



**BIST DU SICHER, DASS DEINE STIMME  
RICHTIG GEZÄHLT WIRD?**

# Can we trust internet voting?

## Internet voting in Norway

**Henrik Nore**

*The Ministry of Local Government  
and modernization*

ONPE-OAS Lima



## Henrik Nore Project Manager

### **1983-2008**

ICT and management consultant  
1983-2008

### **2008-**

Employed in Election management  
body (EMB) within the Norwegian  
Ministry of local Government and  
modernization.

Responsible for acquisition,  
implementation and operation of new  
fully integrated election system in  
Norway.



## Facts on voting in Norway

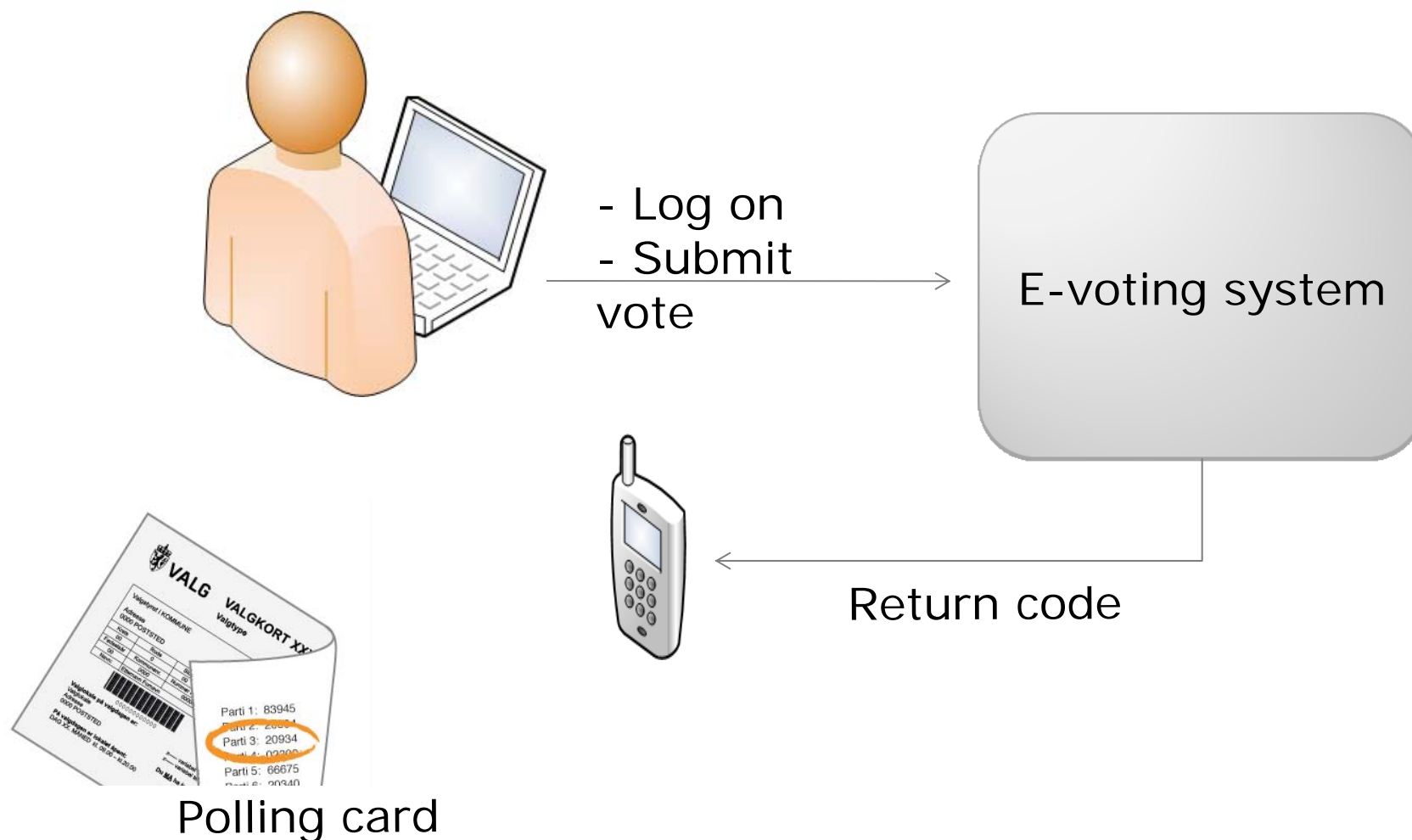
- 3.600.000 in electoral roll
- 78,2% turnout in 2013 parliament election
- Election period 4 years
- Complex ballot (A preferential list system where voters can choose one or more candidates across multiple lists.)
- 25 days advance voting period (Internet and paper)
- Voters can cast multiple electronic votes, and cancel them by voting on paper (both in advance and on election day)

# What do we use of NVT in Norway?

<b>Medium</b>	<b>Use in an Controlled Environment</b>	<b>Use in an Uncontrolled Environment</b>	<b>Use in Mixed Environments</b>
Voting with paper ballots	Voting with paper ballots in polling stations ✓	Postal voting ✓	Mobile ballot box voting ✓
Voting with NVT	<b>Direct recording electronic (DRE) voting systems</b> In 2015 (no VVPT) ✓	<b>Internet voting</b> ✓	<b>Hybrid NVT:</b> DRE systems using Internet voting technology
Paper ballots and electronic counting	<b>Ballot scanner</b> ✓		Centrally counted postal votes using <b>ballot scanners</b> ✓

