of actions to make its success more likely. First, it would need to increase the agency's budget. The new role would constitute a major expansion of the EAC's regulatory mandate. In recent years, despite the increased threat of cyberattacks against our nation's election infrastructure, funding for the EAC has dropped sharply. The agency's budget in fiscal year 2019 was just $9.2 million, down from $18 million in fiscal year 2010.[29]

With expanded oversight authority, the EAC would need to dramatically increase its cybersecurity competency and knowledge. To facilitate this increased technical focus, we outline below how the existing Technical Guidelines Development Committee would need to be modified to emphasize technical proficiency and, specifically, cybersecurity expertise. We also recommend greater deference to this modified technical committee, permitting its recommended voluntary guidelines to take effect absent overriding action by the EAC. These changes, too, would require congressional action.

On the personnel front, Congress would need to commit to keeping EAC seats filled by leaders who are dedicated to working with each other and with career staff to ensure the security of our election infrastructure. Congress's failure to replace commissioners left the EAC without a quorum between December 2010 and December 2014 and then again between March 2018 and February 2019.

Finally, given the breadth and scope of this new mandate, Congress would need to subject the agency to more scrutiny and oversight than it has in the past.[30]

If Congress is unable or unwilling to take these steps, it should find a different agency to oversee election vendor certification. Any agency placed in that role must be structured so as to remain independent of partisan control. It will need experienced, effective staff and leadership who are committed to election security, cybersecurity, technical competency, and good and effective election administration.

How to Expand Voting System Vendor Registration without Legislation

Most of the policies suggested in this report will require congressional authorization. Not least of these is the ability of the Election Assistance Commission's regulatory authority to reach election system vendors for products and services other than voting machines — including voter registration databases, electronic pollbooks and election night reporting. However, the EAC can under its current authority institute a voluntary system of oversight of the security practices of vendors that supply voting systems, using a combination of its registration and certification schemes.

In order to register, voting system vendors must already provide the EAC with critical information about their ownership, along with written policies regarding their quality assurance mechanisms. Vendors must agree to certain program requirements, and registrants can be suspended if they fail to continue to abide by the registration requirements. A system cannot be submitted for certification unless its manufacturer is currently registered with the EAC.[i] The need for this type of information is clear: in order to carry out its certification, decertification, and recertification authority, including the provision of a fair process to vendors who risk decertification or denial of certification, the EAC must be able to maintain communication with voting system vendors and ensure compliance with quality assurance mechanisms on an ongoing basis.

To ensure that certified voting systems are secure, the EAC can adopt Voluntary Voting System Guidelines (VVSG) that outline best practices for vendors as they relate to cybersecurity, personnel, foreign control, and supply chain integrity. Voting system vendors can then be required, as part of registration, to provide information on their compliance with these standards.

For instance, the current VVSG provide special guidelines for voting systems that use public telecommunications networks in order to ensure that they are protected against external threats, including monitoring requirements. Similarly, the guidelines require verification methods for both software setup and any software update packages.[ii] New guidelines could outline why background checks for personnel are necessary to ensure the ongoing security of voting systems, including upgrades and changes.[iii]

The current registration process could also allow the EAC to ensure that various voting system vendor best practices remain in force over time. The process imposes a continuing responsibility on vendors to report any changes in the information supplied to the EAC and to "operate . . . consistent with the procedural requirements" established by the EAC's testing and certification manual. Thus, if registration mandated, for example, the provision of cybersecurity information from vendors, they would be required to report cybersecurity changes or incidents pursuant to their responsibility to keep registration information up to date. Registration could be suspended if vendors failed to maintain policies consistent with the EAC's requirements.[iv]

While expanding oversight of voting system vendors to ensure compliance with the basic security measures discussed in this paper would not be a substitute for a full certification system for all election system vendors, it would be a significant step toward providing greater accountability for voting system vendors.

A New Framework for Election Vendor Oversight

Under the Brennan Center's proposal, the Election Assistance Commission's oversight role would be substantially expanded. Oversight would extend beyond voting equipment[31] to election vendors themselves. The current voting system testing is intentionally quite limited: it occurs at the end of the design, development, and manufacture of voting system equipment. It does not ensure that the vendors have engaged in best supply chain or cybersecurity practices when developing equipment or when servicing or programming it once it is certified.[32] Nor does the system ensure that the vendor has conducted background checks on employees or set up controls limiting access to sensitive information.

Despite its limitations, the EAC's Testing and Certification Program — a voluntary program that certifies and decertifies voting system hardware and software — provides a good template for a vendor oversight program. A variety of bills, including the Election Security Assistance Act proposed by Rep. Rodney Davis (R–IL) and the Democratic-sponsored SAFE Act and For the People Act, have called for electronic pollbooks, which are not currently considered voting systems and covered by the program, to be included in its hardware and software testing regime.[33]

Currently, the Technical Guidelines Development Committee, a committee of experts appointed jointly by the National Institute of Standards and Technology (NIST) and the EAC, sets certification standards for voting systems. These guidelines, known as the Voluntary Voting System Guidelines (VVSG), can be adopted, with modifications, by a majority of EAC commissioners. Once approved, they become the standards against which voting machines are tested for federal certification. The VVSG ensures that voting systems have the basic functionality, accessibility, and security capabilities required by the Help America Vote Act (HAVA).[34]

Future iterations of the VVSG and certification process may change slightly: commissioners have suggested that they may support a new version of the VVSG that adopts high-level principles and guidelines for the commission to approve, along with a more granular set of certification requirements, which staff could adjust from time to time.[35]

Once new voting system guidelines are adopted, the EAC's Testing and Certification Division tests the systems (per the VVSG), certifies them, monitors them, and, if critical problems are later discovered, decertifies them. The EAC conducts field tests of voting machines only if invited or given permission by a state election official. It does not do this on a routine basis.[36] Rather, election officials using the certified voting machines have the option to report system anomalies to the EAC. If the EAC deems a report credible, it may begin a formal investigation and work with the vendor to address the problem. If the vendor fails to fix the anomaly, the EAC is obligated to decertify the voting system.[37]

With some important modifications, we recommend a similar regime for certifying election system vendors. The commissioners should adopt a set of principles and guidelines for vendors recommended by a Technical Guidelines Development Committee, as well as a more detailed set of requirements that could be adjusted as needed by EAC staff. We recommend that the EAC routinely monitor certified vendors to ensure ongoing compliance and establish a process for addressing violations of federal standards, including through decertification.

A Voluntary Regime

Federal certification will only be meaningful if state and local governments that contract with election system vendors rely on it when making purchasing decisions.

For this reason, some have recommended that state and local governments be required to use only vendors that have been federally certified. For instance, the Election Vendor Security Act proposes that state and local election administrators be banned from using any vendor for federal elections that does not meet some minimum standards.[38]

There are obvious benefits to a mandatory regime. Most important, it would ensure that all jurisdictions throughout the country use vendors that have met minimum security standards. But there are drawbacks as well. Not least of these is that some states and localities might view a federal mandate to use certain vendors as a usurpation of their power to oversee their own elections, making the creation of a federal program politically challenging.

Moreover, since private vendors are so deeply entwined in the running of our elections, requiring towns, counties, and states to use only certified vendors could present problems. If a vendor failed the certification process (or decided not to apply for certification), some counties would not be able to run their elections. Others might be forced to spend tens of millions of dollars to purchase

new equipment and services before they could run elections again, even if they had determined that they could have run their elections securely.

A voluntary approach — leaving it to the states and local jurisdictions to decide whether to contract with non–federally certified vendors — could draw states into the voting system certification process. It may also be more politically feasible. A voluntary approach would give state and local jurisdictions the flexibility to take additional security measures if their current vendors did not obtain federal certification. In selecting new vendors, most states and local election officials would likely rely on federal certification in making purchases, as they do with voting machines. Democrats in Congress opted for this approach in the For the People Act and the SAFE Act. Both measures would incentivize participation by providing grants to states that acquire goods and services from qualified election infrastructure vendors or implement other voting system security improvements.[39]

The drawback of a voluntary program is that states and vendors may ignore it. But there is reason to believe that there would be wide participation in a voluntary federal program. Even though the current voting machine certification program is voluntary, 47 of 50 states rely on the EAC's certification process for voting machines in some way.[40] Another voluntary program, DHS's Election Infrastructure Sector Coordinating Council, was founded in 2018 to share information among election system vendors. Numerous major election vendors have supported it as organizing members.[41]

Guidelines Developed by an Empowered, More Technical Committee

A new Technical Guidelines Development Committee, with additional cybersecurity experts, should be charged with crafting vendor certification guidelines for use by the Election Assistance Commission, incorporating best practices that election vendors must meet. These guidelines should go into effect unless the EAC overrides the recommendation within a specified period of time. This deference to the technically expert TGDC in the absence of an override by policymakers is necessary to avoid the kinds of lengthy delays that have stood in the way of prior attempts to update the VVSG.[42] The NIST cybersecurity framework should be the starting point for these best practices, and the TGDC need only apply election-specific refinements to this existing framework.

