

# Part II

# Reflections on Voting in Denmark

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# DEMTECH

- DemTech: Trustworthy Democratic Technology
- DSF-funded for approx. €2M with total budget of approx. €4.4M
- IT University of Copenhagen
  - Carsten Schürmann (PI), Nina Boulus, Christopher Gad, Joseph Kiniry, Randi Markussen (co-PIs), Andreas Christiansen (PhD)
- Academic Partners
  - David Basin (ETHZ) and Peter Ryan (Univ. of Luxembourg)
- Public Partners
  - The Cities of Aarhus, Copenhagen, and Frederiksberg
- Private Partners
  - Assembly Voting (Siemens A/S & Aion ApS)

[www.itu.dk](http://www.itu.dk)

IT UNIVERSITY OF  
COPENHAGEN

# STATUS UPDATE

- project organization started in late 2010
- project officially started on 1 July 2011
- project runs for 5 years
- interviewing and hiring postdocs and PhD students
- will hire a total of 4 postdocs and 6 PhD students
- about 1/3rd of hires will be sociologists, ethnographers, etc., 1/3rd in computer scientists, and 1/3rd in software engineers
- consortium agreement is complete and being ratified
- IPR resolved as ITU has agreed to Open Source all IPR

# PROJECT ORGANIZATION

- members of research board of project and its role has been defined
- external advisory board and its role has been defined (members include political scientists, researchers, hackers, etc.)
- project management process has been defined and started (democracy with low overhead)
- regular bi-weekly meetings have started

# RECENT ACTIVITIES AND PRESS

- DemTech personnel were embedded with the public partners since the day the election was announced
  - we had “full access” to all meetings, rooms, equipment, etc.
  - dozens of hours of audio and video interviews conducted
  - more post-election interviews to come with those who ran the election from the city and public, citizens who voted, etc.
- Industrial partners demonstrated prototype kiosk-based VVPAT e-voting systems in Frederiksberg before and during the election
- Copenhagen City ran a vote-by-mail scheme for the first time at the main train station in Copenhagen for two days
- significant press coverage in major newspapers, on the radio, and on TV
- outreach to new organizations and countries has started (United Nations, Copenhagen Elections, representation at events in Kenya, Egypt, etc.)

# DANISH DEMOCRACY

- democracy in Denmark is a rare exemplar (subjectively)
- voter participation is high (86% this election in Copenhagen)
- Danes have an usually high trust in elections, their democracy, their government, and the parliamentary process
- parties in government typically work together to solve problems and enact

# PROS AND CONS OF E-VOTING

- pros for e-voting
  - can increase efficiency of voting process
  - can increase accuracy of tally
  - can increase speed of release of results
  - can increase access for the disabled
  - can potentially increase the trust of the voter in the process
- cons for e-voting
  - complexity and computing decreases transparency and can decrease public control
  - computing renders the electoral process vulnerable to programming errors and hacker attacks

# COMPUTERS IN DANISH ELECTIONS

- Danes have never used e-voting machines to cast ballots
- in 2009 digital voter lists were used for the first time to confirm a citizens right to vote at a voting place
- the digital voter list used again in this election in around a dozen polling places
- ballots are designed on computers and printed on normal paper
- ballots are tallied several times, in two different ways, by hand
- regional count results are input into computers by hand and roughly aggregated using Excel and uploaded to websites by hand
- regional count results are transferred to the Ministry over the internet
- the digital voter list and the systems used to aggregate votes and transfer results are all designed, constructed, and run by KMD
- final computation of parliamentary form performed by a computer at the Danish Statistics Bureau (2011) and in the Ministry (pre-2011)



# THE DEMTECH HYPOTHESIS

It is possible to modernize the electoral process while balancing the trust of the people on the trustworthiness of the deployed technology.