Table 1: Forms of Voting in the OSCE Area

# A quick overview of the solution



# Evote project timeline

2005: Feasibility study

2007: Parliament approval

2008: Project starts

2010: Internet voting tested in 10 referenda

## **2011: Local and regional election**

Internet pilot in 10 municipalities

168.000 eligible voters (4,5% of population)

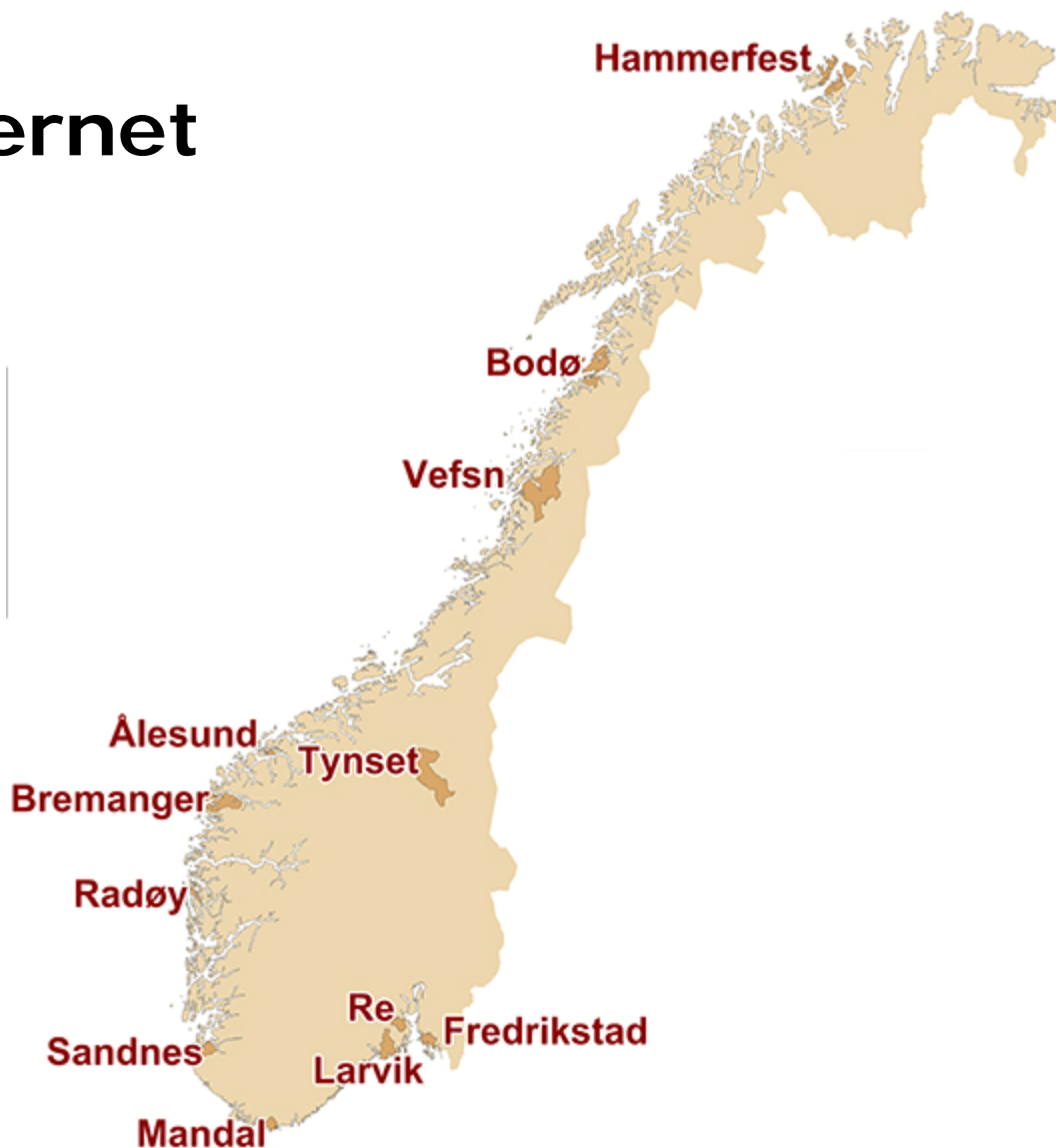
## **2013: Parliament election**

Internet pilot in 12 municipalities

250.000 eligible voters (7%)

# Participating municipalities in the 2013 Internet voting pilot

Electorate 250.000  
(7% of population)





VALG

# Changes to the EMB's role in Norway

- **Previously** all election ICTs used in Norway were provided by private vendors
- **From 2013** All 428 municipalities in Norway used election ICT systems owned and operated by the EMB
- **Previously** the EMB was only responsible for the legal framework for elections
- **From 2013** the EMB is also responsible for implementation, operations and maintenance of the all election ICT systems used in Norway



