



ELECTORAL COMMISSION  
OF GHANA

# Ghana's BVMS

Understanding the need for a new Biometric Voter Management System

# Objectives

- Explain the current Biometric Voter Registration Process
- Discuss the challenges of the current system
- Offer you reasons for the acquisition of a new system
- Discuss the financial implication of the acquisition of a new system
- Questions and Answers

# Importance of a Credible Voters Register

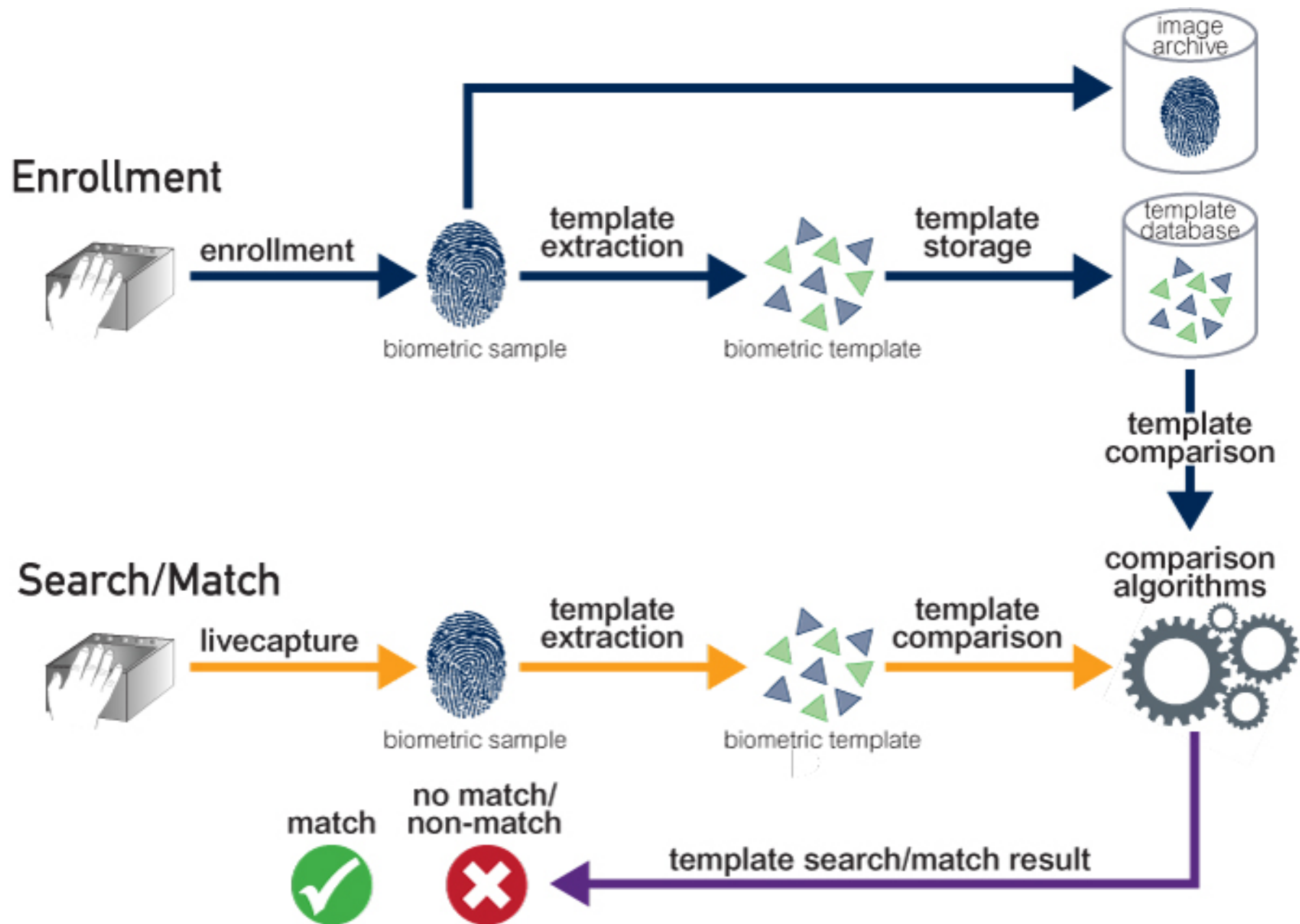
- Voter registration is one of the most important activities that an electoral management body (EMB) needs to conduct.
- A credible voter register confers;
  - Legitimacy on the electoral process
  - Prevents electoral fraud
  - Every eligible voter can vote only once
- An inaccurate voter register creates problems in the electoral process by
  - raising doubts about the election's inclusiveness and outcome
  - opening up avenues for fraud and manipulation

