



# An investigation of the effectiveness and security of passwords derived from African languages





# Hello!

## I am Sibusiso Sishi

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# About Me

1

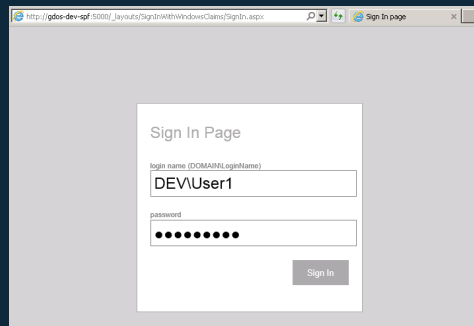
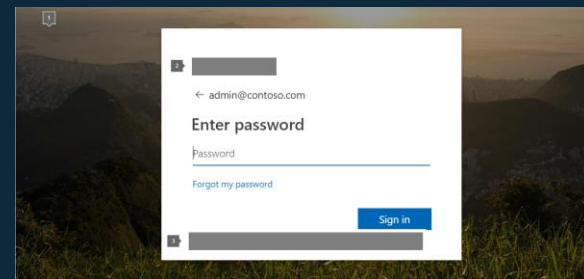
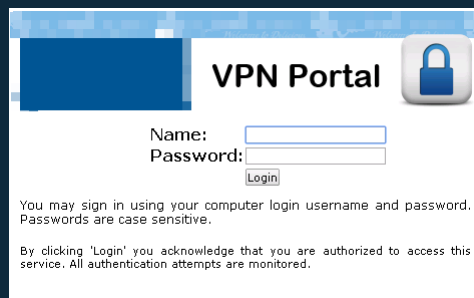
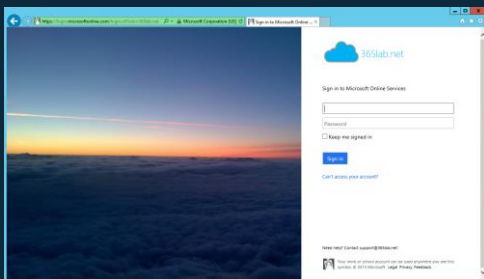
- Co-owner of IronSky PTY Ltd a South African based cyber security company
- Penetration Tester
- Used to be a professional athlete represented South Africa at:
  - Beijing Olympics 2008
  - Berlin World Athletics Championships 2009
  - World Students Games 2009
- I enjoy picking up heavy things at gym

# Agenda

1. Corporate South Africa
  1. Password policy
  2. Default windows password policy
  3. Collected user LM and NTLM hashes
  4. Results
2. Backstory about my research
3. South African languages
4. Experiment
  1. Weak passwords per language
5. African passwords cracked
6. Conclusion
7. Takeaways

# Motivation

◇ Passwords are used everywhere!!!



# Corporate South Africa

- ◇ Business language in South Africa is English even though there are 11 other official languages
- ◇ Found that many organizational password policies were in English
  - With English password examples
  - Employee workstations have the language set to English
- ◇ User awareness around passwords is low
- ◇ User education about cyber risks was low

## Corporate Password Policy

- ◇ Reviewed some organizational password policies
- ◇ Found that some organizations password policies lacked basic sections such as:
  - Minimal password length
  - Password complexity
  - And what makes a “bad” password e.g. using usernames, “password”, company products, things that could be found on social media
- ◇ One organization had two policies one for users/ desktop administrators and one for privileged users/server administrators
- ◇ One organisation carries out regular password audits
  - Following NIST 800-63-3
  - Proactive around password security and resetting passwords