The TGDC is chaired by the director of the NIST. Its 14 other members are appointed jointly by the director and the EAC.[43] We recommend that Congress authorize NIST to expand TGDC's membership to include the wider range of expertise necessary to fulfill its role in defining vendor best practices. These new members should explicitly be required to have cybersecurity expertise. Congress should also mandate that a representative from the new DHS Cybersecurity and Infrastructure Security Agency (CISA), a leading voice in cybersecurity defense, including in the elections sector, join the TGDC. The Vendor System Cyber Security Act of 2019, introduced by Sen. Gary Peters (D–MI), would require this step.[44] Similarly, Congress should mandate the inclusion of a representative from the National Association of State Chief Information Officers (NACIO) with expertise in cybersecurity.[45]

Reconstituting the TGDC in this manner would not only ensure that it has the relevant expertise to set guidelines for vendors but also that there are more members with technical backgrounds.

As noted above, we recommend permitting the guidelines developed by the TGDC to take effect in the event that the EAC fails to act on them within a specified time period. We also recommend that vendors seeking certification must always meet the most recent set of guidelines. This, along with the expanded membership of the TGDC, will provide the necessary assurance that best practices are updated in a timely fashion and that vendors seeking certification meet the most up-to-date standards.[46]

The new TGDC will be responsible for developing federal certification guidelines that vendors must satisfy to sell key election infrastructure and services for use in federal elections. Areas that should be covered in such guidelines include

- cybersecurity best practices,
- background checks and other security measures for personnel,
- transparent ownership,
- processes for reporting cyber incidents, and
- supply chain integrity.

Below, we discuss the importance of each of these items, what guidelines in each of these areas could look like, and how to ensure compliance.

CYBERSECURITY BEST PRACTICES

The lead-up to the 2016 presidential election provided numerous examples of the devastating consequences of failing to heed cybersecurity best practices. Through a series of attacks that included spearphishing emails, Russian hackers gained access to internal communications of the Democratic National Committee (DNC).[47] The DNC reportedly did not install a "robust set of monitoring tools" to identify and isolate spearphishing emails on its network until April 2016, which, in retrospect, was far too late.[48] The chairman of Hillary Clinton's campaign,

John Podesta, fell prey to a similar attack.[49] These threats did not end in 2016; in the run-up to the 2018 elections, hackers targeted congressional candidates including Sen. Claire McCaskill (D–MO) and Hans Keirstead, who ran in a Democratic Party primary in California.[50]

Guarding against spearphishing emails is Cybersecurity 101. Yet the numerous reports of successful spearphishing attacks suggest that many individuals and organizations fail to meet even that low bar of cyber readiness. Are vendors guarding against these (and other) attacks?[51] Special Counsel Robert Mueller's report on 2016 election interference indicates that an employee at an election vendor fell victim to a spearphishing attack, enabling malware to be installed on that vendor's network. The vendor, which many assume is VR Systems, has denied that that the attackers were able to breach its system.[52] Under the current regime, which lacks any meaningful visibility into vendors' cybersecurity practices, we simply do not, and cannot, know.

The new Technical Guidelines Development Committee should craft cybersecurity best practices that include not only equipment- and service-related offerings but also internal information technology practices, cyber hygiene, data access controls, and the like. Various bills have proposed that the TGDC take on this role, including the SAFE Act, the Election Security Act, and the For the People Act.[53]

The NIST Cybersecurity Framework[54] should be the starting point and be supplemented by election-specific refinements. NIST advises that "the Framework should not be implemented as an un-customized checklist or a one-size-fits-all approach for all critical infrastructure organizations. . . . [It] should be customized by different sectors and individual organizations to best suit their risks, situations, and needs."[55]

When seeking Election Assistance Commission certification, vendors should have to demonstrate that they meet the TGDC's cybersecurity best practices. The EAC should consider providing a self-assessment handbook or other form of guidance to facilitate vendor compliance with this requirement.

Such a self-assessment handbook exists in the defense sector for contractors that handle certain sensitive information. Department of Defense contractors "that process, store or transmit Controlled Unclassified Information must meet the Defense Federal Acquisition Regulation Supplement minimum security standards" and certify that they comply with published requirements.[56] An EAC resource along these lines would provide vendors with clarity about how to assess compliance and agreed-upon metrics.

Similarly, DHS has published resources associated with its Cyber Resilience Review program, which "align[s] closely with the Cybersecurity Framework . . . developed by the National Institute of Standards and Technology."[57] They include a self-assessment package and a "Question Set with Guidance,"[58] which could prove useful in developing analogous resources for the EAC.

BACKGROUND CHECKS AND OTHER SECURITY MEASURES FOR PERSONNEL

Much of the conversation about election cybersecurity has imagined attackers in distant lands reaching our election infrastructure through the internet. But some of the most effective cyberattacks of recent years have involved insiders. To mitigate these risks, vendors should demonstrate during certification that they have sound personnel policies and practices in place.

At a minimum, vendors should describe how they screen prospective employees for security risks, including background checks, and how they assess employees for suitability on an ongoing basis, including substance-abuse screening. The Election Assistance Commission should also require vendor disclosure of controls governing staff access to sensitive election-related information. Since the bulk of such sensitive information would presumably not constitute classified information, which is subject to its own set of robust controls, the EAC's scrutiny of vendor personnel risk management will be critical.

> Vulnerability to attacks by insiders is a threat **separate and apart** from a hack over the internet.

Vulnerability to attacks by insiders is a threat separate and apart from a hack over the internet, demanding entirely different controls and defensive measures. Without adequate personnel screening and other safeguards, vendors that provide critical election services could be exposed to malfeasance from within. The FBI's thorough background checks for Justice Department attorneys and other law enforcement personnel provide a good model for aggressively vetting personnel. In the event election vendors require access to formally classified information, examples abound in the defense, nuclear, and other sectors of how to handle security clearances.

The Nuclear Regulatory Commission (NRC) regulates personnel in ways potentially relevant to election vendors.[59] Its fitness-for-duty program requires that individuals licensed to operate a nuclear reactor[60] meet several performance objectives, including "reasonable assurance" that they

- "are trustworthy and reliable as demonstrated by the avoidance of substance abuse," and
- "are not under the influence of any substance, legal or illegal, or mentally or physically impaired from

any cause, which in any way adversely affects their ability to safely and competently perform their duties."[61]

These programs also include "reasonable measures for the early detection of individuals who are not fit to perform the duties."[62] The regulations include training requirements[63] and penalties for violations,[64] as well as robust substance-abuse testing protocols.[65] The NRC also regulates access to national security information[66] and nuclear-related restricted data[67] by individuals working for entities regulated by the commission.[68]

The defense sector also tightly circumscribes processes on personnel clearances and the handling of sensitive classified information. For example, the National Industrial Security Program Operating Manual (Department of Defense guidance on the regulation of contractors in the industrial security sector) addresses contractors' protection of such information and the processes for contractor personnel to obtain clearances.[69]

Failure to have robust and adequate personnel safeguards can lead to significant harm inflicted by those on the inside. The Swiss financial institution UBS provides a telling example. A systems administrator who worked for UBS in New Jersey, Robert Duronio, wreaked havoc on company systems after reportedly expressing dissatisfaction with his salary and bonuses. Duronio planted a "logic bomb" in UBS's systems that activated after his departure and brought down roughly 2,000 UBS computers. The attack cost the company more than $3 million in repairs, in addition to lost revenue stemming from crippled trading capability.[70] (Duronio was sentenced to 97 months in prison.)[71]

We should assume that determined foreign adversaries are capable of hiring programmers who can damage American elections. We have certainly seen foreign governments engage in similar actions against private companies. In 2006, Dongfan "Greg" Chung, a former engineer at Boeing, was arrested for hoarding trade secrets about the U.S. space shuttle program with the intent to pass this information to the Chinese government. Federal agents found sensitive documents in his home, along with journals detailing his communications with Chinese officials. Chung was convicted in 2009 of economic espionage and acting as an agent of China,[72] and sentenced to 15 years in prison.[73]

TRANSPARENT OWNERSHIP

Lack of transparency into ownership and control of election vendors can mask foreign influence over an election vendor and corruption in local certification and contracting. We recommend mandated disclosure of significant — more than 5 percent — ownership interests and a prohibition on significant foreign ownership or control (with the option to request a waiver, if certain conditions are met). The purpose is not only to deter malfeasance and corruption but also to reassure voters that the motives of election vendors are aligned with the public's interest in free and fair elections.

The threats posed by foreign influence over a U.S. election vendor — including the heightened potential for foreign infiltration of the vendor's supply chain or knowledge of client election officials' capabilities and systems — should be obvious. A federal framework for securing elections should limit significant foreign ownership of election system vendors.

Over the last several years, the topic of foreign ownership of election vendors has occasionally made headlines.[74] In 2018, the FBI informed Maryland officials that a vendor servicing the state, ByteGrid LLC, had been under the control of a Russian oligarch with close ties to President Vladimir Putin.[75] In 2019, ByteGrid sold all of its facilities and customer agreements to a company called Lincoln Rackhouse.[76]

At the same time, lack of insight into election vendor ownership presents a serious risk that vendor-led influence campaigns and public officials' conflicts of interest will escape public scrutiny. Officials might award vendor contracts in exchange for gifts or special treatment rather than to those that would best facilitate free and fair elections. Transparency into ownership and control is required for the public to assess whether officials engaged in procurement and regulation have been improperly influenced.