# The Biometric Voters Register

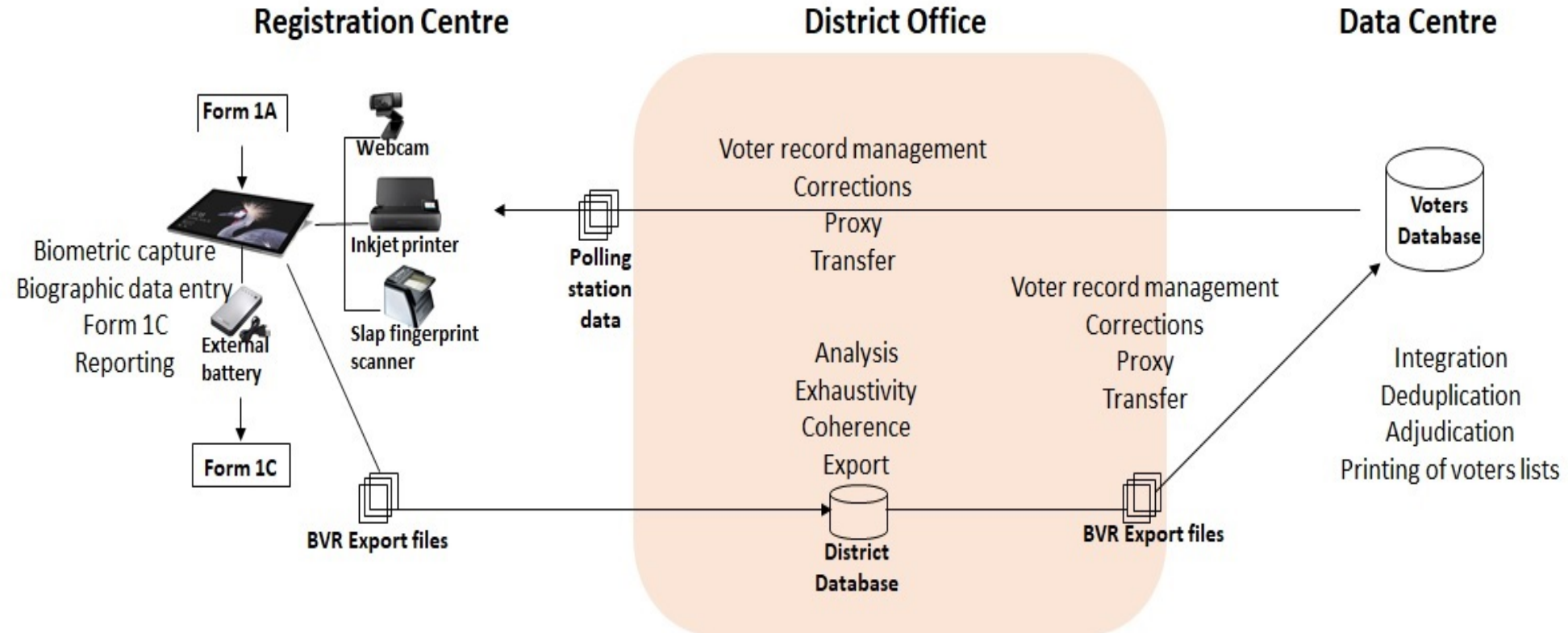
- Biometric Modalities have been used for some time now to enhance the legitimacy of voters register worldwide
- The largely apolitical nature of the a Biometric Voter Register makes it the preferred choice especially in situations where political tensions tend to be very high.
- Biometrics involves the measurement and analysis of unique physical or behavioural characteristics of an individual
- Currently modalities in common use are: fingerprints, palm prints, retina and iris scans, voice patterns and facial patterns