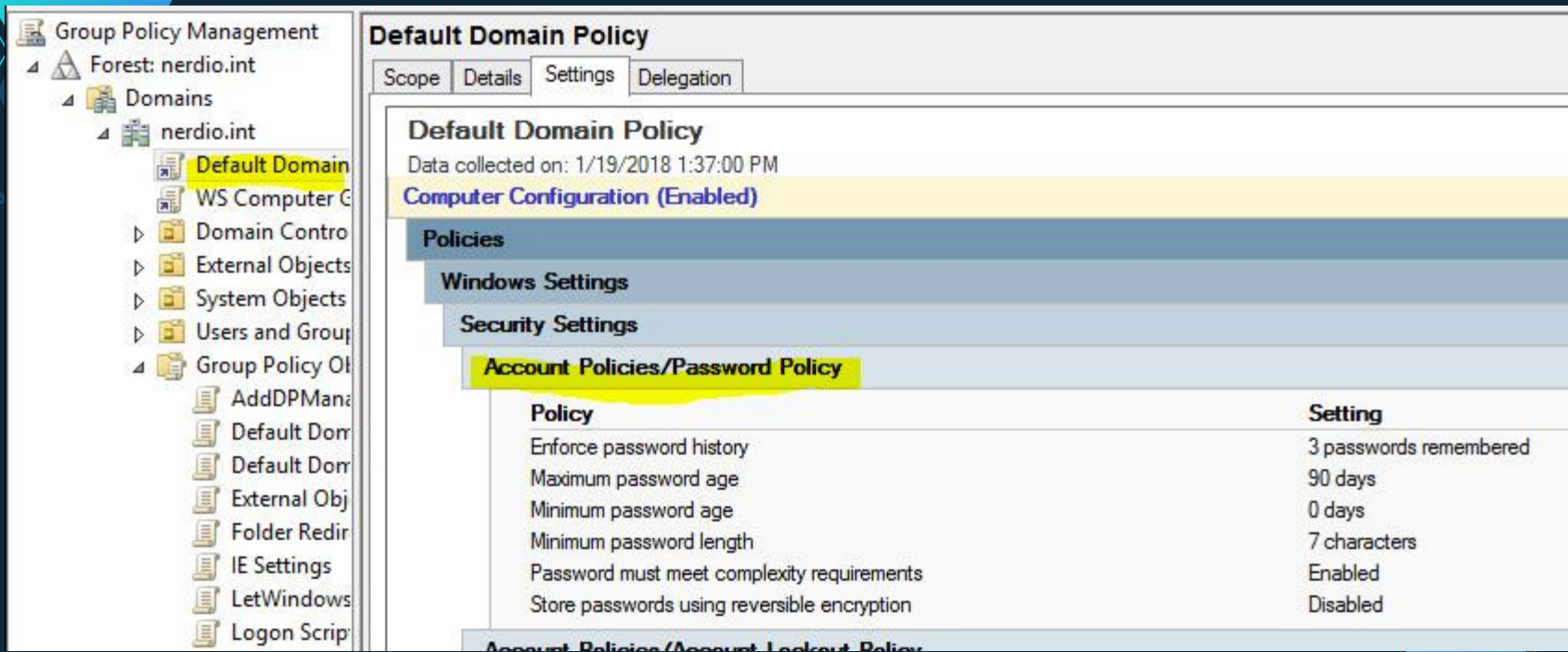
## Corporate Password Policy

- ◆ Please note having a password policy doesn't mean Bob and Jane will conform to the rules set out by your policy.
- ◆ Users are very creative in bypassing password policies
- ◆ Be proactive





# Default Windows Password Policy



The screenshot shows the Group Policy Management console for the Forest: nerdio.int. The left-hand tree view is expanded to 'Group Policy Objects', where 'Default Domain Policy' is selected. The right-hand pane displays the 'Default Domain Policy' settings, with the 'Settings' tab active. The 'Computer Configuration (Enabled)' section is expanded, showing 'Policies', 'Windows Settings', 'Security Settings', and 'Account Policies/Password Policy'. The 'Account Policies/Password Policy' section is further expanded, showing a table of password policy settings.

Policy	Setting
Enforce password history	3 passwords remembered
Maximum password age	90 days
Minimum password age	0 days
Minimum password length	7 characters
Password must meet complexity requirements	Enabled
Store passwords using reversible encryption	Disabled

## Corporate user passwords

- ◇ Assessed seven South African based organizations
- ◇ Collected 2614 LM hashes
  - Still found in organizations for legacy systems
  - Or Administrators do not know that they are active
- ◇ Collected 170433 NTLM hashes

## Corporate user passwords – LM and NTLM hashes

- ◇ Cracked 2242 LM hashes
- ◇ Most found passwords were:
  - ABC123
  - ABC12345
  - FISHEAGLE\$
- ◇ Cracked 76588 NTLM hashes
- ◇ Most found passwords were:
  - Password01
  - PASSWORD
  - Company names

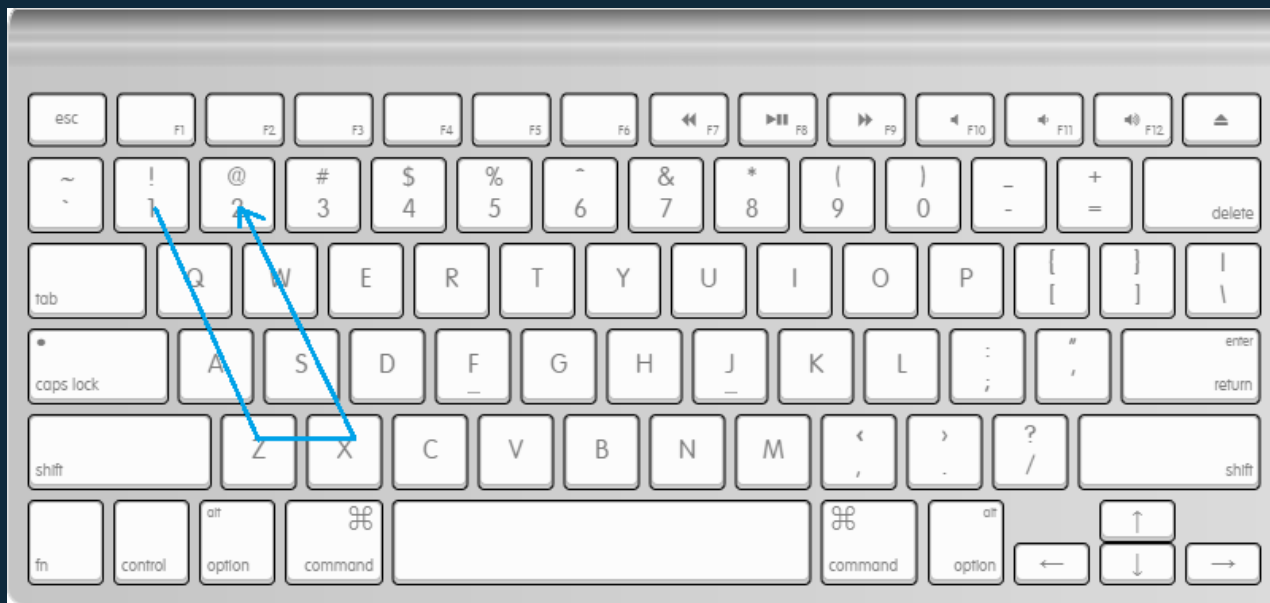
# Corporate user passwords

Password	Count (n=70751)	Frequency (%)
ABC123	179	0.25
FISHEAGLE1\$	116	0.16
ABC12345	111	0.16
Password01	91	0.13
PASSWORD	63	0.09
<REDACTED NAME>123 (Company E)	56	0.08
pass@word1	51	0.07
PP<REDACTED NAME>123 (Company D)	49	0.07
PA\$\$W0RD	47	0.06
<REDACTED NAME>00 (Company B)	34	0.05