**Internet voting:**

**A solution in search  
of a problem?**

# Why introduce electronic voting

- A decade of international experience has shown us that electronic voting does not affect turnout in any way
- Internet voting makes it possible to vote remotely for groups, who for various reasons find it hard to access polling stations
  - ex-pats
  - Disabled
- A quick and *correct* count
- Reduce cost



# Why vote on paper?





## You may think paper is perfect...

- Mistakes are made in counting and reporting
- Interpreting voter intent is not always straightforward
- Mailed Paper votes gets lost
  - 5% of votes mailed from outside of your municipality on last day of advance voting where lost
  - 4% of mailed votes from abroad arrived to late
  - **In comparison, exactly zero e-votes were lost**



## Premises for the Norwegian solution

- Voting from standard computers – no extra equipment needed
- Use of existing authentication infrastructure (IDporten)
- A government owned and operated system
- Full transparency of process and solution

## Why is Internet voting possible in Norway? (2)

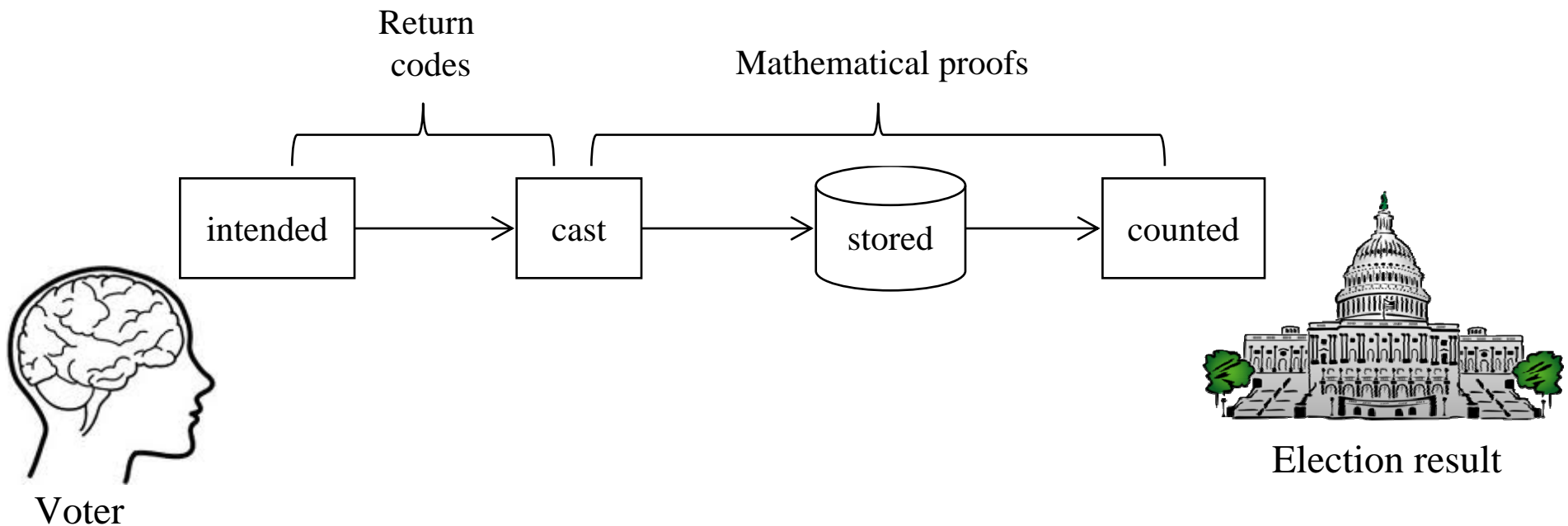
- Economical and academic resources to implement a secure Internet voting solution
- Widely available strong authentication mechanisms
- 98% have access to Internet from home
- Public services are commonly available online

# Why is Internet voting possible in Norway? (1)

- Legislation for piloting different voting methods is in place
- Very high trust in central election administration and elections in general
- Relatively low level of political conflict
- No history of electoral fraud

# The promise of verifiable e-voting

- Mathematical certainty that a submitted vote will be counted correctly





# Why verifiability?

- Return codes makes attacks on voter pc's detectable
  - and voters appreciate feedback that the vote was successfully cast
- Verifiability builds trust among stakeholders
  - Academia will never trust a non-verifiable electronic voting system!
- Mathematical proofs of correct counting gives the EMB confidence that the system is working correctly