# Capturing, processing and storing biometric data for Electoral Purposes

- Most commonly captured biometric features for electoral purposes are fingerprints for automatic fingerprint identification systems (AFISs), and
- Facial images of voters for facial recognition systems (FRSs)
- Biometric data is first captured by a camera or sensor as an image
- Image is then further processed into a biometric template
- Matching algorithms used for verification and de-duplication are based on comparing these biometric templates



# Registration and Creation of Voters List



# Challenges of the Current System – BVR Kit

1. The Kit had been in use since 2011
2. Many of the Component parts had reach end of life and end of support
3. A large quantity of the kits had many faulty component parts that were difficult to replace (keyboard, mouse, screen, camera)
4. The battery packs had worn out and therefore the decreased battery autonomy could not guarantee continuous use of the BVR
5. The image quality obtained from the fingerprint scanner we increasing deteriorating leading to repeated image acquisition prolonging the registration process
6. The inkjet printers were failing at a frequent rate



# Challenges of the Current System – BVD

1. Purpose built device for EC had been in operation since 2011
2. High failure rate of the BVDs
3. A lot of money had to be spent refurbishing them for use for the various elections
4. Worn out sensors meant poor image acquisition leading to repeated attempts on verification
5. Manual verification had been an increasing trend due to failure of the BVDs to electronically verify voters.

# Challenges of the Current System – Network

1. Very Small Aperture Terminal (VSAT) technology had been deployed to connect the various remote offices to the datacentre
2. VSAT had low bandwidth, very high latency and was susceptible to changes in the weather such cloud cover and rain
3. This was of particular challenge during the Limited Registration Exercise resulting in low utilization rate of the online VMS
4. The network design was rigid and poorly documented not allowing for integration of newer technologies
5. Communication between nodes were not encrypted and in some instances microwave links were shared with other customers raising security concerns

# Challenges of the Current System – Datacentre

1. All the equipment within the DC were either EOL or EOS
2. Some of the equipment did not have an active warranty since 2014
3. Most of the software licenses had expired
4. The Storage Array System were running on 1G iSCSI which made for very slow processing.
5. Disks in the array were a combination of 10K and 7.2K RPM HDD
6. The rest of the network within the DC were a mixture of 100Mbit/s and 1G connectivity
7. The Combination of the above could not deliver the IOPs that was required to meet the demands of the system.

# Challenges of the Current System – BVMS Application Components

1. The BVMS application modules were built by different vendors and were poorly documented.
2. Troubleshooting and problem isolation was very difficult as it involved a lot of finger pointing with vendors located in different time zones involved in the troubleshooting.
3. Root cause analysis could take days
4. Vendor would not commit to any service levels
5. Source code was not available to EC
6. Biometric templates were being kept in a proprietary format

# Challenges of the Current System – Operational Issues

1. None of the EC IT Staff were trained on the BVMS. The EC was complete reliant on the vendor for the management of the system
2. The application server used for the online VMS was limited by allowing only 200 concurrent connections. The EC has some 260 district offices nation wide each with at least 2 VMS machines
3. There was no business continuity or an IT disaster recovery plan.
4. The backup strategy in place was such that the best recovery point objective (RPO) attainable was about 1 month and the best recovery time object (RTO) was about 1 week.
5. Full backup of the Oracle DBMS took at least 72 hours and this is with the system quiesced.