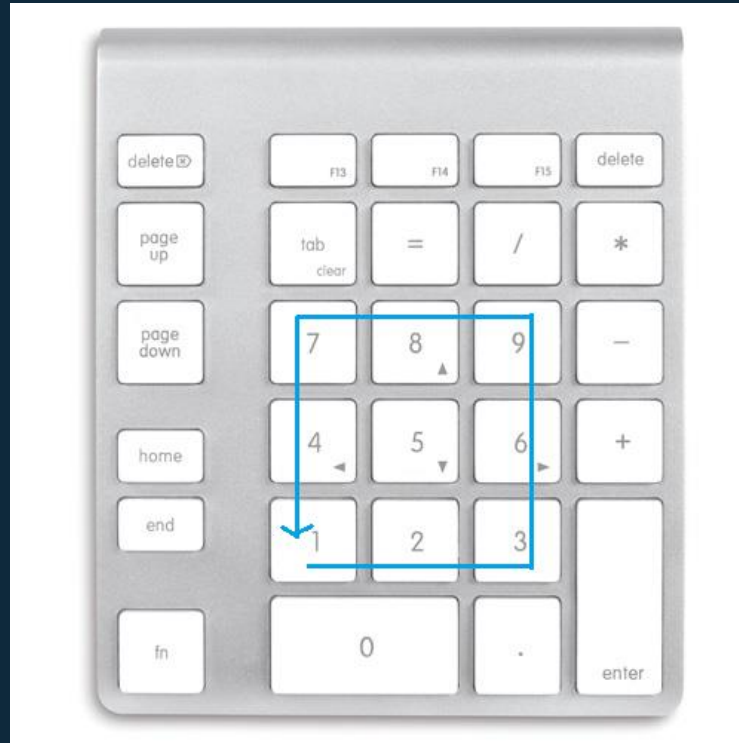
## Corporate user passwords

- ◇ Other interesting information
- ◇ Users created passwords to the product the organization creates
- ◇ Users created passwords for the cities and towns they were in
- ◇ Created passwords for the department they work in e.g SQL-SQL-30
- ◇ Bible verses – All the bible verses appeared in the passwords assessed.
- ◇ Used months as coping mechanisms
- ◇ Used keyboard walking as coping mechanisms

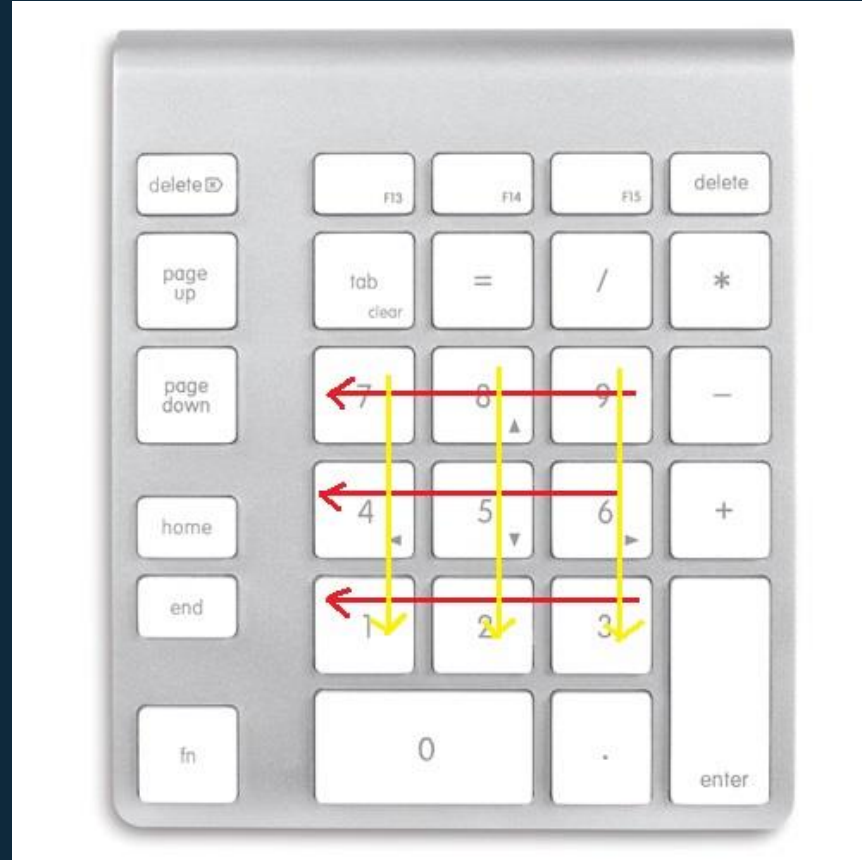
# Examples of keyboard walking done by users



# Examples of keyboard walking done by users



# Examples of keyboard walking done by users





## Corporate user passwords

Password Length	Count (n=70750)	Frequency (%)
8	20463	28.92
9	17124	24.2
10	13373	18.9
11	8119	11.48
12	4499	6.36
13	2159	3.05
7	1706	2.41
6	1197	1.69
14	1086	1.53
15	320	0.45