# RESEARCH AGENDA

- study electoral schemes and infrastructures from a sociological/ethnographic point-of-view
- use and develop new epistemic logics to be used as foundation for reason about elections and other systems
- develop DSL for specifying and reasoning about elections
- develop a new software engineering process called Trust-by-Design whose purpose is to guarantee trust of observers and the verifiability of the election
- verified election software and hardware

# STAKEHOLDERS AND USERS

- citizens
  - understand, enable, and support public control while maintaining trust in process
- public partners
  - help them run elections that are better understood, more secure, less expensive, and perhaps increase participation
- industrial partners
  - provide technical know-how and prototypes



personal reflections



# The Election Campaign





# Copenhagen City Hall



Folketingsvalget den 15. september 2011

## Københavns Storkreds 3. opstillingskreds

### Kandidatliste

#### A. Socialdemokratiet

Ikram Sarwar  
Yildiz Akdogan  
Jan Andreasen  
Thomas Bogh  
Lars Gaardhøj  
Susan Hedlund  
Karen Hækkerup  
Mette Reissmann  
Bo Sandberg  
Helle Thorning-Schmidt  
Michael Vindfeldt  
Lars Weiss

#### B. Radikale Venstre

Mia Nyegaard  
Christian Donatzky  
Uffe Elbæk  
Pernille Boye Koch  
Karsten Lauritsen  
Lone Lokindt  
Karen Lumholt  
Sofie Plenge  
Lars Richard Rasmussen  
Mette Annelie Rasmussen  
Manu Sareen  
Ditte Sendergaard

#### C. Det Konservative Folkeparti

Rasmus Jarlov  
Channe Bjerringgaard  
Helle Bonnesen  
Nikolaj Begh  
Mogens Lønborg  
Per Stig Møller  
Jakob Næsager  
Jette Nøhr  
Per Junker Thiesgaard  
Heidi Winther  
Pernille Ørsted

#### F. SF – Socialistisk Folkeparti

Mette Boye  
Balder Mørk Andersen  
Ida Auken  
Özlem Sara Cekic  
Trine Mach  
Kamal Qureshi  
Ole Riisgaard  
Dorte Skovgård  
Annika Smith  
Charlie Stjerneklar  
Villy Søvdal  
Lotte Wassini  
Anne-Mette Wehmüller

#### I. Liberal Alliance

Simon Emil Ammitzbøll  
Karl Iver Dahl-Madsen  
Benjamin Dickow  
Lars Berg Dueholm  
Thomas Köhler  
Laura Lindahl  
Heidi Wang

#### K. Kristendemokraterne

Kirsten Hasberg  
Simon Høeg Jensen  
Simon Poulsen  
Bess Serner-Pedersen  
Kåre Skarsholm  
Jesper Truelsen  
Anne-Marie Valentin

#### O. Dansk Folkeparti

Lærke Helene Becker  
Gunnar Biering  
Morten Dreyer  
Carl Christian Ebbesen  
Martin Henriksen  
Paw Karslund  
Daniel Norhave  
Christina Pedersen  
Peter Skaarup  
Karin Storgaard  
Henrik Svendsen  
Jakob Vanddam

#### V. Venstre, Danmarks Liberale Parti

Steffen Kjær Johansen  
Leslie Arentoft  
Ulrik E. Fink  
Martin Geertsen  
Michael Haugaard  
Jan E. Jørgensen  
Michael Lange  
Cecilia Lønning  
Marion Pedersen  
Søren Pind  
Sven Aage Schlosrich  
Jimmy Sindahl

#### Ø. Enhedslisten – De Rød-Grønne

Allan Mylius Thomsen  
Johanne Schmidt-Nielsen  
Rosa Lund  
Finn Sørensen  
Helge Bo Jensen  
Mette Bang Larsen  
Sune Blom  
Gorm Anker Gunnarsen  
Susanne Langer  
Jens Kjær Christensen  
Gunna Starck  
Marianne Frederik

#### Uden for partierne

Klaus Trier Tuxen  
Morten Versner  
Tom Gillesberg  
Mads Vestergaard  
John Erik Wagner  
Per Zimmermann

