



Electronic Voting in Belgium: Past and Future

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Slides available from <http://godot.be/slides>

Outline

- Requirements for (Belgian) Voting Systems
- Current and Future eVoting Systems
- Interesting things to know
- Conceptual view on voting systems
- Classic eVoting
- Requirements for Belgian elections
- Organizing elections

Classic Electronic Voting...

- Introduced in 1991, pilots in 1994, large scale deployment in 1999, currently 44% coverage
- Standalone voting computers – not networked
 - Impossible to cast invalid vote – only valid or blank
 - Open-source software
- Voter uses light pen to select candidates
- Voting ballot encoded on magnetic stripe card
 - Ballot secrecy & integrity through cryptography

Interesting Things to Know (ITK) 😊

- Voting is mandatory in Belgium
- Different voting channels
 - Belgian citizens abroad
 - Postal vote, paper ballot
 - Voting booth in polling stations
 - Vote by proxy in polling stations
 - Belgians and other citizens in Belgium
 - Paper voting ballot
 - Voting booth for Belgian citizens in polling station
 - Vote by proxy in polling station
 - Online/Internet
- Ballot types
 - Paper ballots
 - Counted manually or automatically
 - Electronic ballots
 - Cast in voting booth
 - Cast online

Interesting Things to Know (ITK) 😊

- Voting is mandatory in Belgium
 - Everyone strictly older than 17 **must** go to the polling station
 - Sanctions & Fines with respect to ignored voting duty:
 - Police court rules, no appeal possible
 - First offender: 50 Euro
 - Second offense for same election type: 125 Euro
 - 4 offenses in less than 15 years: 10 years revocation of
 - Voting rights
 - Right to become a new civil servant
 - Possibility to get a promotion or distinction as a civil servant
- 7 Election types → 7 Paper ballot forms 😊
 - European, Federal (Chamber + Senate), Provincial, Regional, Communal, Local Council

Requirements for (Belgian) Voting Systems

- Universal
 - Everybody can cast a vote
- Equal
 - Everybody has just one vote
- Freedom
 - Everybody can cast his/her vote of his/her choice
- Secrecy
 - Only the voter knows who he has voted for
- Transparency
 - All procedures are simple, publicly available and known
- Verifiability
 - Voting and counting systems are verifiable

Mechanisms to Cast a Vote

- Uncontrolled environment
 - Pencil + paper
 - Postal vote
 - Electronically
 - Internet voting
- Controlled environment
 - Pencil + paper
 - Voting booths
 - Electronically
 - Offline voting machines
 - Networked voting machines

Comparing (e)Voting Systems

- Paper + Pencil
- Current System (Magnetic Stripe Cards)
- Improved Paper-based Voting

Paper + Pencil

- Cheap
- Simple
 - Everybody understands how it works
 - Not everybody understand potential problems...
- Invalid votes
- Unclear voting ballot marks
- Physical traces on paper: finger prints, scratches, stains,...
- In practice
 - Size of voting ballot in some cantons
 - Preparation, printing and distribution of ballots
 - Counting is cumbersome and slow

Classic Electronic Voting Booth



Observations wrt the Magnetic Stripe Cards System

- How to convince a voter that the magnetic stripe card corresponds with the voter's choice?
 - Voting computer may have stored a different ballot
- How to convince a voter that his/her vote is read from the magnetic stripe?
 - Voting urn may have overwritten the magnetic stripe

Organizational and procedural measures
neutralize these potential issues

Key Arguments to Introduce New System

- Hardware of “current” system is outdated
 - Supply issues
- Countering issues with magnetic stripe cards
- Dependable and verifiable marking of candidates
 - Voter can verify voting ballot
- Secure transport of voting ballots
 - Protection against eavesdropping and modification of ballot storage and transmission
- Counting votes: accurate and fast
 - No need for manual counting
 - Support for recounting
 - Manual audit

Future eVoting Booth Components 😊



printer



Bernde Election	Chamber Election	Kantons Election	Provincie Election	Region Election	Local Election
Control Code	Control Code	Control Code	Control Code	Control Code	Control Code
1 First Name	11 First Name	21 First Name	31 First Name	41 First Name	51 First Name
2 Second Name	12 Second Name	22 Second Name	32 Second Name	42 Second Name	52 Second Name
3 Third Name	13 Third Name	23 Third Name	33 Third Name	43 Third Name	53 Third Name
4 First Name	14 First Name	24 First Name	34 First Name	44 First Name	54 First Name
5 First Name	15 First Name	25 First Name	35 First Name	45 First Name	55 First Name
6 First Name	16 First Name	26 First Name	36 First Name	46 First Name	56 First Name
7 First Name	17 First Name	27 First Name	37 First Name	47 First Name	57 First Name
8 First Name	18 First Name	28 First Name	38 First Name	48 First Name	58 First Name
9 First Name	19 First Name	29 First Name	39 First Name	49 First Name	59 First Name
10 First Name	20 First Name	30 First Name	40 First Name	50 First Name	60 First Name
11 First Name	21 First Name	31 First Name	41 First Name	51 First Name	61 First Name
12 First Name	22 First Name	32 First Name	42 First Name	52 First Name	62 First Name
13 First Name	23 First Name	33 First Name	43 First Name	53 First Name	63 First Name
14 First Name	24 First Name	34 First Name	44 First Name	54 First Name	64 First Name
15 First Name	25 First Name	35 First Name	45 First Name	55 First Name	65 First Name
16 First Name	26 First Name	36 First Name	46 First Name	56 First Name	66 First Name
17 First Name	27 First Name	37 First Name	47 First Name	57 First Name	67 First Name
18 First Name	28 First Name	38 First Name	48 First Name	58 First Name	68 First Name
19 First Name	29 First Name	39 First Name	49 First Name	59 First Name	69 First Name
20 First Name	30 First Name	40 First Name	50 First Name	60 First Name	70 First Name