## Corporate user passwords

Character set	Count (n=70750)	Frequency (%)
mixedalphanum	33496	47.34
mixedalphaspecialnum	24378	34
loweralphaspecialnum	6368	9
loweralphanum	1974	2
upperalphaspecialnum	1431	2
upperalphaspecial	1235	1
mixedalphaspecial	609	0.86
loweralpha	603	0.85
upperalpha	281	0.4
numeric	138	0.2
upperalphaspecial	123	0.17
mixedalpha	83	0.12
loweralphaspecial	24	0.03
special	4	0
specialnum	3	0





# Back story

- ◇ Internal penetration test for an organization that is based in Harare, Zimbabwe.
- ◇ Obtained password hashes for various users.
- ◇ Struggled to obtain the clear-text passwords of hashes using wordlists I had onsite.
- ◇ Started to play around with usernames as passwords
- ◇ Started to get hits e.g Chamunorwa

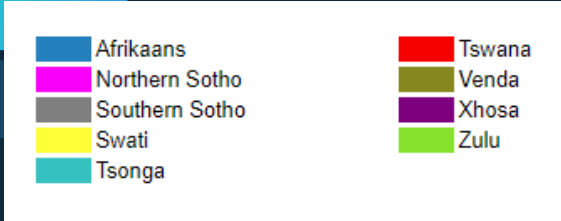




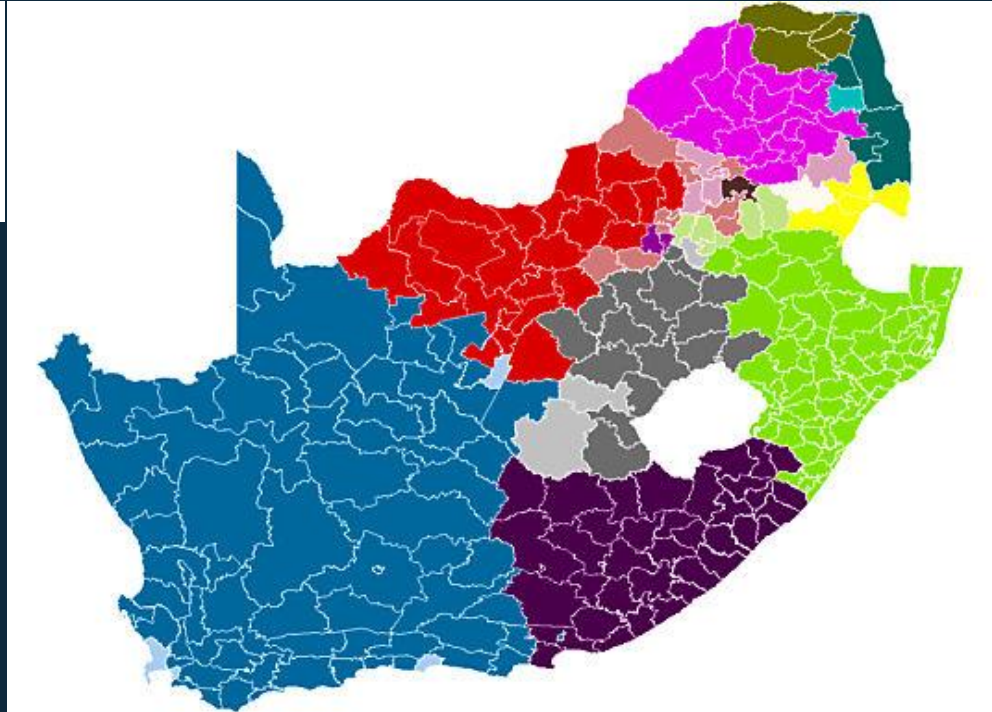
How effective are weak  
English passwords that  
have been converted to  
another language?



# South African languages



- ◇ South Africa has 11 official languages
- ◇ Languages regional based



Credit: <https://www.south-africa-tours-and-travel.com/languages-of-south-africa.html>

# Languages selected

- ◇ South Africa has 11 official languages
- ◇ For the purpose of this research only the following languages were selected
  - English
  - IsiZulu
  - Siswati
  - Sepedi
  - Tshivenda
  - IsiNdebele
  - Setswana
  - Xitsonga
  - IsiXhosa

# Experiment



## **Collect weak English passwords**

Collect as many weak English passwords

## **Convert them to African languages**

Convert the selected passwords to the eight Southern African languages

## **Upload to various password cracking websites**

Hash the African passwords and upload online cracking services.

# Process

- ◇ Randomly selected top 19 worst passwords from Symantec's Top 500

Here an extract :

Lists the top 500 worst passwords

NO	Top 1-100	Top 101-200	Top 201-300	Top 301-400	Top 401-500
1	123456	porsche	firebird	prince	rosebud
2	password	guitar	butter	beach	jaguar
3	12345678	chelsea	united	amateur	great
4	1234	black	turtle	7777777	cool
5	pussy	diamond	steelers	muffin	cooper
6	12345	nascar	tiffany	redsox	1313
7	dragon	jackson	zxcvbn	star	scorpio
8	qwerty	cameron	tomcat	testing	mountain
9	696969	654321	golf	shannon	madison
10	mustang	computer	bond007	murphy	987654
11	letmein	amanda	bear	frank	brazil

Credit: <https://www.symantec.com/connect/blogs/top-500-worst-passwords-all-time>



# Process

- ◇ Remove special characters from Tshivenda language

Ñ D L N T ñ d l n t

Credit: <https://africanlanguages.com/venda/>

- ◇ Make all the words lowercase

# Process

- ◇ Because in some Southern African languages such as isiZulu we capitalise the 3<sup>rd</sup> letter and not the first letter e.g isiZulu
- ◇ But sometimes even the 2<sup>nd</sup> letter can be capitalized e.g iBhola - soccer
- ◇ Special characters used are from my previous study into the passwords that are used in corporate South Africa