Samtlige kandidater er godkendt af de partier, hvorunder de er opført



# Election Observers



Københavns Storkreds 3. opstillingskreds

# Folketingsvalget 2011

Sæt x til højre for et partinavn eller et kandidatnavn  
Sæt kun ét x på stemmesedlen

## A. Socialdemokratiet

Ikram Sarwar	Karen Hækkerup
Yildiz Akdogan	Mette Reissmann
Jan Andreasen	Bo Sandberg
Thomas Bech	Helle Thorning-Schmidt
Lars Gaardhøj	Michael Vindfeldt
Susan Hedlund	Lars Weiss

## B. Radikale Venstre

Mia Nyegaard	Karen Lumholt
Christian Donatzky	Sofie Plenge
Uffe Elbæk	Lars Richard Rasmussen
Pernille Boye Koch	Mette Annelie Rasmussen
Karsten Lauritsen	Manu Sareen
Lone Lokkild	Ditte Sendergaard

## C. Det Konservative Folkeparti

Rasmus Jarlov	Jakob Næsager
Channe Bjerringgaard	Jette Nøhr
Helle Bonnesen	Per Junker Thiesgaard
Nikolaj Bøgh	Heidi Winther
Mogens Lønborg	Pernille Ørsted
Per Stig Møller	

## F. SF – Socialistisk Folkeparti

Mette Boye	Dorte Skovgård
Balder Mørk Andersen	Annika Smith
Ida Auken	Charlie Stjernklar
Özlem Sara Cakic	Villy Søvnal

# The 2011 Ballot



**F. SF – Socialistisk Folkeparti**

Mette Boye	Dorte Skovgård
Balder Mørk Andersen	Annika Smith
Ida Auken	Charlie Stjerneklar
Özlem Sara Cekic	Villy Søvdal
Trine Mach	Lotte Wassini
Kamal Qureshi	Anne-Mette Wehmüller
Ole Riisgaard	

**I. Liberal Alliance**

Simon Emil Ammitzbøll	Thomas Köhler
Karl Iver Dahl-Madsen	Laura Lindahl
Benjamin Dickow	Heidi Wang
Lars Berg Dueholm	

**K. Kristendemokraterne**

Kirsten Hasberg	Kåre Skarsholm
Simon Høeg Jensen	Jesper Truelsen
Simon Poulsen	Anne-Marie Valentin
Bess Serner-Pedersen	

**O. Dansk Folkeparti**

Lærke Helene Becker	Daniel Nørhave
Gunnar Biering	Christina Pedersen
Morten Dreyer	Peter Skaarup
Carl Christian Ebbesen	Karin Storgaard
Martin Henriksen	Henrik Svendsen
Paw Karslund	Jakob Vanddam

**V. Venstre, Danmarks Liberale Parti**

Steffen Kjær Johansen	Michael Lange
Leslie Arentoft	Cecilia Lonning
Ulrik E. Fink	Marion Pedersen
Martin Geertsen	Søren Pind

# The 2011 Ballot



Simon Poulsen	Anne-Marie Valentin
Bess Serner-Pedersen	
<b>O. Dansk Folkeparti</b>	
Lærke Helene Becker	Daniel Norhave
Gunnar Biering	Christina Pedersen
Morten Dreyer	Peter Skaarup
Carl Christian Ebbesen	Karin Storgaard
Martin Henriksen	Henrik Svendsen
Paw Karslund	Jakob Vanddam
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Steffen Kjær Johansen	Michael Lange
Leslie Arentoft	Cecilia Lonning
Ulrik E. Fink	Marion Pedersen
Martin Geertsen	Søren Pind
Michael Haugaard	Sven Aage Schlosrich
Jan E. Jørgensen	Jimmy Sindahl
<b>Ø. Enhedslisten - De Rød-Grønne</b>	
Allan Mylius Thomsen	Sune Blom
Johanne Schmidt-Nielsen	Gorm Anker Gunnarsen
Rosa Lund	Susanne Langer
Finn Sørensen	Jens Kjær Christensen
Helge Bo Jensen	Gunna Starck
Mette Bang Larsen	Marianne Frederik
<b>Uden for partierne</b>	
Klaus Trier Tuxen	Mads Vestergaard
Morten Versner	John Erik Wagner
Tom Gillesberg	Per Zimmermann