Check and hold up ballot



chip card reader

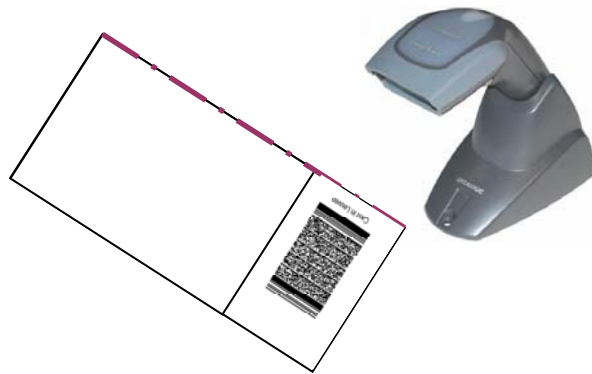


optional interface for visually challenged

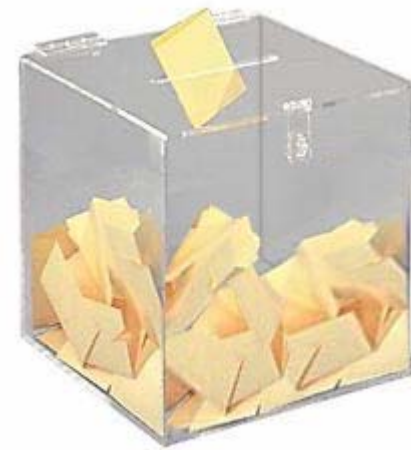


mini PC

Future Voting Office's Equipment



Ballot Verifier



Ballot Box

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Voter's Secrecy

- Belgian election system is 'vulnerable' to pattern-based voting
 - Avoid manual processing of ballots
- Voter's fingerprints or marks on paper based ballots
- Cameras in mobile phones, cf. vote selling
- Miniaturized cameras in voting office or booth
- Electromagnetic radiation (TEMPEST)
 - Perfect protection is complicated and expensive
 - Adequate protection is feasible

ITK – Representation of a Voting Ballot

- Candidates are numbered
- Large voting ballot is represented electronically in two-layered menus:
 - Party Menu
 - Voter selects his/her party
 - Candidates Menu per party
 - Number of candidates determines the number of columns
 - Voter selects candidates or list

ITK – Casting a Valid Vote

- Number of elected seats equals number of List votes + number of votes of main candidates + number of votes of successors
- Number of list votes influences the number of elected candidates per list
- A ballot is rendered invalid if a voter ticks candidates of more than one list

The diagram shows a vertical ballot interface. At the top is a large white circle on a black square background. Below it is a list of 13 rows, each with a white circle on a black square background followed by a cyan rectangular box. The boxes contain the numbers 1., 2., 3., ..., a blank space, ..., 25., 26., 27., 28., and 29. from top to bottom.

Voter can tick List Vote

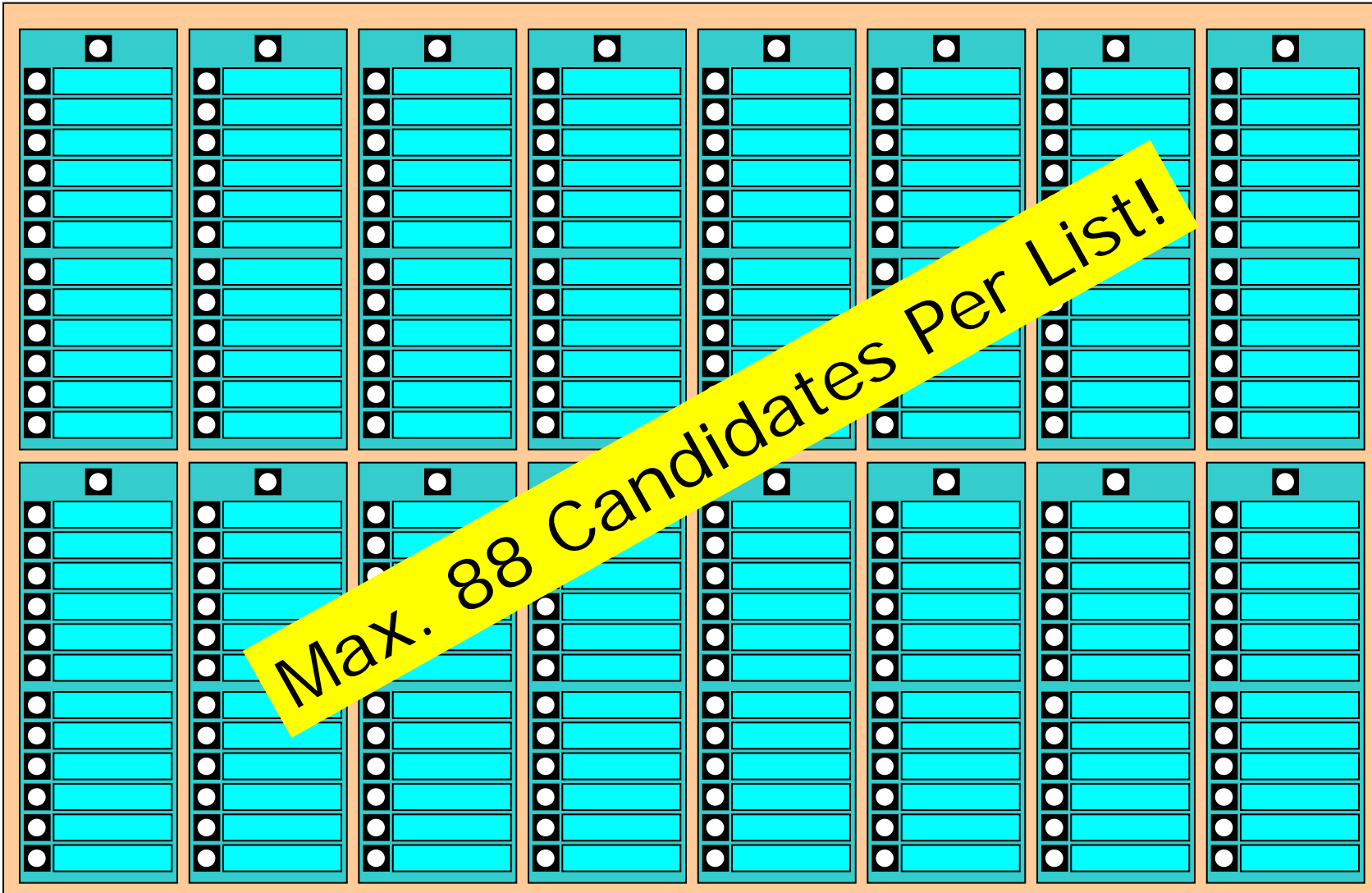
Voter can also tick any number of main candidates

Voter can also tick any number of successors

1 Voting Ballot per Election (Chamber, Senate, Regional, European Parliament,...)

Easily 1 meter

Easily 0.5 meter



Max. 88 Candidates Per List!