There are a range of approaches to these problems of improper foreign and domestic influence. We recommend a stringent yet flexible standard: a requirement to disclose all entities or persons with a greater than 5 percent ownership or control interest, along with a ban on foreign ownership in that same amount,[77] with an option for the EAC to grant a waiver after consultation with DHS. While this proposal would address instances of foreign control over election vendors, such as ByteGrid, it could also impact companies such as Dominion Voting Systems, the second-largest voting machine vendor in the United States, whose voting machines are used by more than one-third of American voters and whose headquarters are in Toronto. Similarly, Scytl Secure Electronic Voting, which offers election night reporting and other election technologies to hundreds of election jurisdictions around the United States, is based in Barcelona.[78] A waiver would provide a means for these and other vendors with foreign ties to disclose those relationships and put in place safeguards to prevent foreign influence and alleviate security concerns, thus offering a reasonable path for a wide range of vendors to participate in the election technology market. Beyond this initial disclosure requirement, vendors should have an ongoing obligation to notify their customers and the EAC of any subsequent changes in their ownership or control.

The EAC can look to other sectors for examples of vendor disclosure of ownership or control agreements.

The Department of Defense's National Industrial Security Program Operating Manual is instructive. It requires companies to "complete a Certificate Pertaining to Foreign Interests when . . . significant changes occur to information previously submitted,"[79] and it requires vendors to submit reports when there is "any material change concerning the information previously reported by the contractor concerning foreign ownership control or influence."[80]

Lawmakers have already introduced legislation to improve transparency in ownership or control of election system vendors, with mechanisms ranging from disclosure requirements to strict bans on foreign ownership or control. One approach recently adopted in North Carolina requires disclosure of all owners with a stake of 5 percent or more in a vendor's company, subsidiary, or parent, so that the state's Board of Elections can consider this information before certifying a voting system.[81]

On the other end of the spectrum, the For the People Act and the SAFE Act would require that vendors in states receiving federal grants be owned and controlled by U.S. citizens or permanent residents, with no option for a waiver.[82] Similarly, the Election Vendor Security Act would have required each vendor to certify that "it is owned and controlled by a citizen, national, or permanent resident of the United States, and that none of its activities are directed, supervised, controlled, subsidized, or financed, and none of its policies are determined by, any foreign principal" or agent.[83]

Other proposals would prohibit foreign control but provide for a waiver, as we suggest. For instance, the Protect Election Systems from Foreign Control Act would require vendors to be "solely owned and controlled by a citizen or citizens of the United States" absent a waiver.[84] Such waivers could be granted if the vendor "has implemented a foreign ownership, control, or influence mitigation plan that has been approved by the [DHS] Secretary . . . ensur[ing] that the parent company cannot control, influence, or direct the subsidiary in any manner that would compromise or influence, or give the appearance of compromising or influencing, the independence and integrity of an election."[85]

With respect to defining an ownership or control interest of greater than 5 percent, the EAC could borrow from the approach used by the Federal Communications Commission (FCC). The FCC typically defines foreign ownership, including indirect ownership, by multiplying the percentage of shares an owner has in one company by the percentage of shares that company owns in a regulated broadcast or common carrier licensee. For instance, if a foreign person owned 30 percent of company A, and company A owned 25 percent of company B, the foreign person would be deemed to own 7.5 percent of company B. For purposes of voting shares, the FCC treats a majority stake as 100 percent, whereas for equity shares, the actual percentages are used.[86]

PROCESSES FOR REPORTING CYBER INCIDENTS

Both the public and local and state governments are often kept in the dark about security breaches that affect election vendors. This state of affairs can undermine faith in the vote and leave election officials unsure about vendor vulnerabilities. To address these concerns, vendors should face robust incident reporting requirements and a mandate to work with affected election authorities.

Federal oversight should require vendors to agree to report security incidents as a condition of certification. The Election Assistance Commission should require that vendors report to it and to all potentially impacted jurisdictions within days of discovering an incident. The EAC's existing Quality Monitoring Program requires only that vendors with certified voting equipment "submit reports of any voting system irregularities."[87] At present, the reporting requirement extends only to vendors of voting systems and does not encompass any other facets of those vendors' services, equipment, or operations. Election officials have long complained that vendors do not always share reports of problems with their systems.[88] Compounding the problem, a single vendor often serves many jurisdictions.[89]

Both the public and local and state governments are often **kept in the dark** about security breaches.

Some legislation has already sought to mandate more fulsome incident reporting by vendors. The Secure Elections Act, which had bipartisan support before losing momentum in 2018, included a mandatory reporting provision. Under the bill, if a so-called election service provider has "reason to believe that an election cybersecurity incident may have occurred, or that an information security incident related to the role of the provider as an election service provider may have occurred," then it must "notify the relevant election agencies in the most expedient time possible and without unreasonable delay (in no event longer than 3 calendar days after discovery of the possible incident)" and "cooperate with the election agencies in providing [their own required notifications]."[90]

Absent robust incident reporting, election officials and the public can be left unaware of potential threats that vendors might introduce into elections. As previously discussed, there is still considerable uncertainty concerning the alleged spearphishing attack and hack of a vendor involved in the 2016 elections. Much of what is known stems from the leak of a classified intelligence report obtained by the *Intercept,*[91] which identified the hacking victim as a Florida-based vendor, coupled with Special Counsel Robert Mueller's report to the attorney

general and indictment of 12 Russian intelligence officers.[92] Further complicating the picture of what happened, the Florida-based vendor, VR Systems, responded to an inquiry from Sen. Ron Wyden (D–OR) via letter, claiming that "based on our internal review, a private sector cyber security expert forensic review, and the DHS review, we are confident that there was never an intrusion in our EViD servers or network."[93] This uncertainty offers little for the vendor's clients to rely on in assessing the vendor's ongoing cyber readiness and whether to continue to contract with the vendor in future elections.

With mandated incident reporting, the EAC could provide the necessary assurance to election officials regarding the security of vendors by sharing information with election officials who need it, as well as by requiring appropriate remedial action, up to and including decertification.

SUPPLY CHAIN INTEGRITY

Federal regulators should require vendors to follow best practices for managing supply chain risks to election security. The new Technical Guidelines and Development Committee should define categories of subcontractors or products that pose serious risks, such as servers and server hosting, software development, transportation of sensitive equipment such as voting machines, and information storage. For instance, Liberty Systems, one of Unisyn Voting Solutions' regional partners, would likely be covered, given that it "provides election and vital statistics, software, and support throughout counties in the State of Illinois."[94] The TGDC's guidelines could then require that vendors have a framework to ensure that high-risk subcontractors and manufacturers also follow best practices on cybersecurity, background checks, and foreign ownership and control, as well as reporting cyber incidents to the vendor.

This approach is being used in other areas of government, where a growing recognition of supply chain risk to national security exists. The Department of Defense has recently stepped up its enforcement of supply chain integrity and security standards, requiring review of prime contractors' purchasing systems to ensure that Department of Defense contractual requirements pertaining to covered defense information and cyber incident reporting "flow down appropriately to . . . Tier 1 level suppliers" and that prime contractors have procedures in place for assessing suppliers' compliance with those requirements.[95]

The Department of Defense now requires that contractors handling controlled unclassified information (CUI) "flow down" contractual clauses to subcontractors whose "performance will [also] involve [the department's] CUI." The TGDC should develop an analogous category of subcontractors and manufacturers for which the same cybersecurity, background check requirements, and foreign ownership concerns that apply to election vendors would apply, based on the subcontractor's role and the opportunity for election security risk to be introduced.

Monitoring Vendor Compliance

To make its oversight most effective, the Election Assistance Commission must have the ability to confirm that federally certified vendors continue to meet their obligations. The fact that a vendor was, at some point in time, certified as meeting relevant federal standards is no guarantee that circumstances have not changed. Failure to stay in compliance should lead to appropriate remedial action by the EAC, up to and including decertification.

The EAC's Quality Monitoring Program for voting systems provides a starting point for how this might work. The EAC offers a mechanism for election officials on the ground to provide information about any voting system anomalies present in certified voting machines. If an election worker submits a credible report of an anomaly, the EAC distributes it to state and local election jurisdictions with similar systems, the manufacturer of the voting system, and the testing lab that certified the voting system.[96] According to the EAC's certification manual, "the Quality Monitoring Program is not designed to be punitive but to be focused on improving the process."[97] The program, then, is focused more on compliance than certification or decertification, although decertification can result in cases of persistent noncompliance.

The SAFE Act and the For the People Act call for the testing of voting systems nine months before each federal general election, as well as for the decertification of systems that do not meet current standards.[98]

A critical difference between the ability to monitor voting equipment and the practices of an election system vendor is that thousands of election officials and poll workers, and hundreds of millions of voters, interact with voting equipment on a regular basis. They can report anomalies when they see them. By contrast, most of the work of election system vendors happens out of public view.

For this reason, vendors must be obligated on an ongoing basis to remedy known security flaws or risk losing federal certification. Congress should provide the EAC with a mandate to ensure that vendors contract with independent security firms to conduct regular audits, penetration testing, and physical inspections and site visits, and to provide the results of those assessments to the EAC. One legislative proposal — the Protect Election Systems from Foreign Control Act — sought to do something similar by subjecting vendors to an annual evaluation to assess compliance with cybersecurity best practices.[99] The EAC's effectiveness in its new oversight role would be diminished absent some power to monitor vendors' efforts on this front — a power Congress ought to provide.