# The 2011 Ballot





# Digital Voter List System



# Voting Booth





# Empty Ballots



# Training Volunteers





# The Ballot Box





# The Ballot Box



# Voting Begins





# Exceptional Conditions



# Letter Votes





# The Mobile Ballot Box

Antal vælgere:	2007		2011	
	Afgivne stemmer	%	Afgivne stemmer	%
KL. 09.00	1233	11,6	1.223	12,0
KL. 10.00	1756	16,5	1.843	18,1
KL. 11.00	2152	20,2	2.326	22,8
KL. 12.00	2631	24,7	2.802	27,5
KL. 13.00	3010	28,3	3.242	31,8
KL. 14.00	3545	33,3		
KL. 15.00	3924	36,9		
KL. 16.00	4487	42,2		
KL. 17.00	5270	49,5		
KL. 18.00	6153	57,9		
KL. 19.00	7061	66,4		
KL. 20.00	7625	71,7		

# Mid-day Participation



# Hiccups





# Public Involvement





# “Rough” Counting



# Tallying

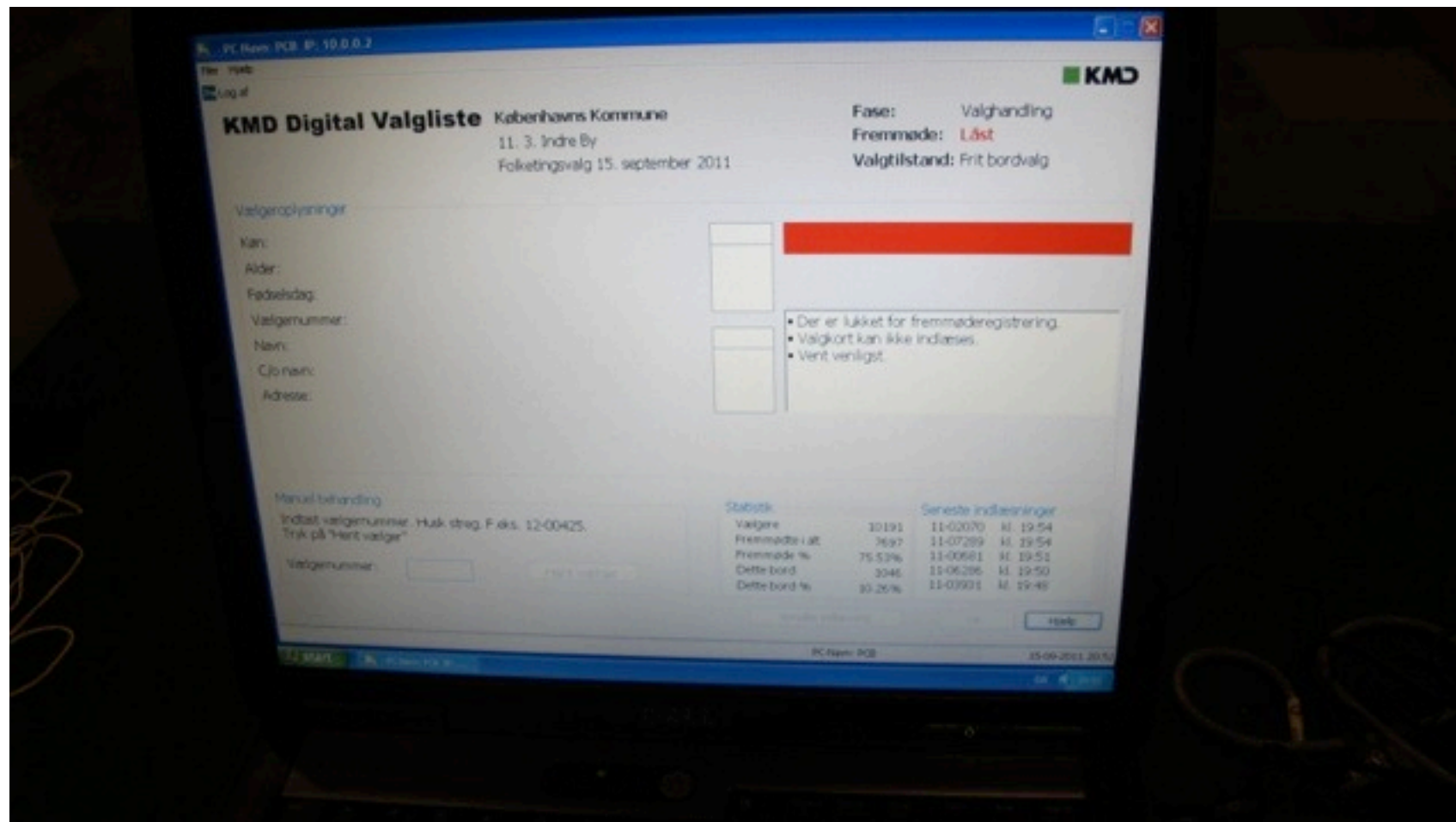




# Tallying

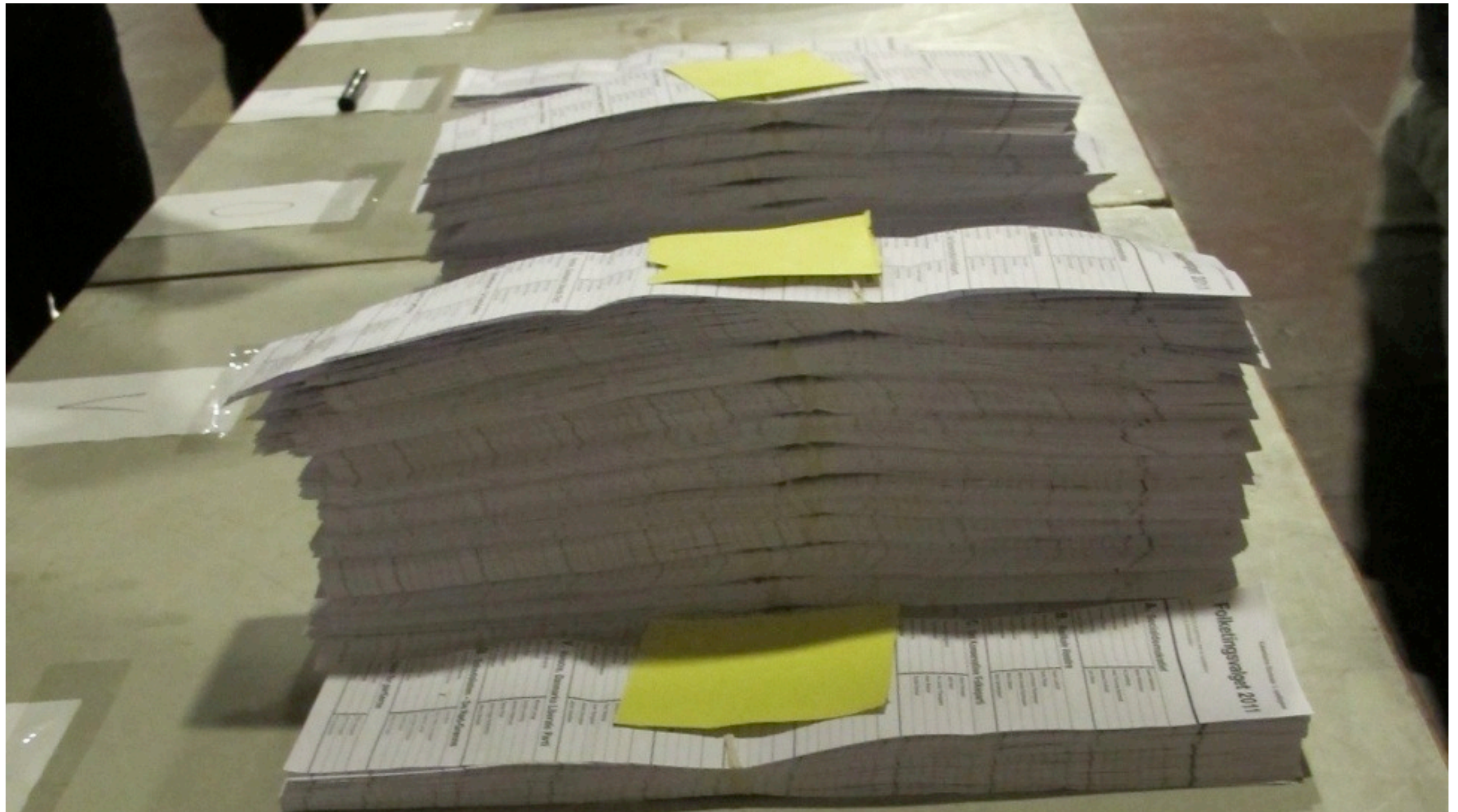


# Tallying Letter Votes



# The Digital Voter List





# Tallying



# Securing Ballots





# Moving Ballots





# The Fine Count



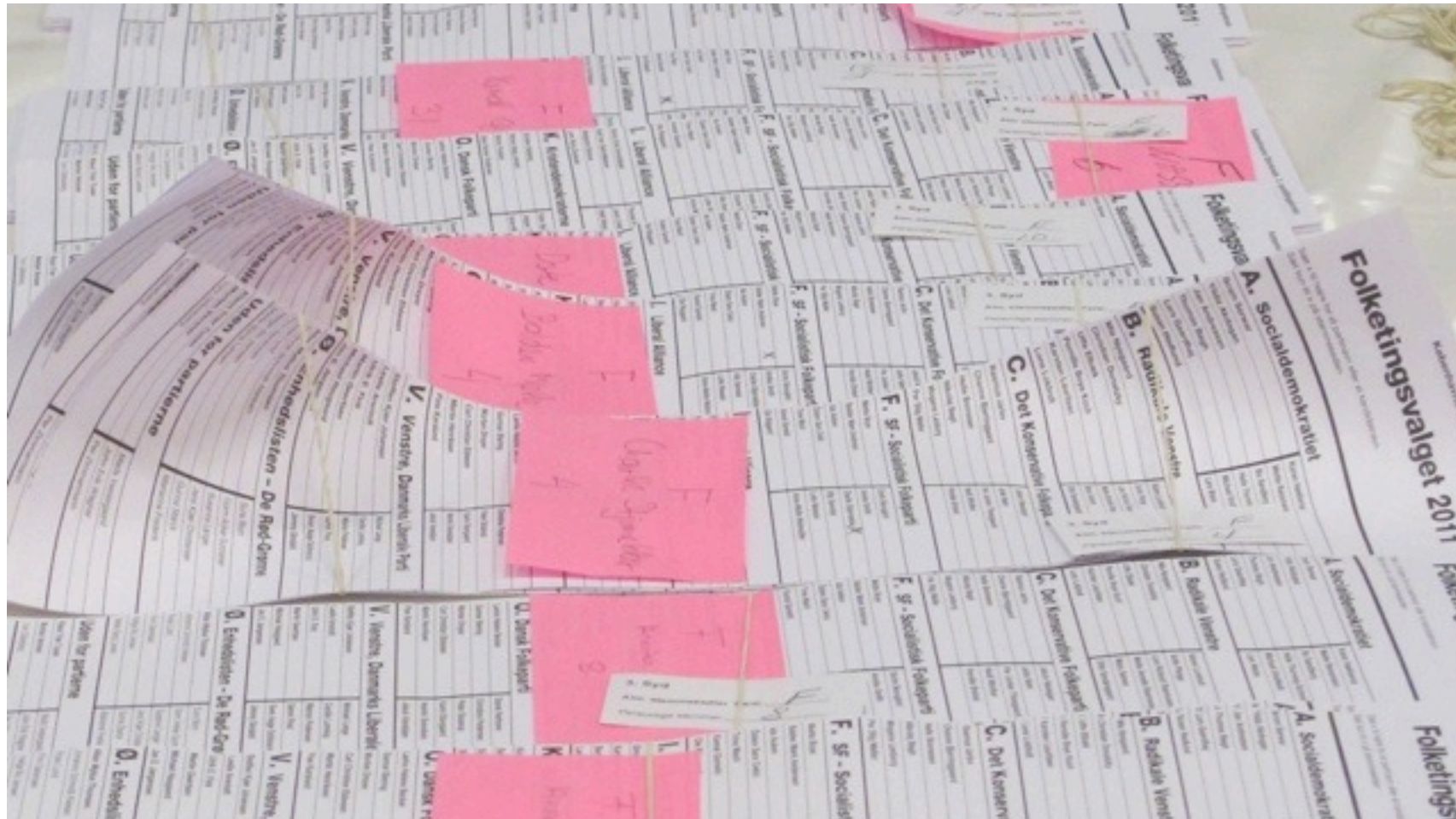