## So how did it go?

2011: 28001 voters logged on and voted

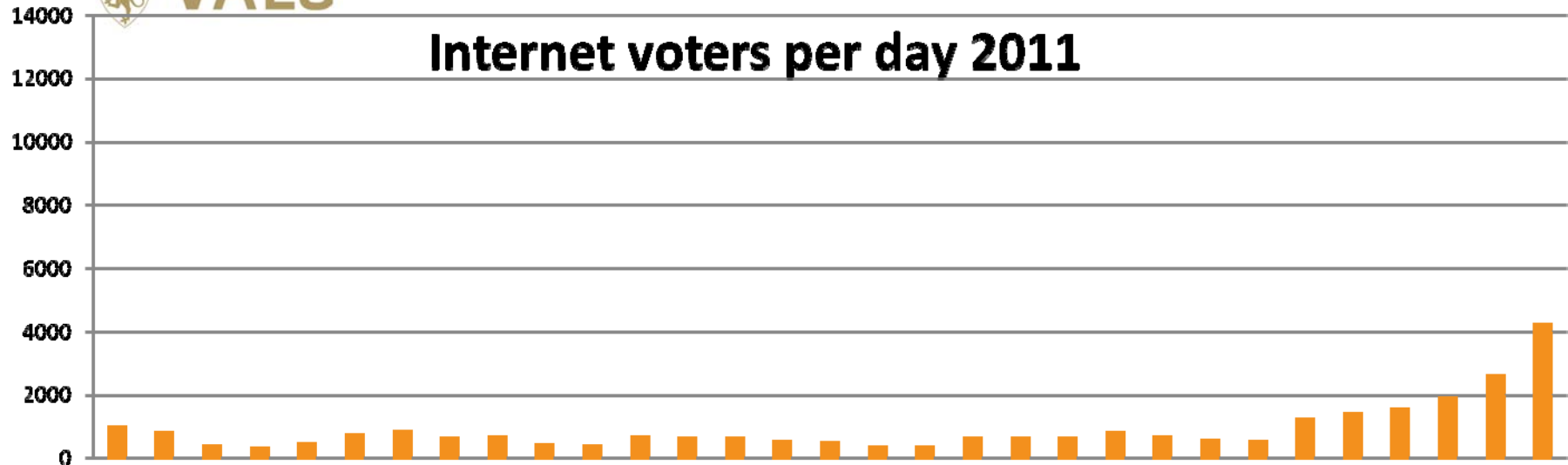
- 73% of advance votes were cast over the Internet
- 16% of total votes

2013: 70622 voters logged on and voted

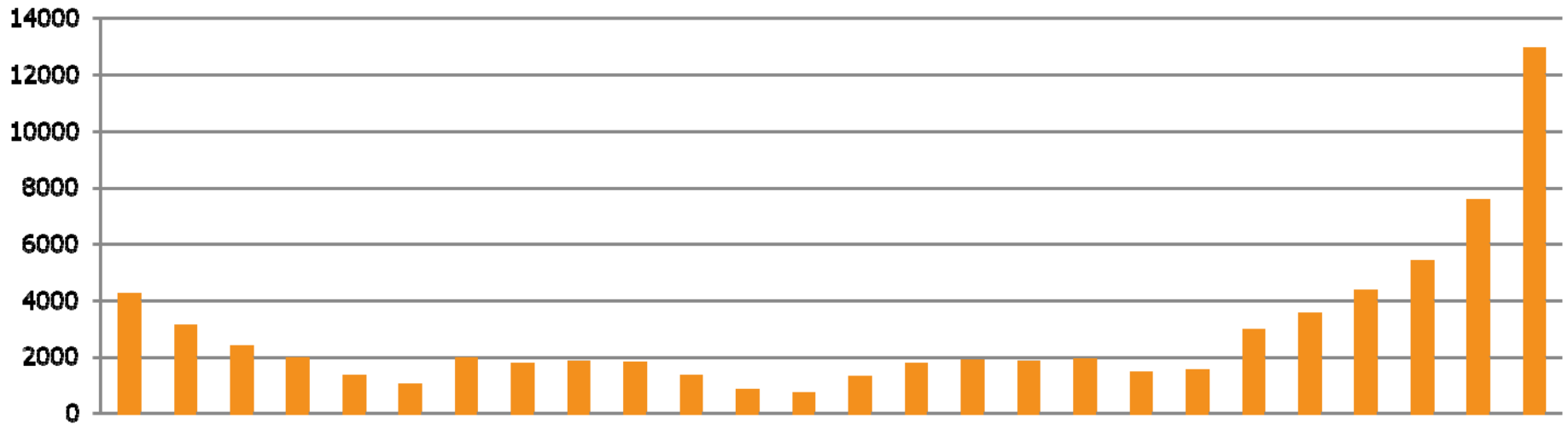
- 76% of advance votes cast over the Internet
- 28% of total votes