# Challenges of the Current System – Operational Issues

1. Application system design was such that there was no insight into the quality of the data being egested
2. There were no checks and balances in the system to determine if some records were missing. This process had to be manually done and it was a laborious process running queries on the database and cross-checking it with manually recorded tallies from the field.

# Software version currently used

Software	Version
Operating System for BVR Kits	Microsoft Windows 7
Operating System for new VMS Kits	Microsoft Windows 10
Linux Operating System for Datacenter Servers	Redhat Enterprise Linux 5.8
Windows Operating System for Servers	Microsoft Windows 2003, 2008 and 2012
Vmware Hypervisor	VMWare ESX 5.0
Oracle DBMS	Oracle 11.2.0.2
Apache Tomcat Application Server	Version 6.0

Out dated and unsupported software have several vulnerabilities that can be capitalize by mischief makers leading to potential data loss

# Challenges of Current System – Conclusion

- The current system was not able to support the current and future demands of the Commission
- It was a closed proprietary system that did not allow itself for upgrades
- There hardware equipment were obsolete, had failing parts and were difficult to maintain with expensive and unsustainable maintenance costs.
- The commission was vendor locked-in
- The IT Staff could not own the system as they were shut out
- There was a potential risk of data loss as there was no backup or disaster recovery plan
- IT WAS TIME TO CHANGE THE SYSTEM



# Features of the New System

- An open system based on standard and open technology (prevents vendor lock-in)
  - Biometric Data must be stored in ISO certified convertible standard
  - Images must be ICAO Compliant
  - Must have an open and well documented API to allow for further enhancement and integration with other government agencies and third-parties
  - Source code to be own by the EC
- A system that is hardware agnostic
- Mechanisms in place to remove dead people and clean-up the register
- Must allow for continuous registration of voters
- Use of facial recognition as an additional verification modality
- Must have IT business continuity and disaster recovery built-in
- Must be secure preventing mischief from external and internal sources

# Why not just upgrade the hardware?

- Throw back question – Which component are you going to upgrade?
  - How are you going to upgrade the VSAT technology?
  - How do you upgrade 2011 Computer with 2019 components?
  - Can you upgrade a battery pack?
  - Can you upgrade a Samsung Galaxy S3 to S10? Sensor upgrade for BVD
  - Can you upgrade a fixed port switch from 10/100 to 1G switch or 1G to 10G?
  - How do you upgrade a Storage Array System that is EOS?
  - Will the legacy operating systems and applications run on the new hardware?
    - Operating Systems will have to be upgraded in order for them to run on new hardware
    - Java version that the application requires then become an issue for new OS
    - Will the application run as it should on this version of Java?

# Advantages of New System Vs Upgrade

- New server hardware can come with three, four, or five years of warranty or support coverage
- Higher system performance than the older server would provide, which might allow 2:1 or 3:1 server consolidation
- Higher memory capacity than the older server would support, and likely less expensive memory
- Other system components are latest technology, providing higher performance
- Other than unlikely manufacturing flaws, a new server should not see any hardware issues
- Longer expected life of a new server

# Is the EC discarding all previous data?

- No, this is not the case
- The EC intends to use the existing data of voters during the registration of voters into the new voters register.
- Existing voters would not be required to go through the same process as new voters
- To be registered unto the new register, existing voters need to only present their existing voters' ID card to the registration officer.
- Their details will be retrieved from the existing database and their biometrics captured i.e. new facial image and 10 fingerprints
- Existing voters can have their details updated anywhere in the country where registration is on-going and new voters ID cards immediately issued to them. We anticipate that this process should take about 5 minutes.

# So if the data is usable why not migrate it?

- Unfortunately the generated templates of the fingerprints in the existing database are stored in a proprietary inconvertible format.
- We are therefore not able to migrate those templates into a usable format. **It is useless**
- It must be also be noted that there is a risk of potential data loss when converting from one template format to the other
- This is why it is a requirement of the EC that for new system that the raw images of the captured biometrics are kept in ISO standard WSQ format and JPEG 2000 before templates are generated.