# Process

- ◇ NTLM and MD5 hash the generated passwords



# Top weak passwords per language

English	Zulu	Swati	Sepedi	Tshivenda	IsiNdebele	Setswana	Xitsonga	Xhosa
Password	iphasiwedi	Lekungena	Phasewete	Phasiwede	Ipasiwedi	Phasewete	Phasiwede	iphasiwedi
let me in	ngingenise					Mpolele		ndifake / phakathi
welcome	wamukelekile	Mukelekile	Amogetswe	Davhidza	Siyalemukela	O amogetswe	Amukela	Wamukelekile
freedom	inkululeko		bolokolohi					inkululeko
hello	Sawubona	Sawubona	Thobela	Matsheloni Avhudi	Lotjhani	Dumela	Avuxeni	Molweni
football	ibhola	ibhola	bolo	bola		bolo	Bolo ya minenge	ibhola
master	inkosi	Inkhosi	Kgosi	Thovhela	Ikosi	Kgosi	Hosi	Ukumkani
bible	iBhayibheli	iBhayibheli	Bibele	Bivhili		bebele	Bibele	iBhayibhile
fish	inhlanzi		hlapi			tlhapi	Nhlampfi	intlanzi
july	uJulayi	Julayi				Phukwi	Mawuwani	EyeKhala
summer	ihlobo	Ihlobo	lehlabula			selemo	Ximumu	ehlobo
Come in	Ngena	ngena				kena		Ngena
shadow	isithunzi	sitfunti				seriti		isithunzi
monkey	inkawu	inkawu				tsweni		isilwanyana
hunter	umzingeli	liphisi						ngumzingeli
trust no one	ungathembemunutu					setshepi/ motho		suthemba namnye
access	ukungena							fi kelelo
hammer	isando	candvula						nyundo
secret	imfihlo					sephiri		mifihlelo

# Months represented in the various languages

English	Zulu	Swati	Sepedi	Tshivenda	IsiNdebele	Setswana	Xitsonga	Xhosa
January	UMasingana	Bhimbidwane	Pherekong	Phando	Zibandlela	Ferikgong	Sunguti	EyoMqungu
February	UNhlolanja	Indlovane	Dibokwana	Luhuhi	Nhlolanja	Tlhakole	Nyenyenyana	EyoMdumba
March	UNdasa	Indlovu	Hlakola	Thafamuhwe	Mbimbitho	Mopitlwe	Nyenyankulu	EyoKwindla
April	UMBasa	Mabasa	Moranang	Lambamai	Mabasa	Moranang	Dzivamusoko	uTshaz'iimpuzi
May	UNhlaba	Inkhwekhwet	Mopitlo	Shundunthule	Nkwenkwezi	Motsheganong	Mudyaxihi	EyeCanzibe
June	UNhlangulana	Inhlaba	Phuphu	Fulwi	Nhlangula	Seetebosigo	Khotavuxika	EyeSilimela
July	UNTulikazi	Kholwane	Mosegamanye	Fulwana	Ntulikazi	Phukwi	Mawuwani	EyeKhala
August	UNCwaba	Ingci	Phato	Thangule	Ncwabakazi	Phatwe	Mhawuri	EyeThupha
September	UMandulo	Inyoni	Lewedi	Khubvumedzi	Mpandula	Lwetse	Ndzhati	EyoMsintsi
October	UMfumfu	Imphala	Diphalane	Tshimedzi	Mfumfu	Diphalane	Nhlangula	EyeDwarha
November	ULwezi	Lweti	Dibatsela	Lara	Lwezi	Ngwanatsele	Hukuri	EyeNkanga
December	UZibandlela	Ingongoni	Manthole	Nyendavhusiku	Mpalakazi	Sedimonthole	N'wendzanhala	EyoMnga

# Example of passwords created



Hashcat all weak password mask

- ◇ ?u?l?l?l?l?d?s – Uppercase \*1, lowercase \*3, digits \*2 and special character