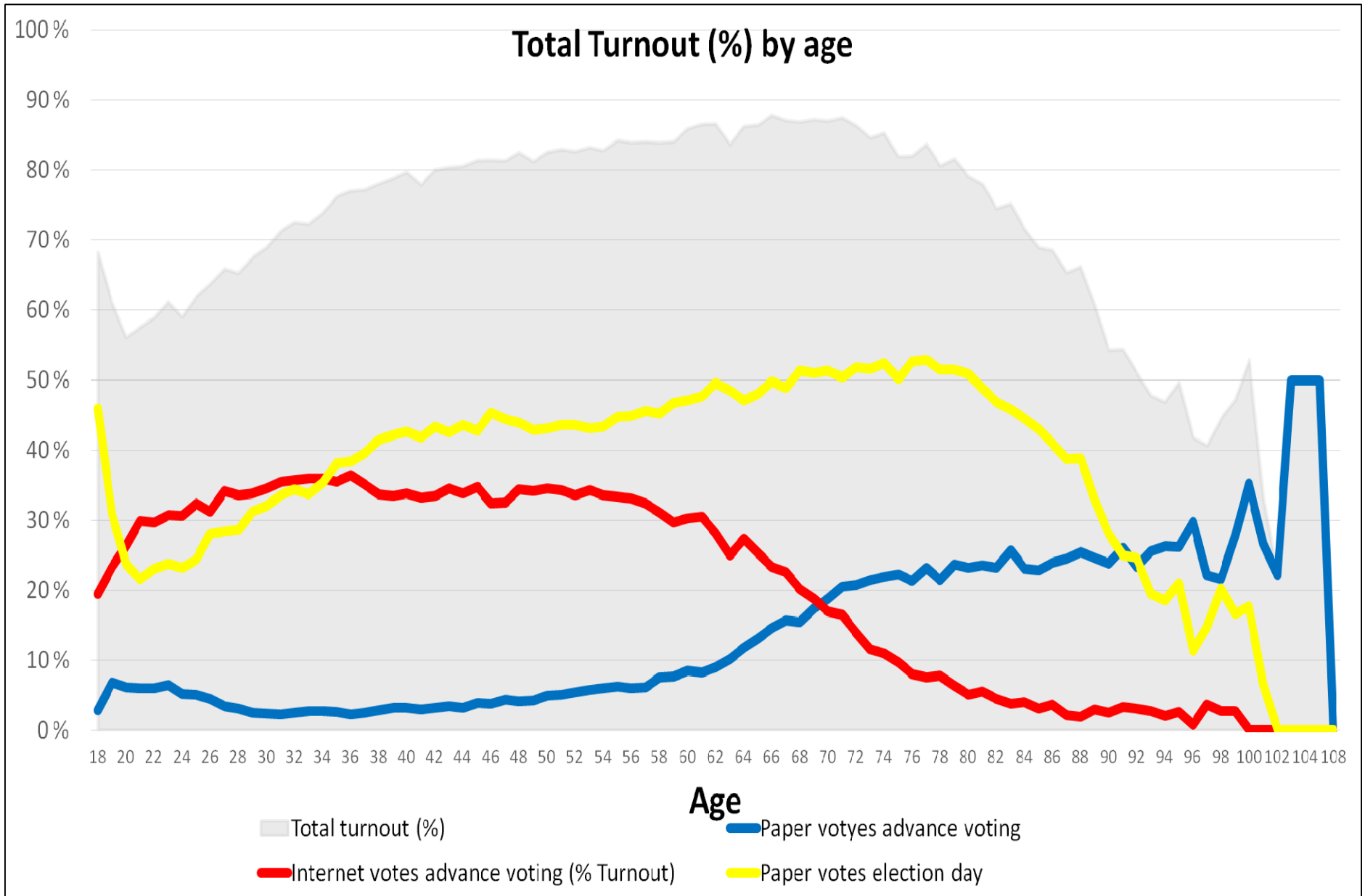
**VALG**



### Internet voters per day 2013



Data from 12 internet municipalities (250.000 possible voters):



# Norwegian Internet voting challenges

Secrecy of the ballot is an absolute requirement

- The only real controversy has been the possibility of coercion / family voting in uncontrolled environment
- The Conservative Party introduced a parliamentary motion to stop remote Internet voting in November 2010
- Again Conservative Party voted against internet voting in 2013 (they are now in power after winning the election)
- A programming error resulted weak Encryption of 40.000 ballots (corrected during election)

# What we believe we've achieved in Norway

## New approach to transparency

- A fully open source system  
(you must be very clear in procurement process)
- End-to-end verification of entire vote life cycle, including voter verification by using return codes
- Near independence of client side (in)security
- Auditing combined with voter observation of return code replaces the observer in the polling station

## Lessons learned...

- This *really* takes a lot of time to implement.
- High security means it's time consuming to test, and there are a lot of special cases to test.
- Work closely with the vendor, but make sure skills are transferred to the EMB

## Why not poll site e-voting in Norway?

- Low frequency of elections means that tailor-made voting machines will be seldomly used
- Cost is much higher than internet voting
- Risk of hacking might be greater in poll stations than on voter's own PC (!)
- However: cost/benefit *might* still be positive. Further pilots are planned for 2015
- The Parliament will decide.....



## Conclusions on e-voting

- If there is a lack of public trust in the EMB, e-voting is probably not the way to go
- Internet voting from home is cost-efficient but requires good public infrastructure
- e-voting in polling stations can improve transparency if implemented correctly
- You need at least 3-4 years from idea to pilot. Academia must be involved at an early stage.