# All Election Ballots



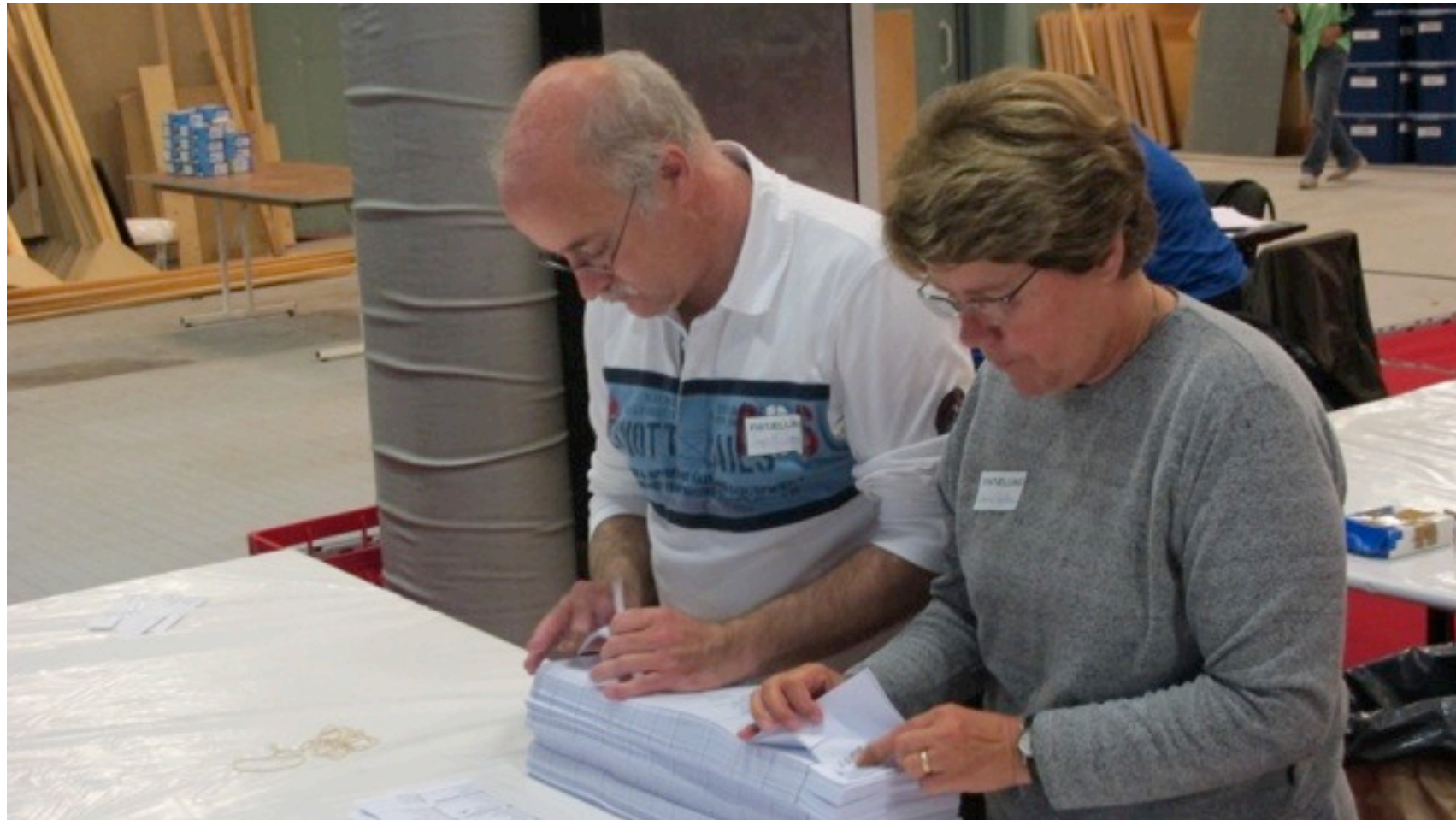


# Tallying the Fine Count





# The Tallying Process



# Protocols for Counting





# Aggregating Results





# Receiving Vote Totals



# National Computer Control

Parties	Leaders	Votes	%	Seats	+/-
Denmark proper					
<b>Liberals</b> ( <i>Venstre</i> ) (V)	Lars Løkke Rasmussen	947,725	26.7%	47	+1
<b>Social Democrats</b> ( <i>Socialdemokraterne</i> ) (A)	Helle Thorning-Schmidt	879,615	24.8%	44	-1