The EAC could require regular penetration testing by third parties to assess vendors' cyber readiness in real time. Such testing would give the EAC (and vendors) an opportunity to identify and remediate security flaws, hopefully before adversaries take advantage of them. The EAC should also consider using bug bounty programs, which have become a common tool deployed by private industry and government entities, including the Department of Defense.[100] Under bug bounty programs, friendly so-called white-hat hackers earn compensation for reporting vulnerabilities and risks to program sponsors. The For the People Act calls for such a program,[101] as does the Department of Justice's Framework for a Vulnerability Disclosure Program for Online Systems.[102]

Certified vendors should be required to submit to extensive inspection of their facilities. To assess compliance with cybersecurity best practices, personnel policies, incident reporting and physical security requirements, and the like, the EAC must be granted wide latitude to demand independent auditors' access to vendor systems and facilities. This should include unannounced, random inspections of vendors. The element of surprise could serve as a powerful motivator for vendors to stay in compliance with EAC guidance.

The Defense Contract Management Agency (DCMA) performs an analogous, if broader, role for military contractors. Serving as the Defense Department's "information brokers and in-plant representatives for military, Federal, and allied government buying agencies," DCMA's duties extend to both "the initial stages of the acquisition cycle and throughout the life of the resulting contracts."[103] In that latter stage of a contract, DCMA monitors "contractors' performance and management systems to ensure that cost, product performance, and delivery schedules are in compliance with the terms and conditions of the contracts."[104] This function includes having personnel in contractor facilities assess performance and compliance.[105] Although our proposal does not envision the EAC performing an ongoing contract compliance role, the EAC's enhanced oversight role could take some cues from DCMA's inspection protocols and ability to closely scrutinize vendors.

The NRC similarly holds inspection rights over those subject to its regulations, including companies that handle nuclear material and those holding licenses to operate power plants.[106] The NRC regulation requiring that those regulated "afford to the Commission at all reasonable times opportunity to inspect materials, activities, facilities, premises, and records under the regulations in this chapter" is of particular relevance to potential EAC oversight.[107] The NRC also has an extensive set of regulations concerning physical security at nuclear sites and of nuclear material.[108] Although these requirements are probably more onerous than those needed in the election sector (especially since nuclear material poses unique physical security risks), they could nonetheless prove instructive in crafting physical security requirements for vendors. Such requirements should go hand in hand with the cybersecurity best practices discussed above.

Enforcing Guidelines

It is critical to have a clear protocol for addressing election system vendor violations of federal guidelines. If states require their election offices to use only federally certified vendors, revocation of federal certification could have a potentially devastating impact on the ability of jurisdictions to run elections and ensure that every voter is able to cast a ballot.

Again, the Election Assistance Commission's process for addressing anomalies in voting equipment through its Quality Monitoring Program is instructive. If it finds that a system is no longer in compliance with the VVSG, the manufacturer is sent a notice of noncompliance. This is not a decertification of the machine but rather a notification to the manufacturer of its noncompliance and its procedural rights before decertification. The manufacturer has the right to present information, access the information that will serve as the basis of the decertification decision, and cure system defects prior to decertification. The right to cure system defects is limited; it must be done before any individual jurisdiction that uses the system next holds a federal election.[109]

If decertification moves forward after attempts to cure or opportunities to submit additional information, the manufacturer may appeal the decision. If the appeal is denied, then the decertified voting system will be treated as any other uncertified system. The EAC will also notify state and local election officials of the decertification.[110] A decertified system may be resubmitted for certification and will be treated as any other system seeking certification.

The EAC's application of this process to the ES&S voting system Unity 3.2.0.0 provides an example of how this can happen. Certification of this system was granted in 2009.[111] In 2011, the EAC's Quality Monitoring Program received information about an anomaly in the system and began a formal investigation.[112] A notice of noncompliance was then sent to ES&S in 2012, listing the specific anomalies found in the voting system and informing ES&S that if these anomalies were not remedied, the EAC would be obligated to decertify the voting system.[113] ES&S attempted to cure the defects, as was its right, and produced a new, certified version of the Unity system.[114] The vendor then requested that its old system be withdrawn from the list of EAC certified systems.[115]

Decertification of a vendor would need to be handled thoughtfully, so that local election officials are not left scrambling to contract new election services close to an election. In this sense, close coordination among federal and local officials and relevant vendors to proactively identify and fix issues would be necessary for any scheme

to succeed. The EAC would also have to be left with the flexibility to decide what, if any, equipment and services could no longer be used or sold as federally certified. To that end, decertification should incorporate these key elements:

- A voting system decertification should not necessarily result in a vendor decertification and vice versa. For instance, a voting machine vendor might be found to be out of compliance with federal requirements for background checks on employees. If the EAC determines this noncompliance did not impact the security of voting machines already in the field, it could leave the voting system certified but ban the vendor from selling additional machines (or certain employees from servicing existing machines) until the failure is remedied. Alternatively, it could allow the vendor's voting machines to continue to be used for a limited time, subject to additional security measures, such as extra preelection testing and postelection audits.
- There should be a clear process ahead of a formal decertification, with notification to affected state and local officials and plenty of opportunities for the relevant vendor to address issues before the EAC takes more drastic action. Only the most urgent and grave cybersecurity lapses should truncate this decertification process.
- Any decertification order should include specific guidance to state and local officials on how existing vendor products or services are affected, assistance to those officials with replacing those goods or services (if necessary), and a road map for the vendor to regain certification.

Conclusion

Private election vendors play a crucial role in securing the nation's elections against malicious actors who have already taken steps toward compromising elections and the public's confidence in our democracy. Yet these vendors are currently subject to little oversight to ensure that they remain secure against these threats and that many of the products and services they provide, such as electronic pollbooks, are secure. Currently, only voting systems — the systems used to cast and tabulate ballots — are subject to robust federal oversight, and then only via a voluntary certification program. We recommend that Congress empower the Election Assistance Commission to certify election vendors more broadly as compliant with voluntary guidelines relating to cybersecurity, personnel, transparent ownership and control, reporting of cyber incidents, and supply chain integrity. In the meantime, the EAC should employ its registration and certification processes to ensure that vendors of certified voting systems keep up with these practices.

Endnotes

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3 Compare, for example, The Labeling of Hazardous Art Materials Act, 15 U.S.C. 1277, and 16 C.F.R. §§ 1500.14, with 11 CFR §§ 9405.1 et seq. Indeed, Chapter II of Title 11 of the Code of Federal Regulations, the principal regulations applicable to the EAC, does not address the certification of voting systems or any potential oversight of election vendors more broadly. Nor does the legislation that established the EAC (the Help America Vote Act of 2002) — which sets some requirements for voting systems used in federal elections, see 52 U.S.C. § 21081 — require the EAC to issue any mandatory regulations on those topics. See, e.g., 52 U.S.C § 20971 (regarding the certification and testing of voting systems), § 20929 ("The Commission shall not have any authority to issue any rule, promulgate any regulation, or take any other action which imposes any requirement on any State or unit of local government . . ."), § 21101 (regarding the EAC's adoption of *voluntary* guidance).

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44 Voting System Cybersecurity Act of 2019, S. 1454, 116th Cong. (2019), § 2.

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- one representative from CISA with technical and scientific expertise related to cybersecurity in election technology;
- one representative of state election information technology directors selected by the National Association of State Election Directors;
- one representative from the National Association of State Chief Information officers (NACIO) with expertise in cybersecurity;
- one representative from the EI-ISAC with technical and scientific expertise related to cybersecurity in elections;
- two representatives who are academic or scientific researchers with technical and scientific expertise related to cybersecurity, chosen by NIST;
- one representative who possesses technical and scientific expertise relating to the accessibility and usability of voting systems, chosen by NIST;
- one representative of manufacturers of voting system hardware and software who possesses technical and scientific expertise relating to cybersecurity and the administration of elections, selected jointly by the EAC and NIST; and
- one representative of a laboratory accredited under section 231(b) who possesses technical and scientific expertise relating to cybersecurity and the administration of elections, selected by the NIST National Voluntary Laboratory Assessment Program (NVLAP).

A similar proposal to modify the TGDC appears in S. Amdt. 3983 to H.R. 6157, 115th Cong. (2018).

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91 Matthew Cole et al., "Top-Secret NSA Report Details Russian Hacking Effort Days Before 2016 Election," *Intercept,* Jan. 5, 2017, https://theintercept.com/2017/06/05/top-secret-nsa-report-details-russian-hacking-effort-days-before-2016-election.

92 United States v. Netyksho et al., No. 1:18CR00215, 2018 WL 3407381, at 26 (D.D.C. Jul. 13, 2018).

93 VR Systems, Letter to Sen. Ron Wyden, May 16, 2019, https://www.politico.com/f/?id=0000016a-e72c-d72a-af6e-f72eb6550002. According to the letter, EViD "is a front-end system used to check voters in at the polls and to provide information such as a voter's polling location when they search for it."

94 Liberty Systems, LLC, "About Us," http://libertysystemsllc.com/.

95 Undersecretary of Defense, *Memorandum Addressing Cybersecurity Oversight as Part of a Contractor's Purchasing System Review, U.S. Department of Defense,* Jan. 21, 2019, https://www.acq.osd.mil/dpap/pdi/cyber/docs/USA000140-19%20TAB%20A%20USD(AS)%20Signed%20Memo.pdf.