Electronic Representation of a Voting Ballot

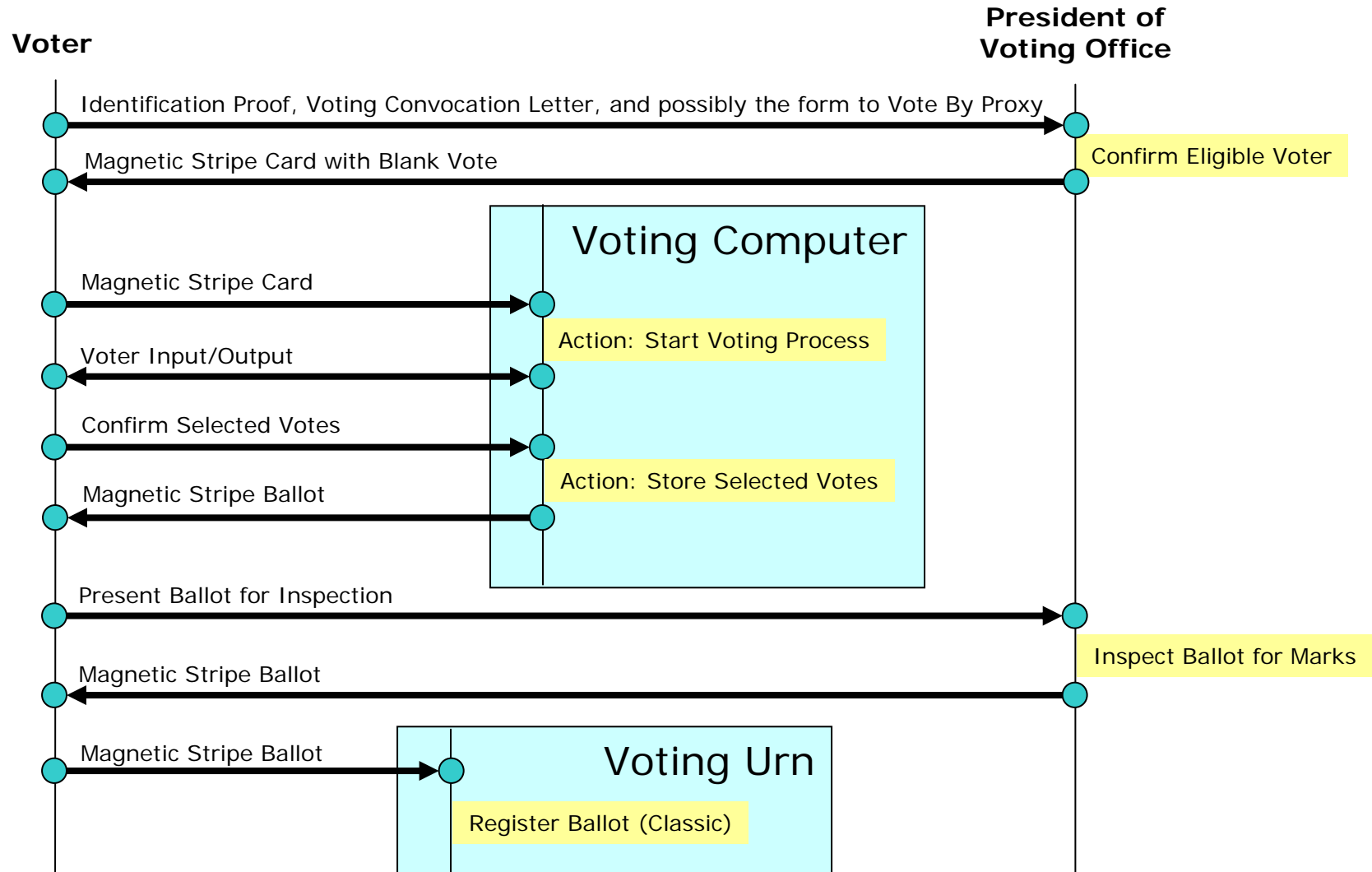
- Candidates are numbered
- Large voting ballot is represented electronically in two menus:
 - Party menu
 - Voter selects his/her party
 - Candidates Menu per party
 - Number of candidates determines the number of columns
 - Voter selects candidates or list
- Note:
 - It is impossible to cast an invalid electronic voting ballot
 - Voter can vote blank by choosing the “Blank party”

Voting in Practice – Voters cast their vote at a Polling Place

Facts:

1. Voters living in a municipality cast their vote in a voting office
2. Each voting office has a list with eligible voters
3. Each voting office has one voting urn to collect completed voting ballots
4. A voting ballot consists either of a paper ballot or of a magnetic stripe card
5. Election period = 1 Sunday, starting at 9.00
 1. Offices using paper ballots close at 13.00
 2. Offices using magnetic stripe cards close at 15.00