More info: <http://evote.stat.no>

The screenshot shows the website for the Ministry of Local Government and Regional Development. At the top, there is a navigation bar with links for 'Bokmål', 'Nynorsk', 'Sámegiella', and 'English'. Below this is a search bar and a 'Search' button. The main header features the ministry's logo and the text 'MINISTRY OF LOCAL GOVERNMENT AND REGIONAL DEVELOPMENT'. A large banner image shows hands typing on a laptop with the text 'THE E-VOTE TRIAL'. To the left of the banner is a sidebar with a 'VALG' logo and a menu with links: 'Ministry home', 'E-vote frontpage', 'About the trial', 'Evaluation of trial', and 'Source Code'. To the right of the banner are several news items and links. The first news item is 'SEMINAR ON INTERNET VOTING 2013' with a description: 'Attend the decryption ceremony and a seminar on the Norwegian Internet voting pilots'. The second is 'HOW TO OBSERVE THE DIGITAL BALLOT BOX' with the description: 'Find your Internet ballot in the digital ballot box'. The third is 'ELECTIONS RESULTS AND STATISTICS' with the description: 'Elections Results and statistics Number of Internet votes 2013 (Norwegian)'. The fourth is 'HOW TO VOTE VIA THE INTERNET' with the description: 'Step-by-step instruction in English (PDF)'. Below the news items is a 'LINKS' section with the description: 'Election statistics in Norway (Statistisk sentralbyrå)'. At the bottom left, there is a URL: 'www.regjeringen.no/en/dep/krd/prosjekter/e-vote-trial.html?id=597658'. At the bottom right, there is a vertical scrollbar.

Internet voting in Norway



# System demonstration (If time)



## The Norwegian Parliamentary Election 2013 TEST

English ▾

### Internet voting

All eligible voters in Bodø, Bremanger, Fredrikstad, Hammerfest, Larvik, Mandal, Radøy, Re, Sandnes, Tynset, Vefsn og Ålesund may vote electronically during the parliamentary election.

You may vote online until September 6th 23:59.

For your security, you will automatically be logged out after 30 minutes.

### How to vote online

Authentication is done through ID-porten (using, for example, MiniID or BankID), where your cell phone number must be registered.

The first time you authenticate, you'll be prompted to share your phone number. **In order to vote online, you must select "Share with eValg".**

Watch a [video](#) illustrating the voting process.

### Your ballot must be kept secret.

You must therefore ensure that you cast your vote unobserved.

Remember that you may vote via the Internet again at any time during the advance voting period. You may also vote with a paper ballot at a polling station. A paper vote will cancel an Internet vote.

[Log in to vote](#) >



## 2013 parliamentary election

### Your ballot must be kept secret

- You must therefore ensure that you cast your vote unobserved.

### You may vote via the Internet as many times you want

- To vote again, you must log out and in again.
- In the interest of keeping the ballot secret, you will never be able to see previously cast votes.
- Your last Internet vote will be the one that counts.

### A paper vote will cancel all Internet votes

- You may vote both via the Internet and on paper.
- You may only vote once on paper.
- On election day you may only vote at the polling station.

Parliamentary election in Hordaland


Online voting period: 1. January 2013 0:00:00 - 31. December 2013 23:59:00


[Start voting](#)


qa-evalg




 Select an electronic ID:

 **MinID**  
Use codes from SMS or PIN code letter >

 **BankID**  
Use security code generator from your bank >

 **Buypass**  
Use smart card and card reader >

 **Commfides**  
Use your USB stick >


[How to obtain an electronic ID](#)

[Contact form](#) | [Tel: 800 30 300](#) | [Help to log in](#) | [Security and privacy](#)

Operated by the Agency for Public Management and e-Government (Difi)

qa-evalg



 Log in with MinID

MinID

Personal ID number:  (11 digits)

Password:

[Forgotten password?](#)

CANCEL

NEXT >

[Register as new user](#) | [Order PIN codes](#) | [Edit user profile](#)

[Contact form](#) | Tel: 800 30 300 | [Help to log in](#) | [Security and privacy](#)

Operated by the Agency for Public Management and e-Government (Difi)



## Select ballot for parliamentary election in Hordaland

There are 15 electoral lists in your county. These are listed in random order below.  
Choose the party you want to vote for.

- Norges Kommunistiske Parti
- Pensjonistpartiet
- Det norske Arbeiderparti
- Miljøpartiet De Grønne
- Sentrumsalliansen
- Rødt
- Demokratene
- Fremskrittspartiet
- Sosialistisk Venstreparti
- Kystpartiet
- Venstre
- Senterpartiet
- Høyre
- Kristent Samlingsparti
- Kristelig Folkeparti
  
- Blank stemmeseddel

Show ballot >





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- Kristent Samlingsparti
- Kristelig Folkeparti
  
- Blank stemmeseddel

Show ballot >



## Ballot for Norges Kommunistiske Parti in the parliamentary election in Hordaland

You may change the sequence of the candidate list by entering new numbering in the boxes to the left of each candidate. You may also delete candidates by clicking in the field to the right of the candidate's name.

### Change order

- Assign a new position to the candidate by clicking the associated field in front of the candidate's name and select the desired number from the list.
- You cannot assign multiple candidates to the same number.
- If you want to change the number of a candidate you have stricken, you must first uncheck the box to the right of the name.

### Delete

- You may delete a candidate by checking the box to the right of the candidate.
- You may delete as many candidates as you want.
- In order to delete a candidate whose position you have reassigned, you must first remove the new number.