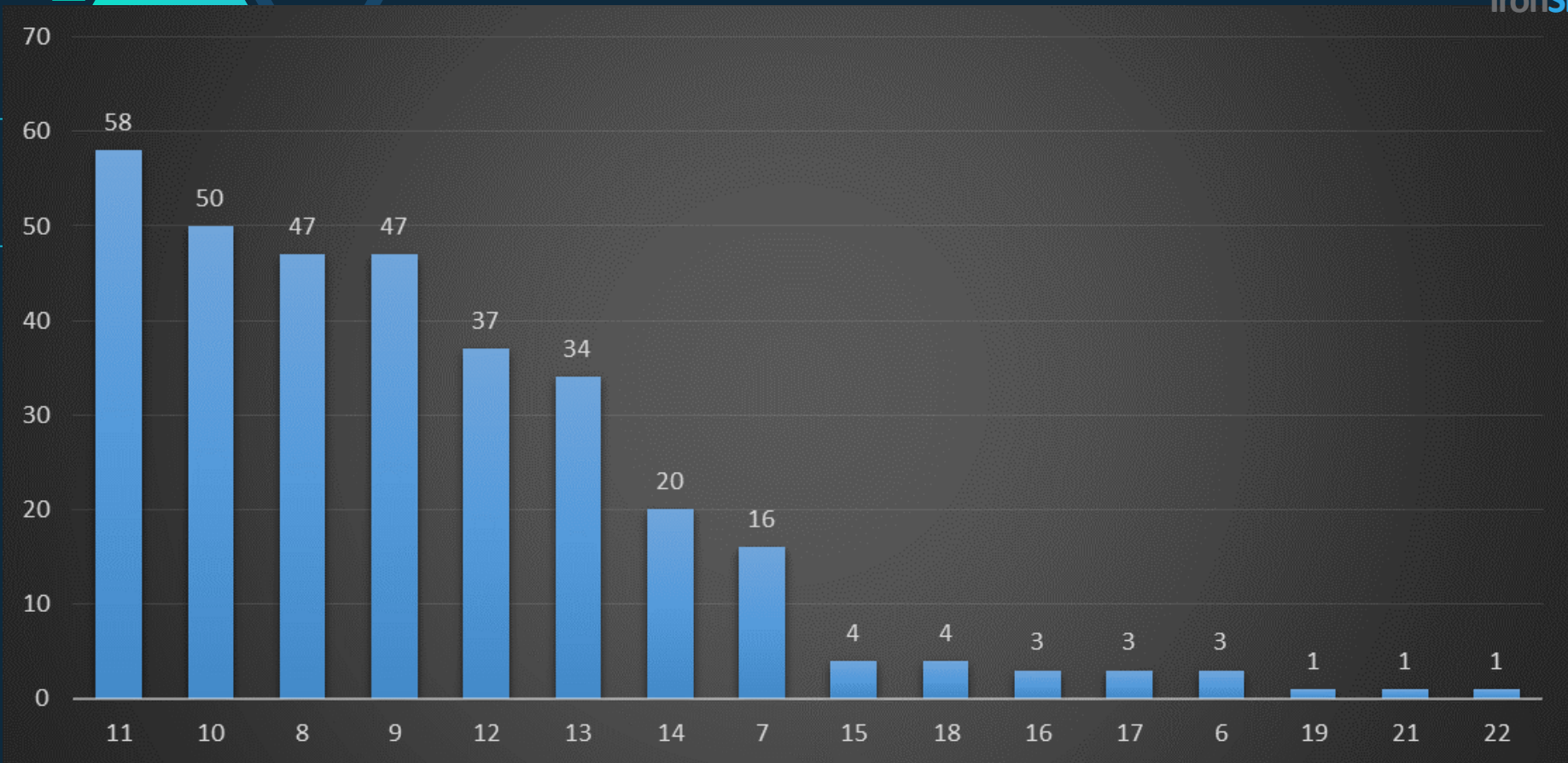
Hashcat month mask

- ◇ ?u?l?l?l?l?d?d – Uppercase \*1, lowercase \*5 and digits \*2

Password	English	African language
Ndifakephakathi33]	let me in	Xhosa
Phakathi78<	Inside	Xhosa/ isiZulu
Wamukelekile13/	Welcome	Zulu
Dibatsela18	November	Sepedi
Ncwabakazi18	August	isiNdebele
Dzivamusoko18	April	Xitsonga



# African passwords generated



A total of 330 passwords were generated







Cracked



## Online password cracking services

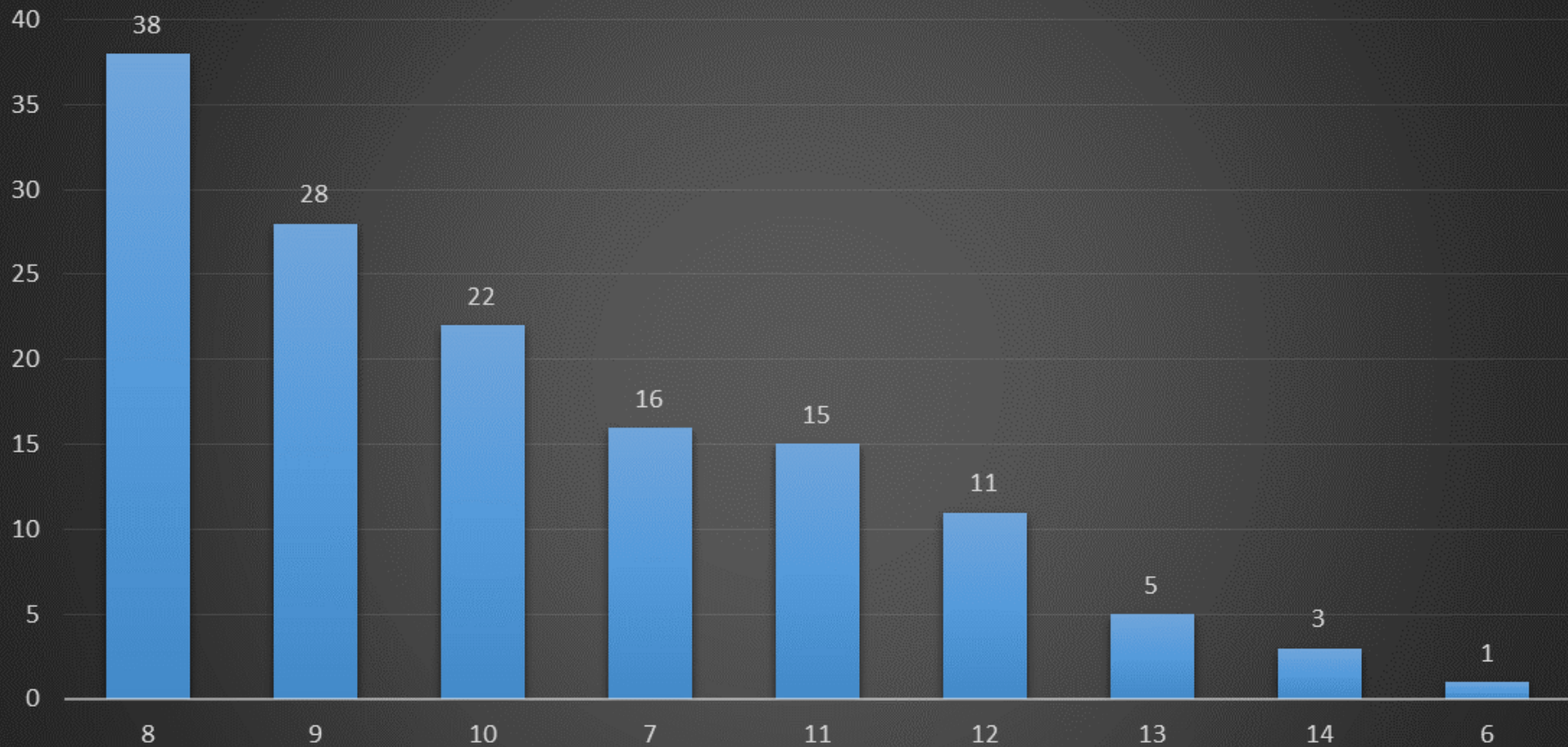
- ◇ All generated passwords were uploaded to online password cracking services such as:
  - <https://hashkiller.co.uk/>
  - <https://www.hashes.org/>
  - <https://www.onlinehashcrack.com/>