Voting Procedure – Magnetic Stripe Ballots



Voting in Practice – Voters cast their Magnetic Stripe Ballot at a Polling Place

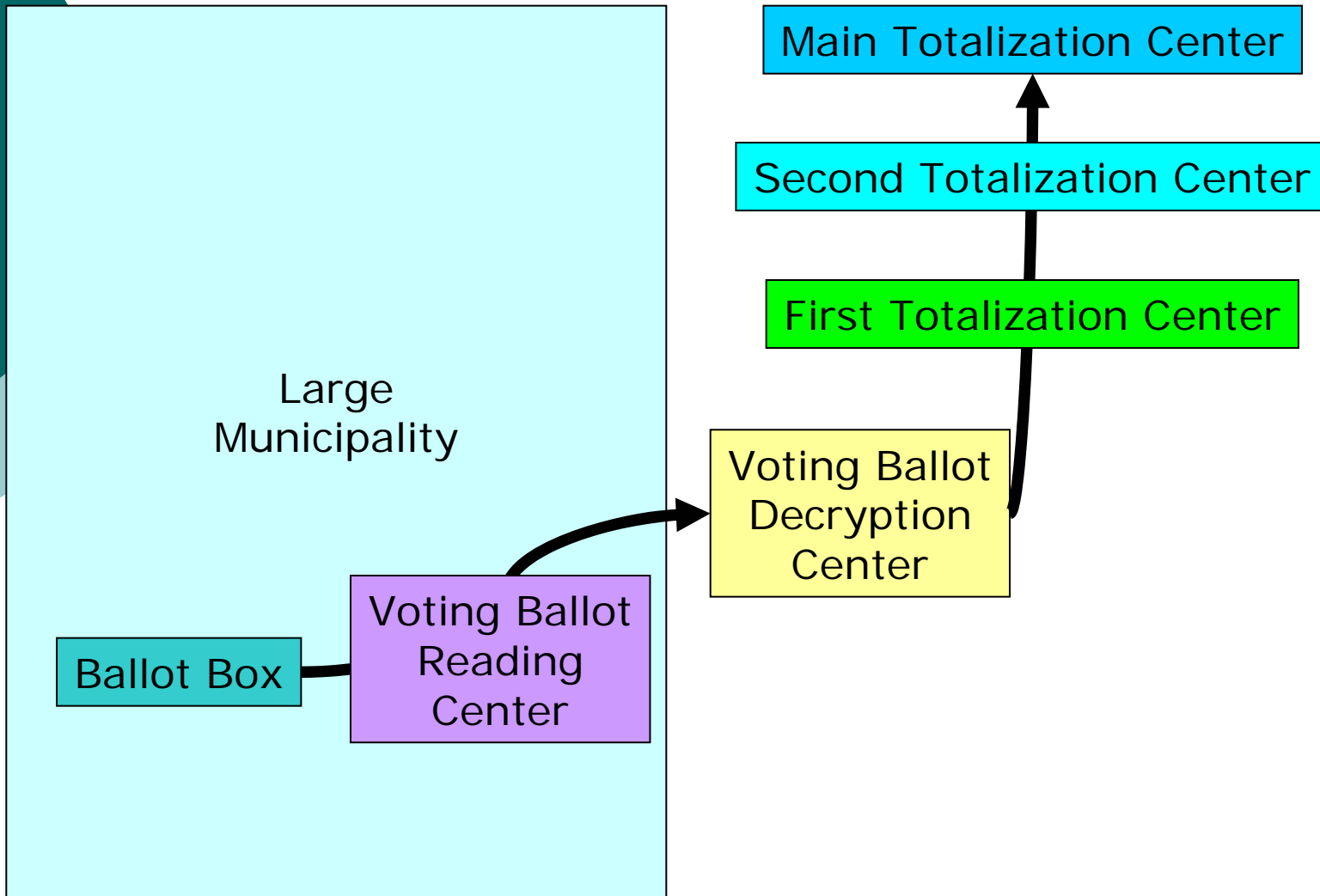
Procedure:

1. Voting officials seal an empty voting urn before first voter arrives
2. Administration broadcasts invitation cards by paper mail to all Belgian citizens who are 18 or older on the Election Day
3. Voter hands over the identity card and invitation card to the voting officials
 - Officials verify identity of the voter
 - Officials check whether the voter is listed on their list with eligible voters
4. Voter receives voting ballot or magnetic stripe card from voting officials
5. Voter casts his/her vote in the voting booth
 - If voter makes a mistake, the president of the voting office may decide to give the voter a second chance
6. Voting official verifies whether the voter did not put a mark on the ballot or magnetic stripe card
 - Marked ballots are invalid
7. Voter inserts the ballot or magnetic stripe card in the voting urn
8. Voting officials stamp the invitation letter to confirm that the voter completed his/her duty
9. Voting officials return identity card and invitation card to voter

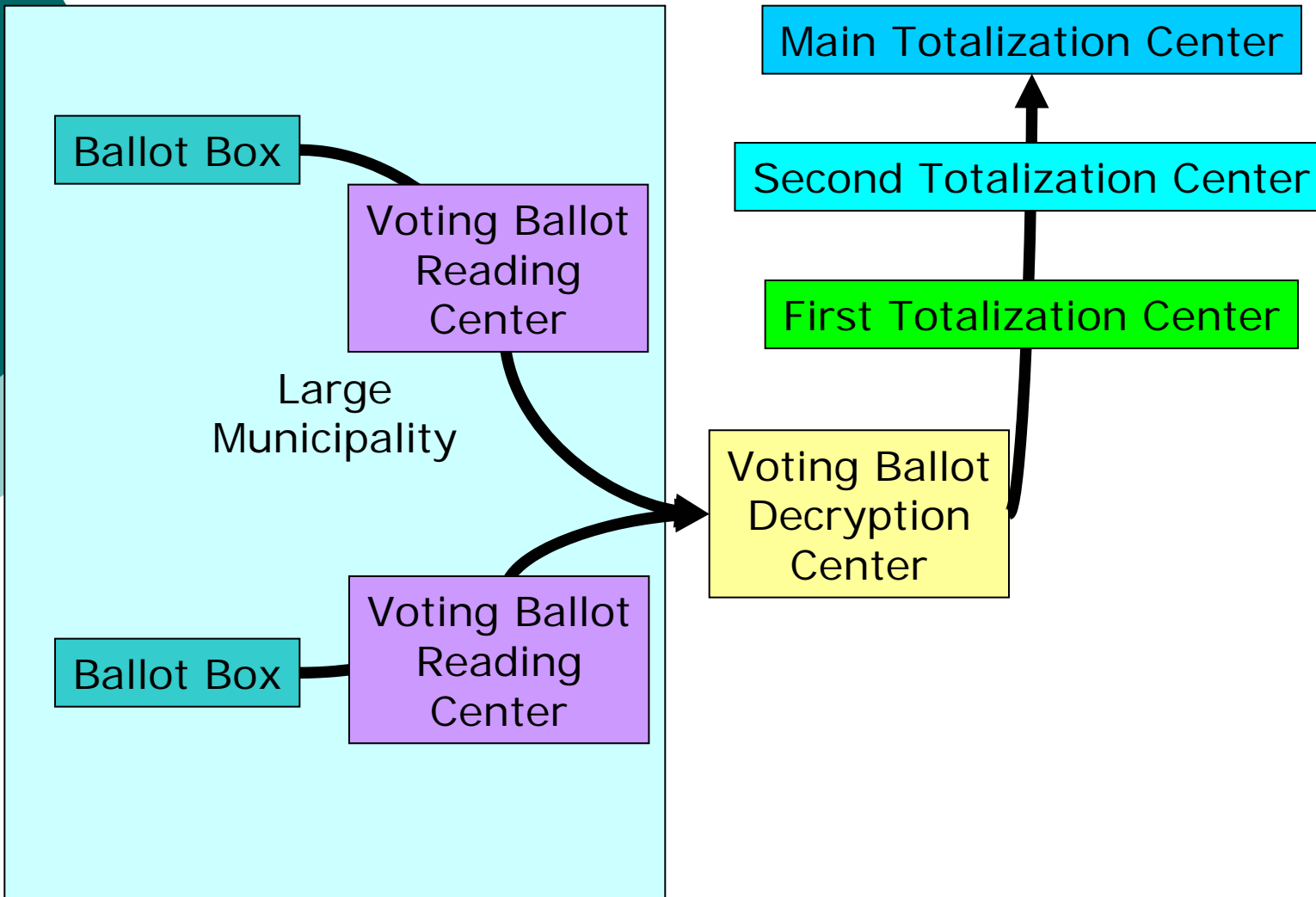
Counting the Magnetic Stripe Ballots

- Paper ballots
 - Seal of the voting urn is removed at the end of the Election Day, e.g., around 14.00
 - Talliers keep tallying at voting office-level until they count twice the same result
- Magnetic stripe cards
 - Voting urn reads magnetic stripe card ballot immediately
 - PC controlling voting urn keeps the score on a floppy
 - All floppies of voting offices are aggregated per municipality at the end of the Election Day
 - Seal of the voting urn with magnetic stripe cards is only removed when recounting is necessary