No	Change	Name	Birth year	Delete
1.	<input type="text"/>	Benedikte Joakimsen	f. 1918	<input type="checkbox"/>
2.	<input type="text"/>	Idunn Kolbjørnsen	f. 1944	<input type="checkbox"/>
3.	<input type="text"/>	Angelina Austad	f. 1928	<input type="checkbox"/>
4.	<input type="text"/>	Mildrid Torgersen	f. 1952	<input type="checkbox"/>
5.	<input type="text"/>	Cecilie Tandstad	f. 1923	<input type="checkbox"/>
6.	<input type="text"/>	Håvard Endal	f. 1920	<input type="checkbox"/>
7.	<input type="text"/>	Bente Børsheim	f. 1970	<input type="checkbox"/>
8.	<input type="text"/>	Ruth Gjørund	f. 1930	<input type="checkbox"/>



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1.	<input type="text"/>	Benedikte Joakimsen	f. 1918	<input type="checkbox"/>																				
<table border="1"> <tr> <td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td> </tr> <tr> <td>11</td><td>12</td><td>13</td><td>14</td><td>15</td><td>16</td><td></td><td></td><td></td><td></td> </tr> </table>					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16				
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No	Change	Name	Birth year	Delete
1.	<input type="text" value="5"/>	Benedikte Joakimsen	f. 1918	
2.	<input type="text"/>	Idunn Kolbjørnsen	f. 1944	<input type="checkbox"/>
3.	<input type="text"/>	Angelina Austad	f. 1928	<input type="checkbox"/>
4.	<input type="text"/>	Mildrid Torgersen	f. 1952	<input type="checkbox"/>
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-	<input type="text"/>	-	-	<input type="checkbox"/>



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3.	<input type="text"/>	Angelina Austad	f. 1928	<input checked="" type="checkbox"/>
4.	<input type="text"/>	Mildrid Torgersen	f. 1952	<input type="checkbox"/>
5.	<input type="text"/>	Cecilie Tandstad	f. 1923	<input checked="" type="checkbox"/>
6.	<input type="text"/>	Håvard Endal	f. 1920	<input type="checkbox"/>
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8.	<input type="text"/>	Ruth Gjørund	f. 1930	<input type="checkbox"/>
-	<input type="text"/>	-	-	<input type="checkbox"/>



## Checking your ballot

Below you will find your completed ballot. If you have made changes to the ballot, these will be displayed. The rest of the candidate list will remain unchanged. Verify your ballot before submission.

You are voting for:

### **NORGES KOMMUNISTISKE PARTI**

You have re-numbered the following candidates:

From	To	Name	Birth year
1	5	Benedikte Joakimsen	f. 1918

You have stricken the following candidates:

No	Name	Birth year
<del>3</del>	<del>Angolina Austad</del>	<del>f. 1928</del>
<del>5</del>	<del>Cecilie Tandstad</del>	<del>f. 1923</del>
<del>7</del>	<del>Bente Børshoim</del>	<del>f. 1970</del>
<del>9</del>	<del>Viljar Løge</del>	<del>f. 1994</del>
<del>11</del>	<del>Sana Sjøen</del>	<del>f. 1968</del>
<del>13</del>	<del>Sanna Grønli</del>	<del>f. 1982</del>
<del>15</del>	<del>Siren Steiro</del>	<del>f. 1955</del>



Your vote will now be recorded.  
Please wait...  
This normally takes between 15 and 60 seconds.





Thank you for voting!



### Your vote has now been recorded.

- You will shortly receive a text message that contains a return code. This code allows you to verify that your vote has been registered correctly.
- Verify that the return code you receive in the text message is identical to the party/group's return code on your polling card. Each voter has a unique set of return codes.
- Please contact user support at 800 38 254 if the return codes received via text message and on the polling card do not match.

[Do you want to help observe the Internet election?](#)



Log out >





## Find your vote in the digital ballot box

### Your vote has now been submitted; this step is voluntary and not necessary in order to complete voting.

It may be advantageous to have a certain technical interest and insight to carry out this step, but in principle anyone can do it.

You can personally verify whether your vote has been saved in the digital ballot box. This will be possible until the votes are counted at the end of election day. By following the instructions on this page you can download an SHA-256 hash of your encrypted vote. It is important to understand that the hash does not reveal who you are or your vote.

A complete list of the hashes of all received votes will be published every hour on the hour at the [GitHub page](#). The list will be updated and available until the votes are counted on election day. By checking that your hash is on the list, you will know that your Internet vote is saved in the digital ballot box. On election day, an independent third party will verify that the list matches the content of the digital ballot box when the contests are counted. As long as the list and ballot box match, we know all the votes are counted.

Please note!! If you navigate away from this page, you will not be able to see the hash of your encrypted vote later. You should therefore make sure that you save your hash.

[See SHA-256 hash](#)

Clicking the link below will display a hash and two digital signatures. The hash is an abbreviation of your encrypted vote. The signatures can be used to verify that the hash is from a real vote.

See the bullet point list below for a description of how to find your hash in the list.

- Click "See SHA-256 hash" below. This will bring up a screen with one hash and two hash signatures. You should save this information in an empty text document so you can look up your hash later.
- The list will be updated each hour. At the GitHub-page for the election you can find the textfile "Bulletin\_130001.txt". When you open this textfile you can search for your hash, Ctrl+f, and paste in (Ctrl+v) your hash, to verify that your vote's hash is on the list. For a more detailed description of how to verify your vote see the "README"-file at the github-page.
- If you find the hash, you know that your vote has been received and stored.
- If you cannot find the hash, you may have been too quick and the list may not have been updated. If you believe the list has been updated after you voted, but you still cannot find your hash, call user support at 800 38 254.
- If you vote multiple times, all the hashes will be in the list. Feel free to verify multiple times.

