OVERVIEW OF IMPLEMENTED ELECTRONIC VOTING AND COUNTING TECHNOLOGIES

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Development of modern technologies has caused emerging practices of using the new smart devices for casting and counting the votes on elections and referendums. Similar to the traditional paper voting system, electronic technologies may be used in supervised environments where the members of local election commission are present (i.e. at the polling stations), or remotely in unsupervised environments (such as voting from a home computer or a smartphone via mobile apps). However, new technologies bring also new threats, which shall be duly safeguarded before their full-scope implementation on the Election Day.

This article is aimed at identifying the main features of recently deployed electronic voting and counting technologies for elections and referendums, their core advantages and disadvantages, as well as the respective challenges tightly connected to their use.

As of 2017, there are many different electronic voting and counting technologies being tested worldwide. According to the Organization for Security

and Cooperation in Europe, they may be divided into four main categories as described below in detail, namely (i) the ballot scanning technology; (ii) the direct recording electronic voting systems; (iii) Internet voting; and (iv) the hybrid forms of new voting technologies[1].

The ballot scanning technology was created primarily as an electronic counting technology. The principle of its use contains a ballot paper that is either marked by a voter him or herself (usually by filling in an oval or connecting an arrow) or with assistance of a ballot marking device having the special ink and provided by the officials at the polling station, which shall be then inserted into a scanning machine and counted by electronically "reading" the voter's mark on the ballot. Such scanning devices can be located in polling stations or counting centers, which are considered to be supervised environments.

There are two methods of counting the votes using the said technology. Firstly, such tallying may be organized at the polling station with the voter "feeding" the ballot into the machine, when the latter stores the respective results whether locally at the polling station, or centrally in the regional or central level. Secondly, the polling station officials may take the marked paper ballots and deliver them into the respective regional/central counting station where all the ballots are scanned and therefore counted automatically.

What is considered to be the best in using the ballot scanning technology for elections and/or referendums, is that it offers the possibility of manual re-count in case the additional verifiability is needed. Moreover, it will not stop the whole counting procedure on the Election Day in case of any system break (as far as the election officials may still proceed with the manual count of paper ballots).

The scanning machines recognize only the ballots marked correctly (i.e. in case the ballot has more than one mark, it will be invalid). Furthermore, it may be decided to have the special digitalized or protected paper used for the paper ballots, which will make it impossible to "feed" the said machine with fake ballots.

Additionally, it shall be noted that the implemented scanning technology may be applicable for the paper ballots containing the readable QR code or other code similar thereto both on the ballot paper where the vote is cast and on the respective voter's receipt. Once "fed" by the voter, such a paper

[1] Handbook For the Observation of New Voting Technologies [Electronic resource] // OSCE Office for Democratic Institutions and Human Rights (ODIHR). – 2013. – Mode of access: http://www.osce.org/odihr/elections/104939?download=true.

ballot is scanned and downloaded to the central server, as well as structured pursuant to the respective candidate. This will allow every voter to verify his/her vote by scanning the respective digital code by his/her smart device and find the scan-copy of it on the central server as counted correctly. Such advanced verifiability tool shall be considered as an added value not only for the election officials, but also for the voter, who will be enabled to check whether his/her vote was casted, scanned, recognized and therefore counted correctly, increasing with the same transparency of the whole system. Moreover, recount of the scanned ballots will be also possible by downloading the scanned ballots. Such a prominent technology had been recently proposed, however, there are no current examples of its use[1].

Ballot scanning technologies cost less if compared to another electronic voting and counting systems, and may require less IT-related skills from the members of the respective local polling stations in terms of sustainability of the systems. On the other hand, these systems entail significant focus on details, such as ballot design, type of ink used, paper stock thickness and other factors that may inhibit the ability of implemented electronic machines to accurately count votes[2]. Despite this, such technologies significantly facilitate the existing counting process, reduce time estimations and enable getting the final election results in hours instead of days and weeks.

The aforementioned electronic voting technology is being widely used in the United States of America, and recently the states still lacking this system were suggested to implement it[3].

The direct recording electronic (DRE) voting systems record the voter's choice in the polling station, usually through touch-screen, keyboard, mouse, pen or other electronic device, and count the votes electronically. Similar to ballot scanners, DRE systems are also usually located in supervised environments.

The DRE system captures the votes and stores them electronically using the inserted removable memory card which is then transmitted centrally (i.e. local storage) or transfers the votes to the regional/central level via In-

[1] Bismark D. E-voting without fraud [Electronic resource] / David Bismark // TED Talks – Mode of access: https://www.youtube.com/watch?v=izddjAp_N4.

[2] Common Electronic Voting and Counting Technologies [Electronic resource] // National Democratic Institute – Mode of access: https://www.ndi.org/e-voting-guide/common-electronic-voting-and-counting-technologies.

[3] Halderman J. Want to Know if the Election was Hacked? Look at the Ballots [Electronic resource] / J. Alex Halderman. – 2016. – Mode of access: https://medium.com/@jhalderm/want-to-know-if-the-election-was-hacked-look-at-the-ballots-c61a6113b0ba.

ternet (so-called hybrid new voting technology). DREs may also provide the electronic protocols which are formed automatically.

DRE systems may also provide a paper record for the voter in order to allow the latter to verify the vote cast. Usually such a paper receipt is called a voter verified paper audit trail (VVPAT).

In addition to the above, DREs are positively evaluated from the standpoint of securing the rights of vision-impaired voters, as far as this technology provides such voters no need to get any external assistance whether from other voter or polling station officials while casting the vote.