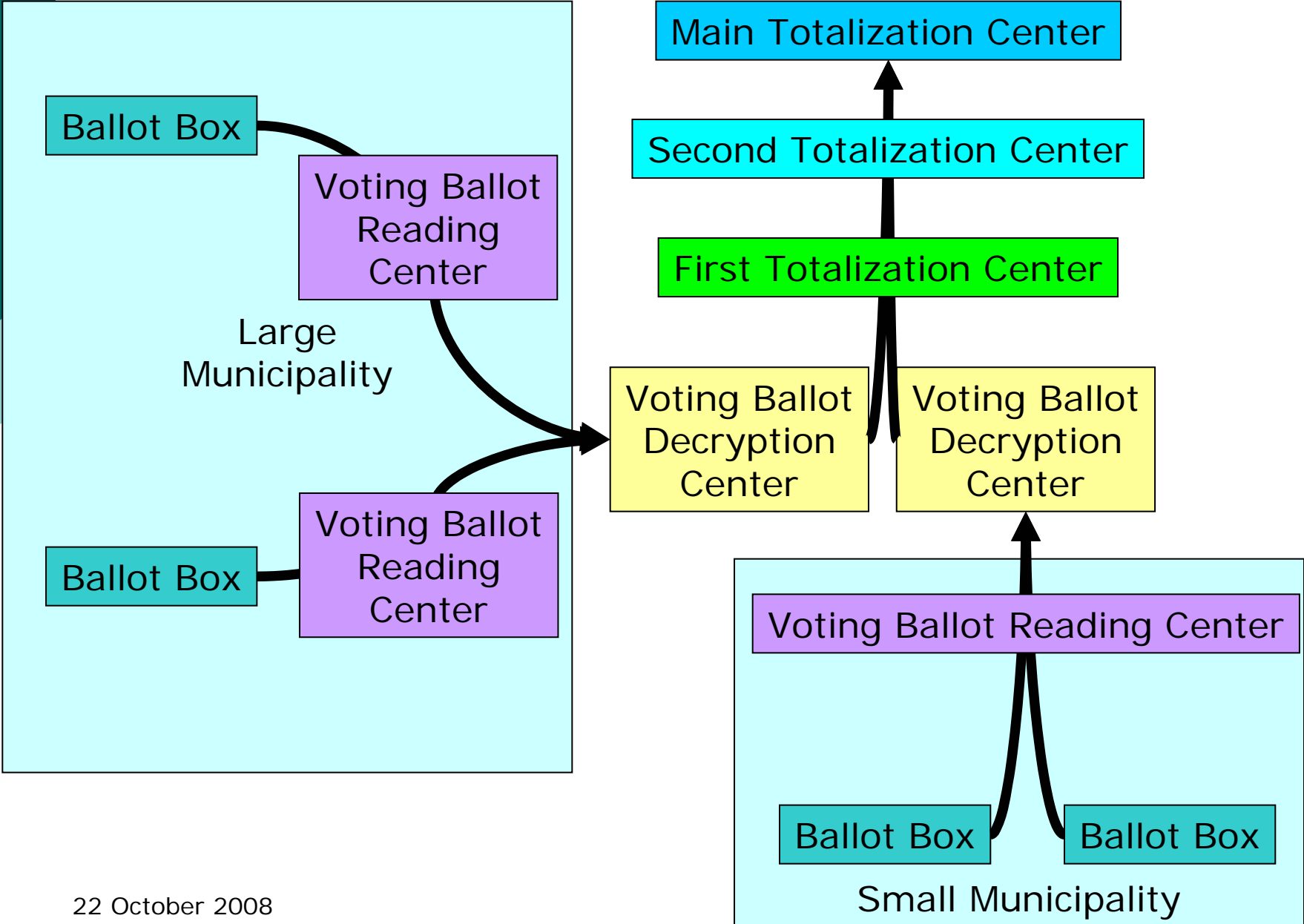
Counting New Voting Ballots



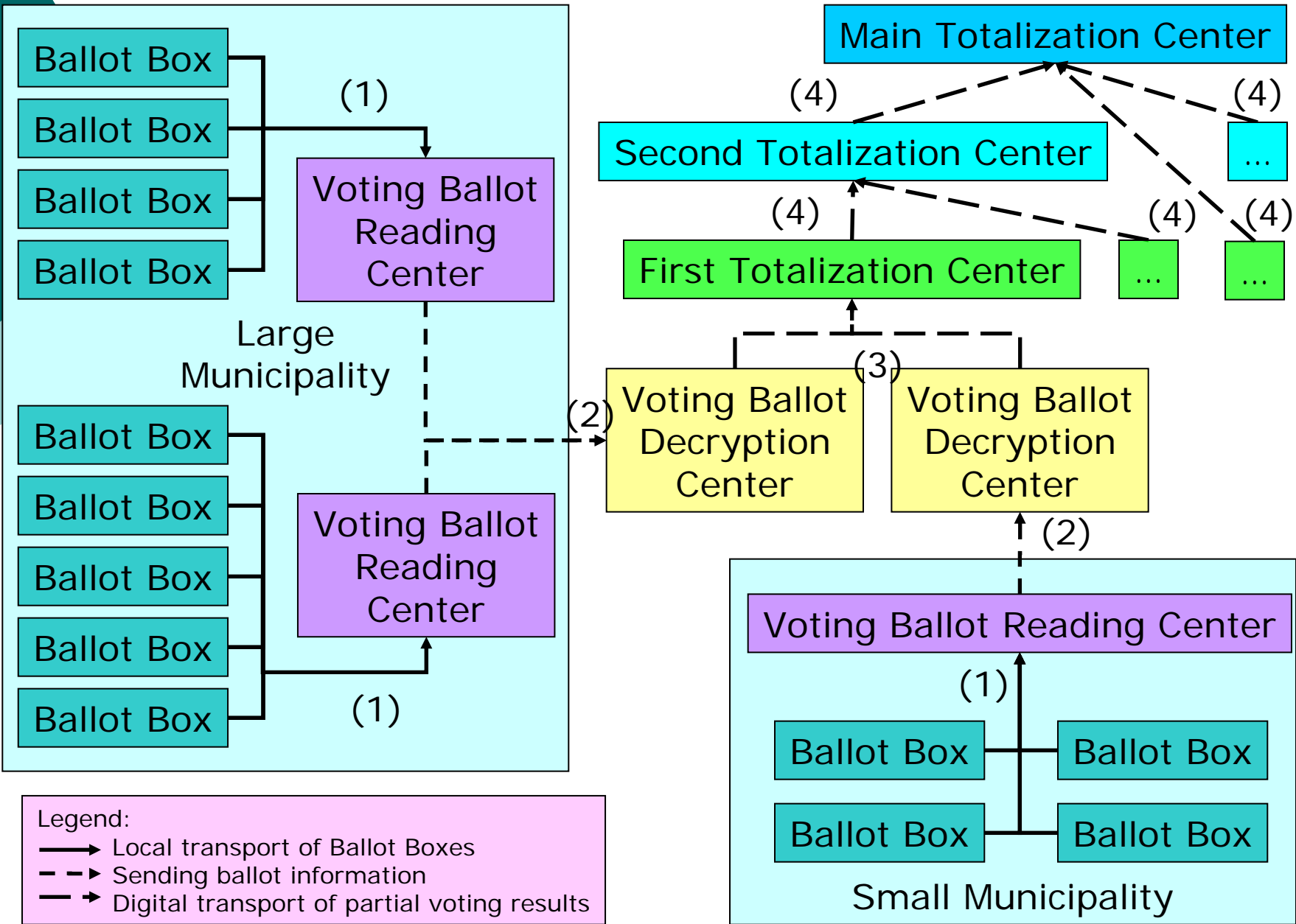
Counting New Voting Ballots



Counting New Voting Ballots



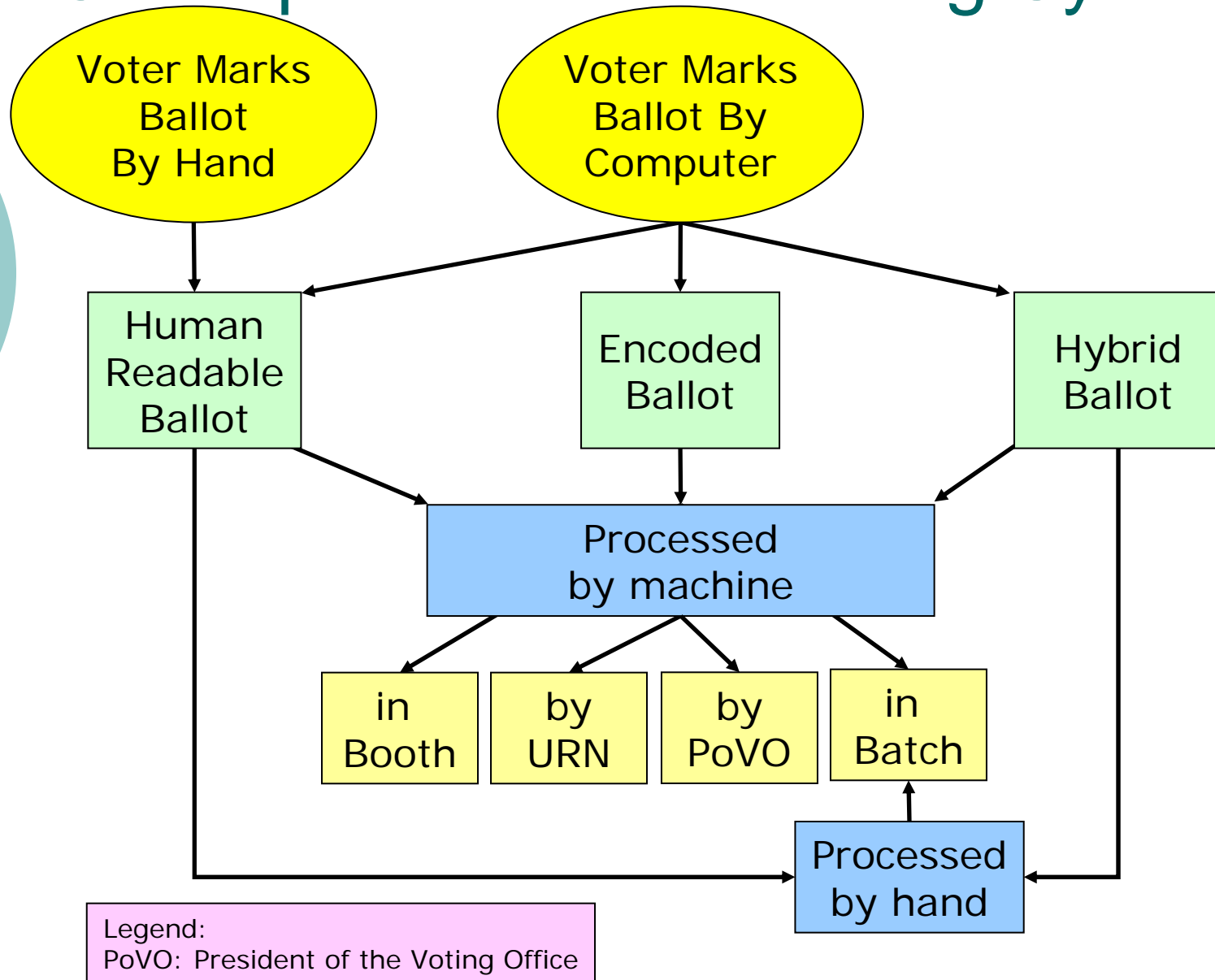
Counting New Voting Ballots



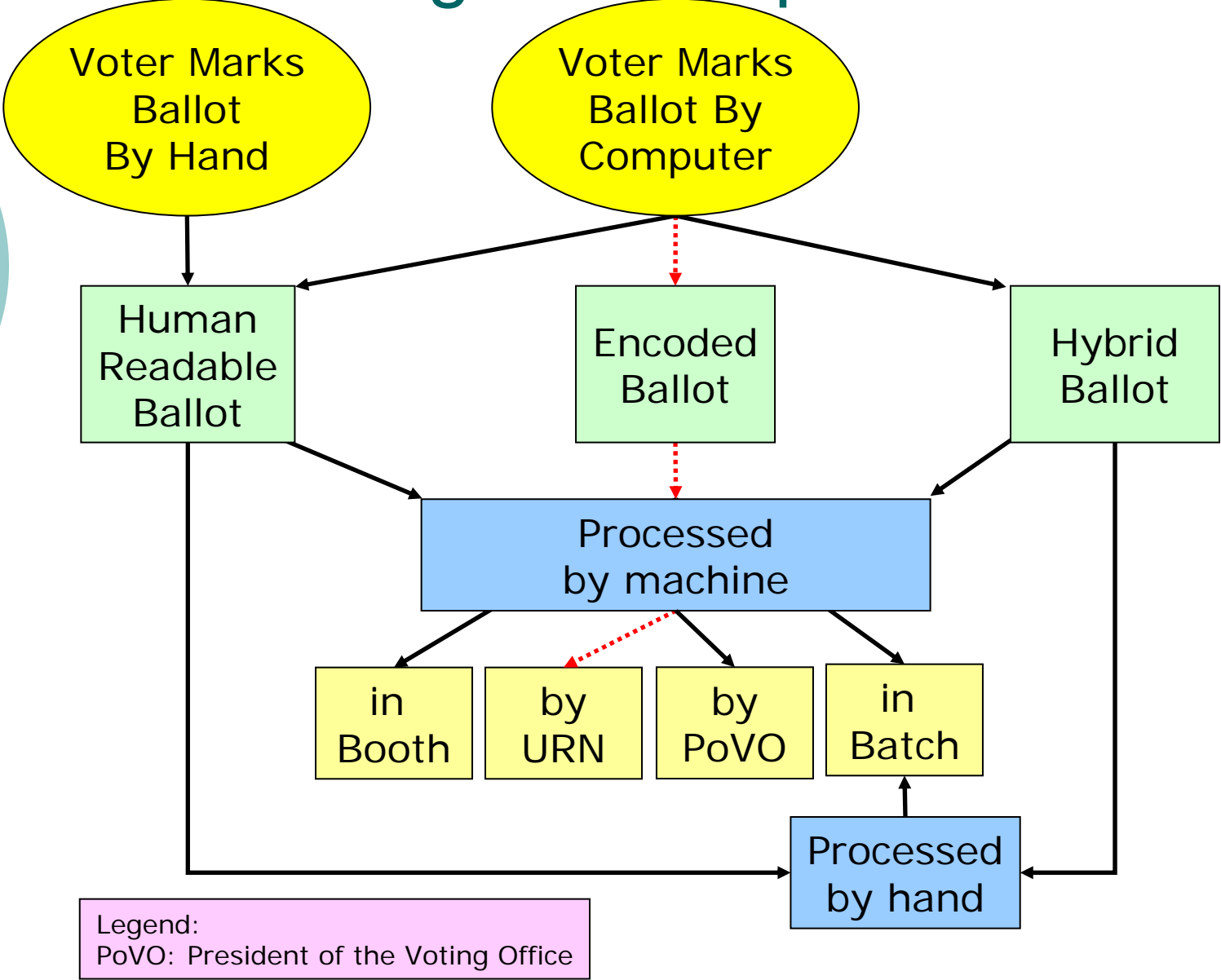
Processing Election Results

- If a candidate dies before the Election Day
 - The deceased is treated as if he/she never existed
 - Votes for the deceased are taken into account to determine the number of voters for the candidate's list
- If a candidate dies on the Election Day or after the Election Day but before the official announcement of the Election Result
 - The deceased may be elected, but the first successor takes his seat
- If a candidate dies after the official announcement of the Election Result
 - The deceased is replaced by the first successor
- If a candidate dies after closing the candidate list but before printing the paper ballots
 - The list does not include the name of the deceased