<b>Danish People's Party</b> ( <i>Dansk Folkeparti</i> ) (O)	Pia Kjaersgaard	436,726	12.3%	22	-3
<b>Social Liberal Party</b> ( <i>Det Radikale Venstre</i> ) (B)	Margrethe Vestager	336,698	9.5%	17	+8
<b>Socialist People's Party</b> ( <i>Socialistisk Folkeparti</i> ) (F)	Villy Søvndal	326,192	9.2%	16	-7
<b>Red-Green Alliance</b> ( <i>Enhedslisten</i> ) (Ø)	Collective leadership	236,860	6.7%	12	+8
<b>Liberal Alliance</b> ( <i>Liberal Alliance</i> ) (I)	Anders Samuelsen	176,585	5.0%	9	+4
<b>Conservative People's Party</b> ( <i>Det Konservative Folkeparti</i> ) (C)	Lars Barfoed	175,047	4.9%	8	-10
<b>Christian Democrats</b> ( <i>Kristendemokraterne</i> ) (K)	Per Ørum Jørgensen	28,070	0.8%	0	0
<b>Candidates without parties</b>		1,850	0.1%	0	0
<b>The Red Alliance</b> (A, B, F, Ø)	Helle Thorning-Schmidt	1,779,365	50.2%	89	+8
<b>The Blue Alliance</b> (C, I, K, O, V)	Lars Løkke Rasmussen	1,764,153	49.8%	86	-8
Invalid votes		34,307			
Subtotal (Turnout: 87.7% – electorate: 4,079,910)		3,545,368	100.0%	175	

# Reporting Results