## Online password cracking services

- ◇ Hashes uploaded on the 30<sup>th</sup> of July 2018
- ◇ Stopped checking process on the 30<sup>th</sup> of August 2018
- ◇ 48% or 159 out of the 330 African derived passwords were successfully cracked between the online cracking services.
  - 100 NTLM hashes
  - 55 MD5 hashes
- ◇ Hashkiller cracked 90 out of the 100 NTLM hashes and most of the MD5 hashes as well.



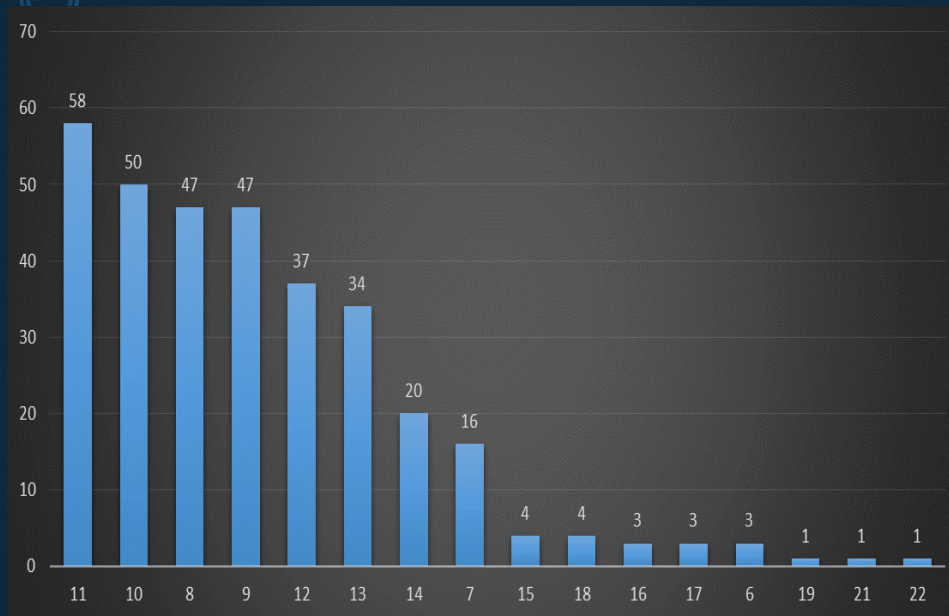
# African passwords cracked lengths



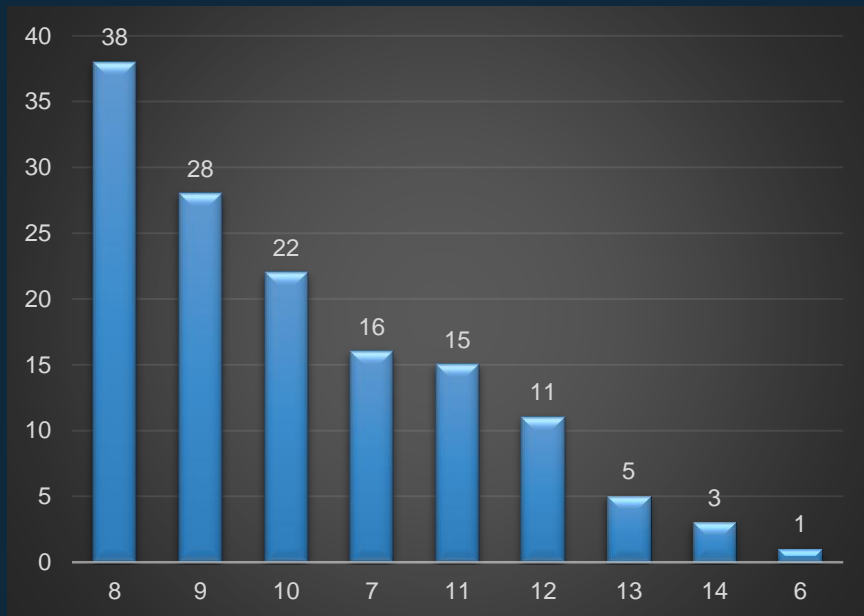
# African passwords cracked



Generated password lengths



Cracked password lengths



## African passwords cracked

- ◇ 15 out of the 58 for 11 character length passwords were successfully cracked
- ◇ All 7 character passwords were cracked
- ◇ For 8 character passwords 38 out of the 47 were successfully cracked.