96 U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0*, 71.

97 U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0*, 73.

98 Securing America's Federal Elections Act, H.R. 2722, 116th Cong. (2019), § 202; For the People Act, H.R. 1, 116th Cong. (2019), § 3301.

99 Protect Election Systems from Foreign Control Act, H.R. 6449, 115th Cong. (2018), § 304.

100 U.S. Department of Defense, "Department of Defense Expands 'Hack the Pentagon' Crowdsourced Digital Defense Program," Oct. 24, 2018, https://dod.defense.gov/News/News-Releases/News-Release-View/Article/1671231/department-of-defense-expands-hack-the-pentagon-crowdsourced-digital-defense-pr.

101 For the People Act, H.R. 1, 116th Cong. (2019), § 3402.

102 *A Framework for a Vulnerability Disclosure Program for Online Systems, Version 1.0,* Cybersecurity Unit, Computer Crime & Intellectual Property Section, Criminal Division, U.S. Department of Justice, July 2017, https://www.justice.gov/criminal-ccips/page/file/983996/download.

103 Defense Contract Management Agency, "About the Agency," https://www.dcma.mil/About-Us/.

104 Defense Contract Management Agency, "About the Agency."

105 See generally, Defense Contract Management Agency, "What DCMA Does," Aug. 22, 2016, https://www.dcma.mil/News/Videos/videoid/480264/nav/Default/.

106 10 C.F.R. §§ 19.1–19.40.

107 10 C.F.R. § 19.14(a).

108 10 C.F.R. §§ 73.1–73.81.

109 U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0*, 65.

110 U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0*, 69.

111 Thomas R. Wilkey (executive director, U.S. Election Assistance Commission), letter to Steve Pearson (vice president, Election Systems & Software), July 21, 2009, https://www.eac.gov/voting-equipment/-unity-3200.

112 Brian J. Hancock (director, Testing & Certification Program, U.S. Election Assistance Commission), letter to Steve Pearson (vice president, Election Systems & Software), Mar. 1, 2011, https://www.eac.gov/voting-equipment/-unity-3200.

113 Mark Robbins (general counsel and acting executive director, U.S. Election Assistance Commission), letter to Steve Pearson (vice president, Election Systems & Software), Feb. 1, 2012, https://www.eac.gov/voting-equipment/-unity-3200.

114 Steve Pearson (vice president, Election Systems & Software), letter to Mark Robbins (general counsel and acting executive director, U.S. Election Assistance Commission), Feb. 7, 2012, https://www.eac.gov/voting-equipment/-unity-3200.

115 Kathy Rogers (vice president, Election Systems & Software), letter to Brian J. Hancock (director, Testing & Certification Program, U.S. Election Assistance Commission), Aug. 3, 2012, https://www.eac.gov/voting-equipment/-unity-3200.

Endnotes for Sidebar

i U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0,* 12–19.

ii *Voluntary Voting Systems Guidelines, Vol.1, Version 1.1,* §7.4.6, §7.5, §7.5.2, §7.5.3.

iii The adoption of modern approaches such as agile software development and the provision of ongoing technical support makes information about a vendor's ongoing compliance with best practices critical for determining the level of risk posed by upgrades and changes, including some that might be deemed de minimis if vendor security practices are strong. See U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0*.

iv U.S. Election Assistance Commission, *Testing and Certification Program Manual, Version 2.0*, 17. Suspension of an entire vendor, like decertification of a vendor, would similarly need to be handled thoughtfully. See Enforcing Guidelines section on this report.

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ABOUT THE AUTHORS

▶ **Lawrence Norden** is director of the Election Reform Program at the Brennan Center for Justice, where he leads efforts to bring balance to campaign funding and break down barriers that keep Americans from participating in politics, ensure that U.S. election infrastructure is secure and accessible to every voter, and protect elections from foreign interference. He has authored several nationally recognized reports and articles related to voting rights and voting technology, including *Securing Elections From Foreign Interference* (2017), *America's Voting Machines at Risk* (2015), and *How to Fix Long Lines* (2013). His work has been featured in media outlets across the country, including the *New York Times*, the *Wall Street Journal*, Fox News, CNN, MSNBC, and National Public Radio. He has testified before Congress and several state legislatures on numerous occasions. Norden is a member of the Election Assistance Commission's Board of Advisors. This report is not affiliated with his role as an EAC advisor. He is a graduate of the University of Chicago and NYU School of Law.

▶ **Christopher R. Deluzio** is the policy director of the University of Pittsburgh's Institute for Cyber Law, Policy, and Security. He was previously counsel in the Democracy Program at the Brennan Center for Justice, where his writing included nationally recognized work on voter purges, a procurement guide to assist in the selection and management of election vendors, and legal analysis of speech restrictions in polling places. Prior to joining the Brennan Center, he was a litigation associate in private practice with Wachtell, Lipton, Rosen & Katz and, before that, law clerk to Judge Richard J. Sullivan of the U.S. District Court for the Southern District of New York. He graduated magna cum laude from Georgetown Law, where he was elected to the Order of the Coif, served as an executive articles editor of the *Georgetown Law Journal*, and was selected as the top oralist in the Robert J. Beaudry Moot Court Competition and the Thurgood A. Marshall Memorial Moot Court Competition. He received a bachelor's degree from the U.S. Naval Academy and, following graduation, served as an active-duty naval officer.

▶ **Gowri Ramachandran** is senior counsel in the Brennan Center for Justice's Democracy Program. She comes to the Brennan Center from Southwestern Law School in Los Angeles, California, where she is on leave from her position as professor of law. At Southwestern, she taught courses in constitutional law, employment discrimination, and critical race theory, as well as the Ninth Circuit Appellate Litigation Clinic, which received the Ninth Circuit's 2018 Distinguished Pro Bono Service Award. She received her undergraduate degree in mathematics from Yale College and a master's degree in statistics and JD from Harvard University. While in law school, she served as editor in chief of the *Yale Law Journal*. After graduating from law school in 2003, Ramachandran served as law clerk to Judge Sidney R. Thomas of the U.S. Court of Appeals for the Ninth Circuit in Billings, Montana. After a fellowship at Georgetown Law, she joined the Southwestern faculty in 2006.

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BRENNAN CENTER FOR JUSTICE

Brennan Center for Justice at New York University School of Law
120 Broadway // 17th Floor // New York, NY 10271
www.brennancenter.org

Appendix B

POLICY REPORT

BRENNAN CENTER FOR JUSTICE

Preparing for Cyberattacks and Technical Failures

A Guide for Election Officials

By Edgardo Cortés, Gowri Ramachandran, Liz Howard, and Lawrence Norden

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Brennan Center for Justice at New York University School of Law

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Introduction

America's intelligence agencies have unanimously concluded that the risk of cyberattacks on election infrastructure is clear and present — and likely to grow.[1] While officials have long strengthened election security by creating resiliency plans,[2] the evolving nature of cyber threats makes it critical that they constantly work to improve their preparedness. It is not possible to build an election system that is 100 percent secure against technology failures and cyberattacks, but effective resiliency plans nonetheless ensure that eligible voters are able to exercise their right to vote and have their votes accurately counted. This document seeks to assist officials as they revise and expand their plans to counter cybersecurity risks.

Many state and local election jurisdictions are implementing paper-based voting equipment, risk-limiting audits, and other crucial preventive measures to improve overall election security. In the months remaining before the election, it is at least as important to ensure that adequate preparations are made to enable quick and effective recovery from an attack if prevention efforts are unsuccessful.

While existing plans often focus on how to respond to physical or structural failures, these recommendations spotlight how to prevent and recover from technological errors, failures, and attacks. Advocates and policymakers working to ensure that election offices are prepared to manage technology issues should review these steps and discuss them with local and state election officials.

Prevent and Recover from Electronic Pollbook Failures and Outages

Electronic pollbooks, or e-pollbooks, are laptops or tablets that poll workers use instead of paper lists to look up voters. E-pollbooks expedite the administration process, shorten lines, lower staffing needs, and save money. Most e-pollbooks can communicate with other units in the same location to share real-time voter check-in updates. They may also be able to communicate directly with a local election office or with other locations, such as vote centers, via physical connections or wireless networks.

There are no national standards for e-pollbook operations or security. E-pollbooks present unique challenges because they need to maintain updated information across numerous devices and locations. Additionally, many devices that may be used as e-pollbooks do not have the ability to connect via physical networks and require some type of wireless communication to convey important information. Election officials should consider the following security recommendations when using e-pollbooks:

Limit or eliminate connectivity to wireless networks whenever possible. E-pollbooks used for voter check-in generally do not need wireless connections. Officials who operate precinct-based voting on Election Day should choose e-pollbook options that use hardwired connections to share voter information in real time across units to complete the voter check-in process. This provides the greatest level of security. Bluetooth is not an acceptable alternative to other types of wireless network connectivity; researchers have found security vulnerabilities that risk the spread of malware and allow unauthorized access to data being transmitted between Bluetooth-connected devices.[3]

Implement proper security protocols when wireless connectivity is required. Election officials using vote centers and multiple early-voting locations may require some network connectivity to share voter check-in information across several locations. Additionally, some e-pollbooks may not fully function if their wireless connections are eliminated or disabled. For example, certain e-pollbooks use Apple iPads, which rely solely on wireless connectivity for communication. If wireless networks must be used, officials should implement security protocols, including encrypting communication between e-pollbooks and requiring strong passwords that are changed after every election.