Log out >

Hi, Erik Vik.

Your vote in the  
parliamentary election was  
received at 7/9-2013:  
12:18.

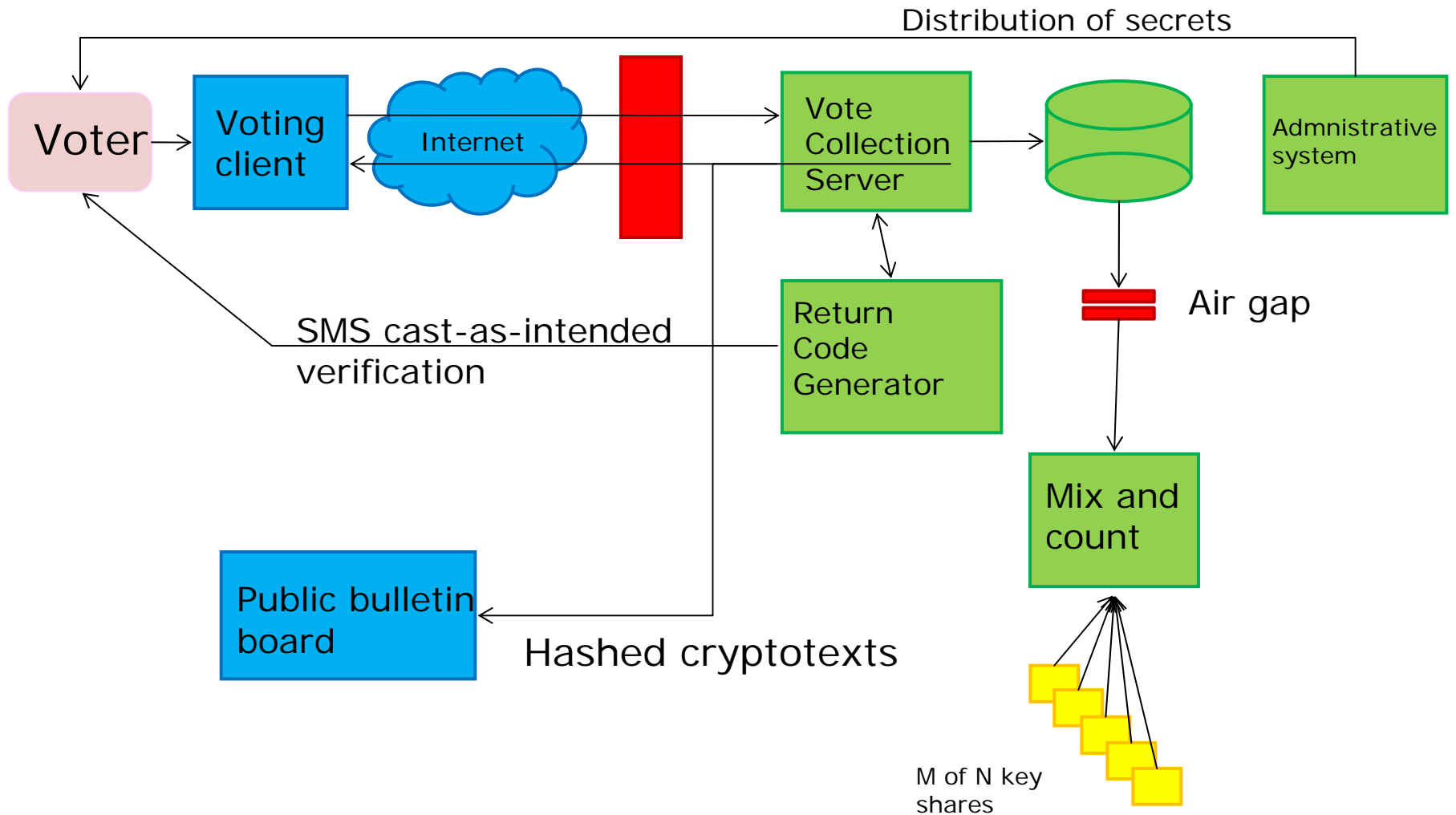
The party/ group you voted  
for has return code 1758.

You deleted 7 candidates  
and made 1 re-numberings.

Please check the return  
code against your poll card.  
Call 800 38 254 if the  
return codes do not match.



# Revised conceptual model for 2013



**From OSCE handbook for observation of NVT Annex B:  
Master Checklist:  
Norway have considered and evaluated all questions,  
here are some:**

- Has the NVT system been certified in a transparent process by a qualified independent body, under both national legislation and international good practice?
- To what extent are voters, election administrators and observers capable of understanding and using the system? What skills are needed to make them educated users? What kind of training or voter education could build these skills?
- Do international observers have full access to the process and to documentation, including certification, testing, verification and audit reports?
- Is a voter-verifiable paper record produced in order to ensure that the voter's choice has been recorded accurately and to create the possibility for observers without technical expertise to observe a recount? If not, what measures ensure universal, end-to-end verifiability of the results?