DREs with VVPATs are considered to have an advantage over DREs without VVPATs, because paper trails provide greater transparency to the voter, which can increase overall trust to the implemented technology. Meanwhile, DREs without VVPATs, do not provide sufficient means for voters to verify whether their votes have been accurately recorded and then counted. As to the National Democratic Institute's (NDI) evaluation, DREs with VVPAT provide the officials at the election commissions to audit the results or conduct a meaningful recount. However, DREs with VVPATs also introduce greater technological complexity into the process, which may result in greater challenges for members of local election commissions in terms of reliability of the machine, training for staff and sustainability of the overall system[1].

On the other hand, DREs can be confusing for voters who are not familiar or comfortable with modern information technologies. In this context it shall be noted that DREs which were recently implemented in Germany were seen to be not compliant with the constitutional principle of public nature of elections as far as examination of the results determination was not possible for an ordinary voter having no special background[2].

However, in some contexts, voters may benefit from a streamlined presentation of ballots on DREs in complicated voting systems – with or without VVPAT – where a paper ballot design may lead to a significant number of spoilt and invalid ballots. For instance, this was a case in Brazil, where many elections of different levels are performed simultaneously involving a significant number of parties taking part in the elections, lists of which shall remain open and require additional castings[3].

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[1] Common Electronic Voting and Counting Technologies [Electronic resource] // National Democratic Institute – Mode of access: https://www.ndi.org/e-voting-guide/common-electronic-voting-and-counting-technologies.

[2] Judgment of 03 March 2009 - 2 BvC 3/07 [Electronic resource] – Mode of access: https://www.bundesverfassungsgericht.de/SharedDocs/Entscheidungen/EN/2009/03/cs20090303_2bvc000307en.html.

[3] Mau A. E-Voting Case Law: a Comparative Analysis / A. Mau, B. Barrat., 2015. – 294 c.

In addition to DREs, the NDI also recognizes application of *electronic ballot printers*[1], which, in fact, are seen as a combination of DREs and the ballot scanners. Particularly, such electronic ballot printers are used in order to cast the vote (e.g., in case the paper ballots appear too complicated), however, they do not store vote data or count the votes automatically. Instead, they print out a paper receipt (a sort of VVPAT) or produce a token containing the vote choices. The voter then takes this receipt or token and places it into the ballot scanner or the traditional ballot box. Hence, like the DREs with a VVPAT, voters are able to verify their votes, either on a printed paper ballot or by inserting the ballot token into another machine. There is the re-count option of the paper receipt or token if the electronic results after using electronic ballot printers are challenged or audited. However, because they involve two separate machines, implementation of the said technology may entail higher costs, require greater IT capacity from members of local election commissions and encounter more challenges to ensure sustainability than other systems.

DRE voting machines started to be massively used in 1996 in Brazil, as well as deployed on a large scale in the US after 2000. DRE systems were also implemented in Europe, e.g. in the Netherlands, where the company NEDAP provided their own DRE machines since 1989[2].

Internet voting is the most flexible technology among the discussed ones, which allows voters to vote anywhere, in an unsupervised environment, using a computer or smartphone with access to the Internet. Votes are stored and aggregated electronically in a centralized location. The Internet is the primary voting channel currently in use in remote electronic voting systems.

Convenience, greater access and attraction of young people are the three key benefits when the move to Internet voting is being considered. In terms of access, Internet voting is perceived to provide access to specific populations that may have difficulty in voting at polling stations, e.g. persons with disabilities and eligible voters living outside a country or serving for the army forces.

Internet voting, by its nature, does not allow for a manual recount of votes. Internet voting systems, therefore, rely on computer security measures, certification and, ultimately, on a degree of trust in the system programmers and operators. Some Internet voting technologies also attempt to provide individual voters with the possibility to verify that their votes have

[1] Common Electronic Voting and Counting Technologies [Electronic resource] // National Democratic Institute – Mode of access: https://www.ndi.org/e-voting-guide/common-electronic-voting-and-counting-technologies.

[2] E-Voting [Electronic resource] // The Electoral Knowledge Network – Mode of access: http://aceproject.org/ace-en/focus/e-voting/types-of-e-voting.

been recorded as cast. Additional measures shall be applied with respect to the secrecy of the votes casted via Internet (e.g., multiple voting is authorized in Estonia because of this reason).

So far, Internet voting has been experienced in Austria, Australia, Canada, Estonia, France, Japan and Switzerland[1].

The hybrid forms of new voting technologies combine the supervised environment of the polling station with the centralized recording and counting of Internet voting. In these systems, voters must cast their vote on a computer in a polling station and the votes are then transmitted electronically to a central server. Example of such hybrid forms are DREs (whether with VVPAT or not), which transmit the casted votes via Internet directly to the central server.

Moreover, hybrid forms of new technologies are advised to use when the electronic voting and counting technologies are still pilot so that voters not familiar with new electronic systems could case their electronic vote in the supervised environment and in case of necessity to receive the explanations from officials at the local election commissions.

Provided the above, it is necessary to note that the current trend in e-voting technology deployment is implementation of any types of electronic devices with the respective software along with some form of paper trail (for instance, while using optical ballot scanners or VVPAT in DREs). In some cases, electronic voting is provided as an alternative voting channel available to all or to only some voters; in other cases, new voting technologies are used exclusively in certain geographical areas, typically for citizen abroad, while paper ballots are used in others.

On a separate note, it shall be highlighted that the respective legal framework enabling implementation of electronic voting and counting technologies shall be developed in a way permitting the use of such devices in the Basic Electoral Law, but specifying the technical requirement pursuant to such tools on the by-law level, which is easier to amend and update.

Also, notwithstanding the type of technology to be used in case of e-voting implementation, the parallel traditional paper-based voting shall be provided to voters for a number of first elections following such implementation.

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[1] E-Voting [Electronic resource] // The Electoral Knowledge Network – Mode of access: http://aceproject.org/ace-en/focus/e-voting/types-of-e-voting.