Ensure that systems are properly patched as part of Election Day preparations. E-pollbooks must receive appropriate operating system updates and software patches in advance of every election to protect against known cyber vulnerabilities. To determine what patches are available or recommended, election officials should start by reviewing any guidelines or requirements created by state or local government IT agencies. States and localities may develop their cybersecurity requirements on the basis of the National Institute of Standards and Technology's cybersecurity framework.[4] Adhering to these requirements will ensure that election officials are using best practices for securing election systems, protecting the personally identifiable information (PII) of voters, and preserving the integrity of voter data used on Election Day. Alerts from the Election Infrastructure Information Sharing and Analysis Center (EI-ISAC) can also provide insights about recent vulnerabilities and emergency security patches.

Keep appropriate backup of e-pollbooks in polling places. Paper backups of e-pollbooks are the best resiliency measure in the event of an e-pollbook failure. They allow poll workers to continue confirming voters' eligibility, diminish the potential for long lines, and may minimize the need to issue provisional ballots. While jurisdictions in 41 states and the District of Columbia (DC) use e-pollbooks, our research indicates that only 11 states and DC formally require paper backups on Election Day, although several other states recommend the practice or have counties that voluntarily keep paper backups.[5] Durham County, North Carolina, experienced a significant failure of e-pollbooks in November 2016, when many voters arrived at the polls to find that they had been marked on the e-pollbooks as already having voted or were improperly marked as needing to provide additional identification.[6] Voting was delayed for more than an hour and a half as the county printed paper pollbooks and delivered them.[7] This delay could have been avoided if printed pollbooks had been sent ahead of time with other polling place materials. Preemptively sending paper backup of e-pollbooks to polling places obviates the need for detailed logistics in case of e-pollbook failure.

Jurisdictions should evaluate their e-pollbook recovery procedures to ensure they will be easy for poll workers

to follow and will not introduce new obstacles to voters casting their ballots quickly. As the use of vote centers and other centralized voting locations increases, printing pollbooks may create logistical and administrative challenges. These types of voting locations may need other backup options, such as nonnetworked devices from a different vendor that contain the entire list of registered voters for a jurisdiction, along with the correct ballot style and current status (i.e., voted, absentee, or not voted) for each voter. Another option is to produce a backup list on demand using high-speed printers. This backup procedure, which New Hampshire law calls for, could allow polling places to quickly transition from malfunctioning e-pollbooks to paper backups.

Provide sufficient provisional ballots and materials for two to three hours of peak voting. A key backup measure for Election Day is to supply sufficient provisional ballots and provisional balloting materials. It is preferable to issue regular ballots to eligible voters if the e-pollbook system fails. However, it may not be possible to determine voter eligibility in the event of such a failure, especially if backup paper pollbooks are unavailable or are found to contain errors. Provisional ballots ensure that individuals can cast a ballot while providing election officials time to determine their eligibility. These ballots should be counted once officials determine eligibility, with no further action required of the voter. Having sufficient provisional ballots to account for two to three hours of peak voting activity will allow voting to continue in the event of system failures.[8] For the November 2020 election, this will require enough provisional ballots for at least 35 percent of registered voters.[9] While not enough to deal with an all-day problem, it will provide sufficient time for other measures to be implemented or additional ballots and materials to be delivered. Contingency plans must provide for additional materials to be delivered if the problem cannot be resolved.

Train poll workers to implement pollbook contingencies. Improper or insufficient training of poll workers can lead to voters being turned away, long lines, and ineligible individuals casting ballots. Poll worker instructions for managing provisional ballots must specify how to handle e-pollbook failures appropriately, including when to allow voters to cast a regular ballot and when to issue provisional ballots instead. Whenever voter eligibility can be confirmed in a timely fashion through the use of appropriate backups, regular ballots should be issued. The U.S. Election Assistance Commission (EAC) provides a list of guidelines for poll workers regarding provisional ballots as well as some best practices for poll worker accountability. Provisional ballot forms must clearly indicate the sections that should be filled out by voters, poll workers, and election staff, so each person knows what he or she needs to do. It is also important to provide a clear list of circumstances in which to use provisional ballot envelopes, including on the envelopes themselves. In 2018, Virginia adopted new provisional ballot materials created in coordination with the Center for Civic Design that illustrate these best practices.[10]

More Resources

Center for Internet Security Handbook
www.cisecurity.org/wp-content/uploads/2018/02/CIS-Elections-eBook-15-Feb.pdf

Belfer Center Cybersecurity Playbook
www.belfercenter.org/publication/state-and-local-election-cybersecurity-playbook#voterreg

Pew E-pollbook Database
www.pewtrusts.org/en/research-and-analysis/data-visualizations/2017/a-look-at-how-and-how-many-states-adopt-electronic-poll-books

National Conference of State Legislatures Page on E-pollbooks
www.ncsl.org/research/elections-and-campaigns/electronic-pollbooks.aspx

EAC Standards for Poll Workers
www.eac.gov/research-and-data/provisional-voting

Center for Civic Design on Provisional Ballots
www.civicdesign.org/you-see-a-provisional-ballot-voters-see-their-ballot

Prevent and Recover from Voting Equipment Failures

Even under the best of circumstances, equipment failures occur. For digital or optical-scan voting systems, recovery in case of an equipment failure can be relatively fast; as ballots are already printed, voting can continue while the tabulator issue is resolved. As a Brennan Center report on voting machines notes, jurisdictions that rely on direct-recording electronic (DRE) machines can face more problems in the event of a failure, since "voters may have to wait in long lines while election workers scramble to repair them."[11]

These problems can occur when jurisdictions use ballot-marking devices (BMDs) and ballot-on-demand (BOD) printers as well. In the event of a system failure, these machines will not function until repaired or replaced, and jurisdictions using them will need to print ballots in advance of the election to allow voting to continue. Regardless of the voting system used, election officials should conduct logic and accuracy testing on all voting equipment prior to every election in order to minimize the chance of unforeseen failures on Election Day.

If using paper ballots, print enough ballots for all registered voters. Many election officials using paper ballots decide how many ballots to print on the basis of prior election turnout or the percentage of registered voters expected to vote. This approach can result in ballot shortages and leave jurisdictions unprepared for unexpected voter surges. This happened across the country during the 2018 midterm elections, when turnout reached historic levels, and many experts predict record-breaking turnout in 2020.[12] To prepare, election officials should print enough ballots for all registered voters. Jurisdictions that allow Election Day registration may require an even higher ballot supply.

If using voting systems that do not require preprinted ballots, print enough emergency paper ballots for two to three hours of peak voting activity. Emergency ballots should be provided to voters who are identified as qualified and meeting all the requirements for voting pursuant to state law but who are unable to vote due to a voting machine malfunction. Emergency ballots are different from provisional ballots, which are given to voters whose eligibility is unclear. Emergency ballots should be counted as soon as functional voting equipment becomes available, without any additional scrutiny of voter qualifications, unlike provisional ballots, which may require research on voter eligibility. Printing enough emergency ballots for two to three hours of peak voting activity will allow voting to continue until equipment can be repaired or replaced, or until additional paper ballots can be delivered to a polling place. For the November 2020 election, this will require enough provisional ballots for at least 35 percent of registered voters. Appropriate procedures should be put in place for chain of custody and accounting for preprinted paper ballots.

DRE voting systems directly record, in electronic form, voters' selections in each race or contest on the ballot. An increasing number of states and local jurisdictions have begun replacing antiquated DREs with BMDs as the primary voting option. Others are increasingly using vote centers, which often rely on BOD printers to produce on-site any ballot style and language that might be needed for a particular voter. Because these systems do not need preprinted ballots, election jurisdictions using DREs, BMDs, or BOD-printed ballots as their primary voting option should preprint and distribute emergency paper ballots that can be counted by existing tabulators. There are 16 states that will use DREs as the principal polling place equipment in at least some jurisdictions in 2020.[13] However, at least seven do not mandate that paper ballots be made available in the event of DRE failure.[14]

In vote centers that have a large number of ballot styles, preprinted emergency ballots for at least the precincts closest to that vote center should be stocked. Vote centers can also be stocked with master copies of emergency paper ballots in all necessary styles and languages, along with a photocopier to reproduce them in emergency situations.

Tabulators should be programmed to accept and read both ballots produced by the BMD/BOD printers and preprinted emergency ballots. Preelection testing should verify that the tabulators properly identify and record both types of ballots.

Develop procedures to manage and track malfunctioning equipment or equipment failure. Machines that appear to be malfunctioning or improperly calibrated should be taken out of service and additional voting equipment deployed to the polling place or vote center. Recalibrating DRE touch screens or conducting any other necessary voting equipment repairs should be done in full view of observers. Any reports from voters of machine errors should be tracked and immediately reported to the

central election office. Election offices should review and compare these reports across voting locations to identify trends that could indicate widespread problems, including potential cyberattacks. Training should ensure that poll workers understand the process for counting ballots, including potentially hand-counting ballots, if equipment failure cannot be resolved before voting ends.