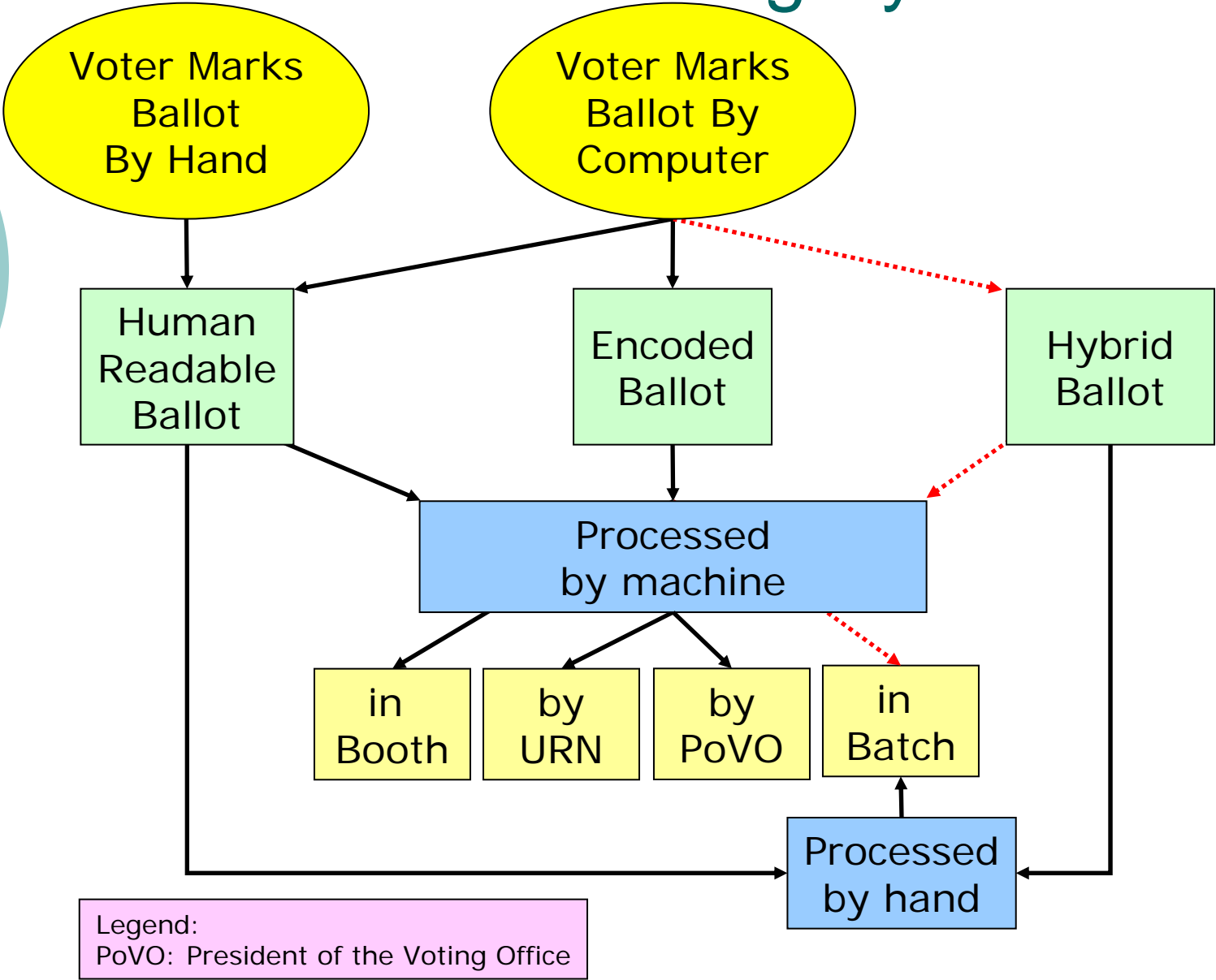
Conceptual View on Voting Systems



Classic Magnetic Stripe Card Voting



New Electronic Voting System



Questions?

- Email:

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- Homepage:

- <http://godot.be>

- Slides:

- <http://godot.be/slides>

Requirements for Belgian eVoting Systems

- Be combinable with classic paper voting system
- Be usable in the Belgian context
 - Cf. 7 election types, complex ballots...
- Not too expensive
- Available at all times
- Modular & flexible
 - Different voting systems may be used in one canton
 - Installable in voting offices and voting booths
- Customizable
 - List of elections, candidates & parties varies per election
- Easy to verify
 - Correct casting of votes, 1 voter = 1 ballot
 - Correct counting of votes
 - Secrecy of the vote
- Encourage the automated processing of votes
 - Automated casting of votes is less important
- Be very easy to use (user friendliness, simple,...)
- Be very accessible/attractive to
 - Non-computer literate people, elderly, disabled people,...

Operational Aspects

- D-80: Preparation of lists with eligible voters
- D-40: Independent experts can start auditing the Election procedure
- D-33: Publication of banned acronyms in Belgian Gazette
- D-30: Lottery to rank parties on voting ballots
- D-26: Publication of parties and their numbers in Belgian Gazette
- D-28: Deadline to submit election candidates
- D-24: Fixing lists with election candidates
- D-15: Publishing names of election witnesses, Mail broadcast of election convocation letters
- D-12: Appointing presidents and assistants of voting offices
- D-10: Mail broadcast of lists with eligible voters per voting office
- D- 5: Appointing election witnesses of voting & counting offices
- D- 3: Deadline of voting computer boot floppy delivery to president of cantonal headquarters
- D- 1: President of voting office receives voting ballots, distribution of computer boot floppies to presidents of voting offices
- D : Election day, processing voting ballots after closing election period
- D+15: End of the audit possibility of independent experts
- D+45: Publication of election results
- D+75: Finalization of election-related expenses

Voting Booth + Barcode voting ballots

2. use touch screen to mark candidates

3. print voting ballot

touch screen with inductive pen

1. use chip card to activate voting computer



mini PC



chip card reader



optional interface for visually challenged

Barde Election	Chandler Election	Karlsruhe Election	Pasadena Election	Regina Election	Local Election
Candidate Name	Candidate Name	Candidate Name	Candidate Name	Candidate Name	Candidate Name
1. First Name	11. First Name	21. First Name	31. First Name	41. First Name	51. First Name
2. Second Name	12. Second Name	22. Second Name	32. Second Name	42. Second Name	52. Second Name
3. Third Name	13. Third Name	23. Third Name	33. Third Name	43. Third Name	53. Third Name
4. Fourth Name	14. Fourth Name	24. Fourth Name	34. Fourth Name	44. Fourth Name	54. Fourth Name
5. Fifth Name	15. Fifth Name	25. Fifth Name	35. Fifth Name	45. Fifth Name	55. Fifth Name
6. Sixth Name	16. Sixth Name	26. Sixth Name	36. Sixth Name	46. Sixth Name	56. Sixth Name
7. Seventh Name	17. Seventh Name	27. Seventh Name	37. Seventh Name	47. Seventh Name	57. Seventh Name
8. Eighth Name	18. Eighth Name	28. Eighth Name	38. Eighth Name	48. Eighth Name	58. Eighth Name
9. Ninth Name	19. Ninth Name	29. Ninth Name	39. Ninth Name	49. Ninth Name	59. Ninth Name
10. Tenth Name	20. Tenth Name	30. Tenth Name	40. Tenth Name	50. Tenth Name	60. Tenth Name
11. Eleventh Name	31. Eleventh Name	41. Eleventh Name	51. Eleventh Name	61. Eleventh Name	71. Eleventh Name
12. Twelfth Name	32. Twelfth Name	42. Twelfth Name	52. Twelfth Name	62. Twelfth Name	72. Twelfth Name
13. Thirteenth Name	33. Thirteenth Name	43. Thirteenth Name	53. Thirteenth Name	63. Thirteenth Name	73. Thirteenth Name
14. Fourteenth Name	34. Fourteenth Name	44. Fourteenth Name	54. Fourteenth Name	64. Fourteenth Name	74. Fourteenth Name
15. Fifteenth Name	35. Fifteenth Name	45. Fifteenth Name	55. Fifteenth Name	65. Fifteenth Name	75. Fifteenth Name
16. Sixteenth Name	36. Sixteenth Name	46. Sixteenth Name	56. Sixteenth Name	66. Sixteenth Name	76. Sixteenth Name
17. Seventeenth Name	37. Seventeenth Name	47. Seventeenth Name	57. Seventeenth Name	67. Seventeenth Name	77. Seventeenth Name
18. Eighteenth Name	38. Eighteenth Name	48. Eighteenth Name	58. Eighteenth Name	68. Eighteenth Name	78. Eighteenth Name
19. Nineteenth Name	39. Nineteenth Name	49. Nineteenth Name	59. Nineteenth Name	69. Nineteenth Name	79. Nineteenth Name
20. Twentieth Name	40. Twentieth Name	50. Twentieth Name	60. Twentieth Name	70. Twentieth Name	80. Twentieth Name