# Cracked password words found per language

Top weak Passwords								
English	Zulu	Swati	Sepedi	Tshivenda	IsiNdebele	Setswana	Xitsonga	Xhosa
Password	iphasiwedi	Lekungena	Phasewete	Phasiwede	Ipasiwedi	Phasewete	Phasiwede	iphasiwedi
let me in	ngingenise					Mpolele		ndifake / phakathi
welcome	wamukelekile	Mukelekile	Amogetswe	Davhidza	Siyalemukela	O amogetswe	Amukela	Wamukelekile
freedom	inkululeko		bolokolohi					inkululeko
hello	Sawubona	Sawubona	Thobela	Matsheloni Avhudi	Lotjhani	Dumela	Avuxeni	Molweni
football	ibhola	ibhola	bolo	bola		bolo	Bolo ya minenge	ibhola
master	inkosi	Inkhosi	Kgosi	Thovhela	Ikosi	Kgosi	Hosi	Ukumkani
bible	iBhayibheli	iBhayibheli	Bibele	Bivhili		bebele	Bibele	iBhayibhile
fish	inhlanzi		hlapi			tlhapi	Nhlampfi	intlanzi
july	uJulayi	Julayi				Phukwi	Mawuwani	EyeKhala
summer	ihlobo	Ihlobo	Ihlabula			selemo	Ximumu	ehlobo
Come in	Ngena	ngena				kena		Ngena
shadow	isithunzi	sitfunti				seriti		isithunzi
monkey	inkawu	inkawu				tsweni		isilwanyana
hunter	umzingeli	liphisi						ngumzingeli
trust no one	ungathembemunutu					setshepi/ motho		suthemba namnye
access	ukungena							fi kelelo
hammer	isando	candvula						nyundo
secret	imfihlo					sephiri		mfihelelo

# Months represented in the various languages cracked

Months	Zulu	Swati	Sepedi	Tshivenda	IsiNdebele	Setswana	Xitsonga	Xhosa
January	UMasingana	Bhimbidwane	Pherekong	Phando	Zibandlela	Ferikgong	Sunguti	EyoMqungu
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June	UNhlangulana	Inhlaba	Phuphu	Fulwi	Nhlangula	Seetebosigo	Khotavuxika	EyeSilimela
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November	ULwezi	Lweti	Dibatsela	Lara	Lwezi	Ngwanatsele	Hukuri	EyeNkanga
December	UZibandlela	Ingongoni	Manthole	Nyendavhusiku	Mpalakazi	Sedimonthole	N'wendzambahala	EyoMnga





# Review

## Password

The word password was successfully cracked in two languages isiZulu and Xhosa

## Hello

The word hello was the only word to be fully cracked in all of the languages

## isiZulu

The African language that had the most cracked passwords.

## Xhosa

The least cracked language when it came to months

## Setswana

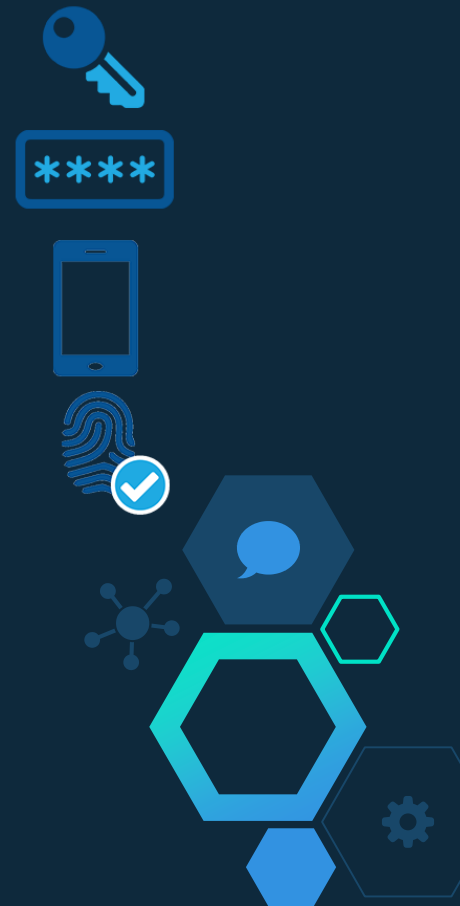
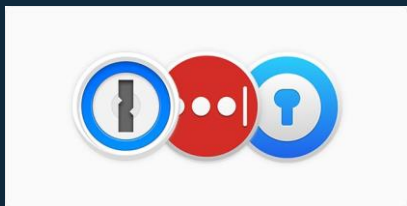
Most cracked language when it comes to months

## Conclusion

- ◇ Corporate South Africa used English based passwords even though there are 11 other official languages
- ◇ South African users used readily available objects and words to create their passwords
- ◇ Password is very popular in South Africa – SADLY!!!
- ◇ Converting English based passwords to Zulu did not offer any additional protection
- ◇ Tshivenda might actually be the better language to create passwords in because of special characters and difficulty of language
- ◇ Using months Xhosa least cracked.

# Takeaways

- ◆ Teach users about good password practices
- ◆ Multifactor authentication gives you that defense in depth so even if a user has a weak password
- ◆ Don't share passwords between social media and corporate for example
- ◆ Avoid periodic password changes
  - NIST 800-63b
- ◆ Conduct password audits
  - Prevention is better than the cure





# Thanks!

## Any questions?

You can find me at:

- ◇ @sibusisosishi
- ◇ sibusiso@ironsky.co.za