Communicate with voters to build trust in the election process. Election officials should preprint signage that will allow poll workers to inform voters of equipment failures in a manner that is consistent across locations and approved by the election office. On Election Day, poll workers should ensure that voters are not directed to use machines that are suspected of producing erroneous records.

Poll workers should also take steps to make sure that voters accurately recorded their selections on their ballots. When using hand-marked paper ballots that are counted without the help of an optical scanner, poll workers should remind voters to check their ballots to prevent overvotes, which occur when voters make more selections than the number allowed. When using DREs with a voter-verifiable paper audit trail (VVPAT) or BMDs, poll workers should clearly explain to voters how their ballots will be cast and remind them to verify that the paper printout matches the selections they made on the machine. For example, when using BMDs that print a ballot that must then be scanned by a separate machine, poll workers should say to voters, after their ballot has been printed and before it is cast: "Don't forget to check the printed ballot carefully. If you see something wrong, you can get a replacement. Then you'll go [over there] to cast it."

Take steps to prevent late polling place openings due to equipment failures. Inoperable voting equipment should not prevent the timely opening of a polling place. Late polling place openings can lead to long lines and voters leaving without an opportunity to cast a ballot.[15] Poll workers should be trained to deal with equipment failures occurring on the morning of Election Day. Voters should be allowed to vote using emergency paper ballots if voting equipment is not operable when the polls open. Poll workers should explain to voters how their ballots will be counted once working voting equipment becomes available.

Plan to assist voters with disabilities if voting machines fail. If accessible voting machines fail and paper ballots are used instead, disabled voters may not be able to vote privately and independently. Jurisdictions with sufficient resources should have backup accessible voting equipment, with all ballot styles available (similar to what would be used at a central voting site for early voting), geographically dispersed so that it can be rapidly delivered to any polling place where accessible equipment has failed. In the longer term, jurisdictions might consider providing each polling place with accessible tablets and printers to be used by voters with disabilities in the event of equipment failure.[16] Poll workers should be appropriately trained on any backup systems used to provide accessibility.

More Resources

Brennan Center Report on Voting Machines at Risk
www.brennancenter.org/analysis/americas-voting-machines-risk-an-update

Brennan Center Voting Equipment Overview
www.brennancenter.org/analysis/overview-voting- equipment

Verified Voting Verifier – Lookup Tool for Polling Place Equipment
www.verifiedvoting.org/verifier

Prevent and Recover from Voter Registration System Failures and Outages

Voter registration systems maintain official lists of registered voters, including all voter information and district assignment information. The statewide systems usually serve additional election-management purposes as well, such as processing absentee ballots. A failure of the registration system on or near Election Day can cause problems producing files for paper pollbooks or e-pollbooks, using voter information lookup tools, or validating provisional ballots immediately after the election.

Establish a 60-day preelection blackout window for all noncritical software updates and patches. These windows increase the likelihood that programming errors, viruses, or other problems will be discovered in a timely manner prior to Election Day. Sixty days provides sufficient time before the close of voter registration or the start of absentee voting to identify whether installed patches or updates have created unintended system issues. Even updates that do not directly impact voter registration databases, such as server patching, networking equipment upgrades, and locality telecommunications system changes, may impact a local election official's ability to access the state voter registration database. Therefore it is critical that these blackout dates be established and communicated with relevant staff to prevent potential issues on or shortly before Election Day. The plan should include a process for emergency updates during the blackout window, indicating who will authorize the emergency update and how it will be tested prior to rollout.

Subject the system periodically to independent vulnerability testing. States can either partner with the Department of Homeland Security or engage outside cybersecurity consultants to test the system for vulnerabilities on a periodic basis. Vulnerability testing should be conducted well in advance of an election, and at least quarterly, to provide sufficient time to resolve any potential vulnerabilities that are discovered. While the specific results of vulnerability testing need not be released so as to maintain system security, officials should be transparent about what entity conducted the testing and what standards it used.

Maintain backup copies of digital records off-line in case online access is limited. In the lead-up to the election, local officials should download an electronic copy of voter information on a daily basis and store it securely, so that they have the most recent information in case the voter registration system becomes unavailable. This can be used to conduct research on provisional ballots after the election.

Provide voters with tools to look up their voter registration status online and conduct outreach to urge voters to use the tool in advance of any registration deadline. Voters can provide crucial information about undesired changes to their registration, including address changes they did not request, which could be an early indicator of a possible breach. Encouraging voters to check before a deadline ensures that problems can be resolved in a timely fashion. It may also reduce pressure on poll workers on Election Day.

Provide voters with tools to look up their polling place information online, and make alternative websites available. In case a voter lookup tool fails, election officials should be prepared to provide links to other polling place lookup tools, such as the Voting Information Project (VIP), an independent entity that provides information to voters using official data. New Jersey successfully used VIP to provide information to voters after Hurricane Sandy made state systems unavailable and necessitated a large number of polling place changes in advance of the 2012 election.[17] Using tools such as VIP for polling place lookups, instead of sites that depend on statewide registration systems, also reduces the load on state servers at busy times in the election season. This requires providing accurate polling place data to the backup site in advance of elections and confirming that the backup site is working correctly.

More Resources

EAC Deep Dive on Election Technology
www.eac.gov/documents/2018/05/01/eavs-deep-dive-election-technology

Pew Project on Upgrading Voter Registration
www.pewtrusts.org/en/projects/election-initiatives/about/upgrading-voter-registration

EAC Checklist for Securing Voter Registration Data
www.eac.gov/documents/2017/10/23/checklist-for-securing-voter-registration-data

Voting Information Project
www.votinginfoproject.org

Prevent and Recover from Election Night Reporting System Failures and Outages

Local and state officials usually post unofficial results on election night. While this information does not reflect the certified results, large differences between unofficial election night results and the final outcome can create questions for voters about the accuracy of the process. Election night reporting sites are prime targets for denial of service (DoS) attacks because the sites' high-use period is known ahead of time, and preventing access to unofficial results can create negative media attention about the electoral process. A hotly contested race can intensify interest in the election results, and a large increase in visitors to a reporting site in a short period can likewise bring down the site.

Establish redundancies. Some states, including Arizona and Virginia, experienced election night reporting failures in the 2014 midterm elections.[18] Addressing the system failures after the election, several of these states established a redundant system that can be made available if the main system fails.[19]

Do not connect election night reporting systems to voting systems or the statewide registration system. Election night reporting systems (ENRs) are attractive targets for cybercriminals and other nations. Bad actors have successfully attacked ENRs around the world, including in Ukraine, Bulgaria, and more recently the United States. By publishing unofficial results through an unconnected system, election officials can minimize the potential that a targeted attack on the reporting system will have any lasting impact. Knox County, Tennessee, experienced a DoS attack linked to foreign IP addresses during its May 1, 2018, primary elections. Although this attack likely served as a distraction from a separate attack on the county's servers, the reporting website itself did not provide an avenue for future disruption. The county's deputy director of IT noted that its reporting system is "not connected to any live databases. . . . It's a repository for being able to report to the public, and we have intentionally kept any primary data extremely isolated."[20]

More Resources

EAC Checklist for Securing Election Night Reporting Systems
www.eac.gov/documents/2017/10/23/checklist-for-securing-election-night-reporting-systems-data- election-administration-security

Communication Strategy

All good contingency plans include a communication plan. At its core, a communication plan is intended to assist election officials in distributing essential information in a timely manner and maintaining public confidence in the election's administration. Communication plans are important in all unexpected situations, from equipment failures to potential cyberattacks to unintentional errors.

Draft, review, and approve a communication plan prior to Election Day. Keeping voters, poll workers, and others informed minimizes the harm that could arise on Election Day in the event of negative developments. The most basic communication plan includes key staff and contacts. A more detailed strategy may include various response options for potential problems as well as longer-term considerations, such as notification requirements in the event personal voter information has been leaked.

Provide a public website for emergency communications. Officials should publicize links where emergency information will be posted on Election Day, possibly including official social media accounts used by state and local election officials. These can serve as official sources where voters, candidates, media, and advocacy organizations can find information regarding extended polling place hours, polling place relocations, and other emergency information. Doing this in advance of an election will make emergency communications easier for election officials.

Be transparent but careful. As the Belfer Center for Science and International Affairs suggests, "Transparent communication builds trust, but in a cyber incident, you will have few facts at hand, especially at the outset. Public comments should demonstrate that you are taking the issue seriously but avoid providing any details that may change as the investigation progresses, so you don't have to correct yourself down the line. Avoid speculation on the perpetrator of the incident."[21]

More Resources

Belfer Center Cybersecurity Playbook
www.belfercenter.org/publication/state-and-local-election-cybersecurity-playbook#voterreg

Endnotes

1 See generally Senate Select Committee on Intelligence, *Russian Active Measures Campaigns and Interference in the 2016 U.S. Election Volume 1*, 2019, https://www.intelligence.senate.gov/sites/default/files/documents/Report_Volume1.pdf; Robert S. Mueller III, *Report on the Investigation into Russian Interference in the 2016 Presidential Election*, U.S. Department of Justice, 2019, https://www.justice.gov/storage/report.pdf; and Olivia Gazis, "Intel Chiefs Warn of Russia-China Alliance as Threats Grow More Complex," CBS News, Jan. 29, 2019, https://www.cbsnews.com/news/intelligence-chiefs-provide-updates-on-worldwide-threats-2019-01-28-live-updates.