# Why build a datacentre? Why not use NITA?

- The Commission appreciates the advantages of using government shared hosting services.
- However in this instance the hosting is not a viable option because of the following;
  1. There would be unnecessary suspicion of government control if the EC kept its application servers in the government managed cloud/facility.
  2. We are not certain of the provision of disaster recovery services
  3. Saving our data in the public cloud is not an option for the Commission
  4. Our biometric matching servers are processor intensive and does not lend itself for being hosted in a virtualized environment
  5. We run process e.g. printing of the voters list that require industrial printers to be in close proximity to the servers.

# Financial Analysis of Old vs New - BVDs

	<b>2016</b>		<b>2020</b>
No of BVD Units Used	68,000.00	Number of BVR Required	80,000.00
Those in good condition	56,000.00	Unit cost of new BVD (USD)	400.00
Unit Cost of Refurbishment (USD)	244.00		
Total Cost of Refurbishment	13,664,000.00		
Additional BVD Required for 2020	24,000.00		
Unit cost for New BVD (USD)	917.00		
Total cost of additional BVDs required	22,008,000.00		
<b>Total cost of BVDs for 2020 Election</b>	<b>35,672,000.00</b>	<b>Total Cost of new BVD (USD)</b>	<b>32,000,000.00</b>

# Financial Analysis of Old vs New – BVR Kits

No of BVR Kits used in 2016	5,500.00		Number of BVR Kits required	8,000.00
No of BVR Kits that are refurbishable	1,500.00		Unit Cost of BVR Kits (USD)	3,000.00
Unit cost of refurbishment (USD)	3,500.00			
Total cost of refurbishment for BVR (USD)	5,250,000.00			
Additional BVR Kits required for 2020	6,500.00			
Unit Cost of new BVR Kits (USD)	5,145.00			
Total cost of additional BVR Kits (USD)	33,442,500.00			
<b>Total for BVR for 2020 Election (USD)</b>	<b>38,692,500.00</b>		<b>Total Cost of new BVR Kits (USD)</b>	<b>24,000,000.00</b>



# Savings for New BVR Kits + BVDs

<b>Summary</b>	
<b>Grand Total for Old BVR + BVD (USD)</b>	<b>74,364,500.00</b>
<b>Grand Total New BVR + BVD (USD)</b>	<b>56,000,000.00</b>
<b>Saving when new system is procured (USD)</b>	<b>18,364,500.00</b>
<b>Saving when new system is procured (GHS) @ 5.7</b>	<b>104,677,650.00</b>

# Financial Analysis of Old vs New - Datacentre

Proposed Cost of refurbishment of Datacentres (USD)	15,000,000.00		Cost of new datacentre	6,000,000.00
Annual Maintenance Cost of Datacentre (USD)	4,000,000.00		Maintenance Cost of New Datacentre	1,000,000.00
Total Cost of Datacentre with maintenance (USD)	19,000,000.00		Total Cost of new datacentre with main	7,000,000.00
<b>Summary</b>				
<b>Total Cost of Refurbishment of Old datacenter (USD)</b>	<b>19,000,000.00</b>			
<b>Total Cost of new datacentre with maintenance (USD)</b>	<b>7,000,000.00</b>			
<b>Saving when new datacentre is acquired (USD)</b>	<b>12,000,000.00</b>			
<b>Saving when new datacentre is acquired in GHS @ 5.7</b>	<b>68,400,000.00</b>			

# Grand Saving with Procurement of new equipment for 2020 (GHS)

- Saving when new system is procured (GHS) @ 5.7  
104,677,650.00
- Saving when new datacentre is acquired in GHS @ 5.7  
68,400,000.00
- **Grand Savings with Procurement of new equipment for 2020 (GHS)**  
**173,077,650.00**

# Questions and Answers