2 See, e.g., Wisconsin State Board of Elections, *Report on Election Related Contingency Planning*, 2007, https://elections.wi.gov/sites/default/files/publication/65/election_related_contingency_planning_2007_pdf_19060.pdf; Senate Select Committee on Intelligence, *Russian Targeting of Election Infrastructure During the 2016 Election: Summary of Draft SSCI Recommendations*, 2018, https://www.burr.senate.gov/imo/media/doc/RussRptInstlmt1-%20ElecSec%20Findings%2CRecs2.pdf.

3 See, e.g., Armis, *Protecting the Enterprise from BlueBorne*, 2017, https://go.armis.com/hubfs/BlueBorne%20Technical%20White%20Paper.pdf; Daniele Antonioli, Nils Ole Tippenhauer, and Kasper B. Rasmussen, "The KNOB Is Broken: Exploiting Low Entropy in the Encryption Key Negotiation of Bluetooth BR/EDR" (paper presented at the 28th Usenix Security Symposium, Santa Clara, CA, Aug. 2019), https://www.usenix.org/conference/usenixsecurity19/presentation/antonioli.

4 National Institute of Standards and Technology, "Cybersecurity Framework," accessed Nov. 20, 2019, https://www.nist.gov/cyberframework.

5 In our research, we found written paper backup requirements for e-pollbooks in 11 states and Washington, DC. These 11 states are Connecticut, Georgia, Michigan, Minnesota, New Jersey, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, and South Dakota. Mississippi and West Virginia have laws recommending paper backups. In Nevada and Wyoming, backup paper pollbooks are available in practice everywhere e-pollbooks are used, while in other states, like Colorado, Kansas, and Texas, paper backups are available in many jurisdictions. Arizona and Maryland formally require that either paper or electronic backups be available, while Idaho has indicated that it makes this recommendation. A few other states require or recommend that electronic backups be available. New Hampshire mandates that a sufficient number of high-speed printers be available to produce a backup paper checklist in the event of a system failure but has not yet deployed its e-pollbook solution.

6 Pam Fessler, "Russian Cyberattack Targeted Elections Vendor Tied to Voting Day Disruptions," NPR, Aug. 10, 2018, https://www.npr.org/2017/08/10/542634370/russian-cyberattack-targeted-elections-vendor-tied-to-voting-day-disruptions.

7 Fessler, "Russian Cyberattack Targeted Elections Vendor."

8 Nicholas Weaver, "Election Vulnerability: Voter Registration Systems," *Lawfare*, Feb. 23, 2018, https://www.lawfareblog.com/2018-election-vulnerability-voter-registration-systems.

9 In the typical state, 35 to 45 percent of voters surveyed arrived at their polling place during the peak three hours of voting. Because historically high turnout is expected in the 2020 elections, we multiplied this range by 90 percent, to estimate that emergency supplies to serve 30 to 40 percent of voters would be prudent, or 35 percent in the typical case. See Charles Stewart III, *2016 Survey of the Performance of American Elections: Final Report*, Massachusetts Institute of Technology, 2017, 343, http://www.legendsvote.org/wp-content/uploads/MIT-Charles-Stewart-Voter-Turnout-Study-2016.pdf.

10 Center for Civic Design, "Making Provisional Voting Easier in Virginia," accessed Nov. 20, 2019, https://civicdesign.org/showcase/making-provisional-voting-easier-in-virginia.

11 Lawrence Norden and Christopher Famighetti, *America's Voting Machines At Risk*, Brennan Center for Justice, 2015, 30, https://www.brennancenter.org/sites/default/files/publications/Americas_Voting_Machines_At_Risk.pdf.

12 Henry Olsen, "We Could Have Record Turnout in the 2020 Election. We're Not Ready for It," *Washington Post*, Oct. 10, 2019, https://www.washingtonpost.com/opinions/2019/10/10/we-could-have-record-turnout-election-were-not-ready-it.

13 These 16 states are Arkansas, Indiana, Illinois, Kansas, Kentucky, Louisiana, Mississippi, Nevada, New Jersey, North Carolina, Ohio, Texas, Tennessee, Utah, Wyoming, and West Virginia. Three states that have recently used DREs — Georgia, South Carolina, and Pennsylvania — have committed to replacing them by 2020.

14 We have identified the following states where there are no provisions mandating that paper ballots be made available in the event of DRE failure: Kansas, Nevada, North Carolina, Texas, Utah, West Virginia, and Wyoming. While not required by statute, polling places in some of these states may provide some form of emergency paper ballots when systems go down. For instance, Kansas requires counties to keep an additional supply of ballots to meet any emergency need for such ballots, although machine failure is not specifically listed; Nevada requires each local election official to submit a plan for the use of absentee ballots in case of an emergency; Texas advises its counties to adopt procedures to provide emergency paper ballots in the event of DRE machine failure; Utah allows the provision of emergency paper ballots; and West Virginia counties have contingency plans in the event of machine failure.

15 For example, during New York's June 2018 federal primary election, a voter was reportedly unable to vote because an election worker had not yet activated voting equipment. The voter was not offered an emergency ballot before having to leave the polling place. See Jake Offenhartz, "Voters Reporting Closed Poll Sites and Other Primary Day Confusion," *Gothamist*, June 26, 2018, http://gothamist.com/2018/06/26/voters_primary_confusion_nyc.php.

16 States like Oregon have adopted remote accessible voting by mail without requiring access to the internet to mark the ballot. Jurisdictions may want to consider having such systems available in the polling place in the event of machine failures. See State of Oregon, "Voting Instructions for Voters with a Disability," accessed Nov. 20, 2019, https://sos.oregon.gov/voting/Pages/instructions-disabilities.aspx.

17 Susan K. Urahn, "Collaboration, Technology and the Lessons of Election Day," *Governing: States and Localities*, Jan. 16, 2013, https://www.governing.com/columns/mgmt-insights/col-collaboration-technology-voting-information-accessibility.html.

18 Eyragon Eidam, "Is Your Election Night Reporting System Ready for 2016?" *Government Technology*, Dec. 21, 2015, http://www.govtech.com/state/Is-Your-Election-Night-Reporting-System-Ready-for-2016.html.

19 Eidam, "Is Your Election Night Reporting System Ready?"

20 Sam Levine, "Hackers Tried to Breach a Tennessee County Server on Election Night: Report," *Huffington Post*, May 11, 2018, https://www.huffpost.com/entry/knox-county-election-cyberattack_n_5af5ca21e4b032b10bfa56ee; and Tyler Whetstone, "Knox County Election Night Cyberattack Was Smokescreen for Another Attack," *Knox News*, May 17, 2018, https://www.knoxnews.com/story/news/local/2018/05/17/knox-county-election-cyberattack-smokescreen-another-attack/620921002/.

21 Siobhan Gorman et al., *Election Cyber Incident Communications Coordination Guide*, Belfer Center for Science and International Affairs, 2018, 12, https://www.belfercenter.org/sites/default/files/files/publication/CommunicationsGuide.pdf.

ABOUT THE AUTHORS

▶ **Edgardo Cortés** is the election security adviser for the Brennan Center's Democracy Program. An expert on election administration and policy, Cortés served as Virginia's first commissioner of elections. During his tenure, he served as chairman of the board for the Election Registration Information Center and chairman of the U.S. Election Assistance Commission Standards Board. He previously served as the general registrar in Fairfax County, Virginia, and deputy director for policy and grants director at the U.S. Election Assistance Commission. Cortés received his undergraduate degree from Cornell University and his master's degree in political management from George Washington University.

▶ **Gowri Ramachandran** serves as counsel for the Brennan Center's Democracy Program. She came to the Brennan Center from Southwestern Law School in Los Angeles, where she is on leave from her position as professor of law. At Southwestern, she has taught courses in constitutional law, employment discrimination, and critical race theory, as well as the Ninth Circuit Appellate Litigation Clinic, which received the Ninth Circuit's 2018 Distinguished Pro Bono Service Award. She received her JD from Yale Law School.

▶ **Liz Howard** serves as counsel for the Brennan Center's Democracy Program, where she works on cybersecurity and elections. Prior to joining the Brennan Center, Howard served as deputy commissioner of the Virginia Department of Elections. During her tenure, she coordinated many election administration modernization projects, including the decertification of all paperless voting systems, implementation of the e-Motor Voter program, and adoption of online, paperless absentee ballot applications. Before her appointment, she worked as general counsel at Rock the Vote and as a senior associate at Sandler Reiff. She received her JD from William and Mary School of Law.

▶ **Lawrence Norden** is director of the Brennan Center's Election Reform Program. He has authored several nationally recognized reports and articles related to voting rights and voting technology, including *Securing Elections from Foreign Interference* (2017), *America's Voting Machines at Risk* (2015), *How to Fix Long Lines* (2013), *Better Design, Better Elections* (2012), and *Voting Law Changes in 2012* (2011). His work has been featured in media outlets across the country, including the *New York Times,* the *Wall Street Journal*, CNN, Fox News, MSNBC, and NPR. He has testified before Congress and several state legislatures on numerous occasions. He received his JD from New York University School of Law.

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Brennan Center for Justice at New York University School of Law
120 Broadway // 17th Floor // New York, NY 10271
www.brennancenter.org