



# National Land Authority

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**Yvonne AKIMANA**

Director of Land Survey and Mapping

Kigali, 27 November 2024

# Outline

## **Geospatial Information Management and Surveying in Rwanda:**

- Evolution of Digital Mapping
- SDI in Rwanda
- Rwanda SDI Hub
  - Tools and technology
  - Structure
- Evolution of Surveying in Rwanda
- CORS Network
- Cadastral Maintenance
- Future perspectives



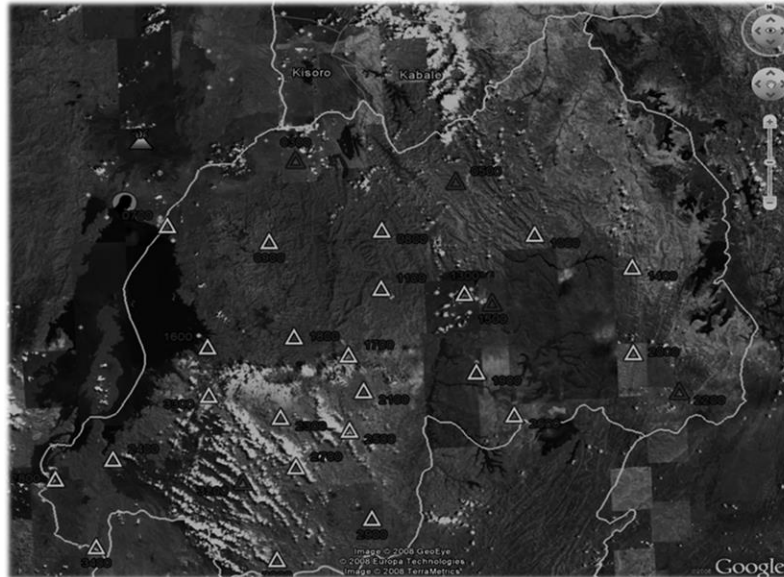
# GIS in Rwanda



# Colonial period

geodetic reference systems

28 stations,  
(each with  
eccentric  
station at a  
distance  
of 2-5 km)





# GPS Campaign 1991-1992

- **Established new terrestrial network using GPS.**
- **Then came the 1994 Genocide against the Tutsi, and some of the ground control points were destroyed**



G.C.P. No. 2500, at King's Palace,  
Nyanza-Rwanda



1999

Centre for GIS and  
Remote Sensing  
(CGIS) created





# Advancement in GIS

- **Since 1999: CGIS organizes GIS trainings for different people from different organizations**
- **Since 2006: introduction of GIS-based academic courses @NUR, Geography Department**



# Data Collection

- **Handheld GPS**



**Manually loading raw data into GIS software  
to prepare a final data set**



**Accuracy  $\approx$  3m (built-in GPS),**



# GIS Products



EPS



PNG



JPG



TIF



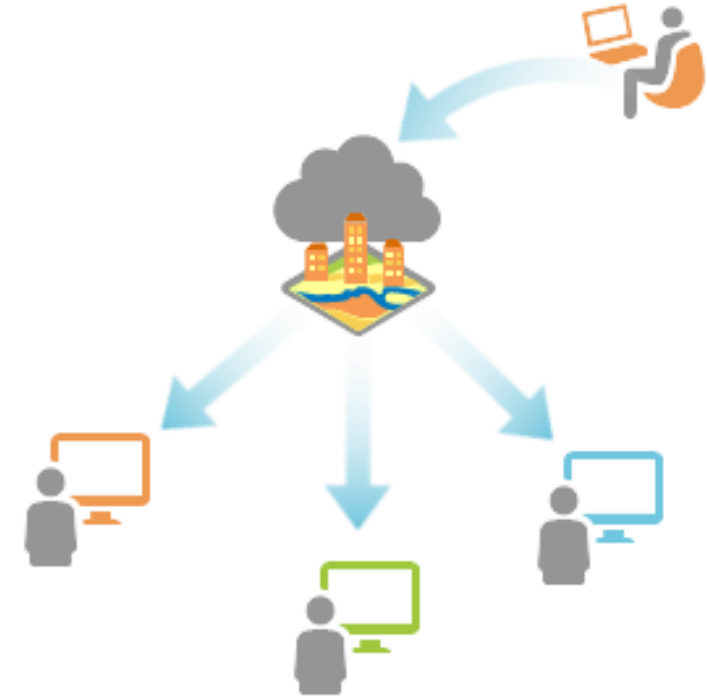
Hard copies, non-interactive maps, “end product”

- **Interactive maps (pan, zoom, select,...)**
- **Connected to data source**
- **Possibility to query**
- **Etc...**

# Data Sharing



- **No possibility to limit access**
- **Possibility of having many versions...**



- **Possibility to open data to the public or restrict access**
- **Shared data can be updated anytime**





# SDI in Rwanda

# SDI Related efforts in Rwanda

1

**October 2006**

First SDI conference by CGIS-NUR in collaboration with the NIS to kick-start the establishment and maintenance of a National Spatial Data Clearinghouse and defining a spatial data policy for Rwanda.

2

**August 2007**

Training on the GIS Portal Toolkit, sponsored by ESRI. Staff of RDB-IT and CGIS-NUR were trained

3

**May 2009**

Two SDI related meetings were organized NLC, and the RDB-IT respectively.

4

**June 2009**

Workshop by CGIS-NUR tagged as *Spatial Data Inventory and Metadata Management: Showcasing the Metadata Search Facility*



# SDI Related efforts in Rwanda

1 — 2009-2013

Systematic Land Registration. Production of many spatial datasets

2 — July 2015

Rwanda Data Portal developed by RCMRD launched by RNRA

3 — 2017

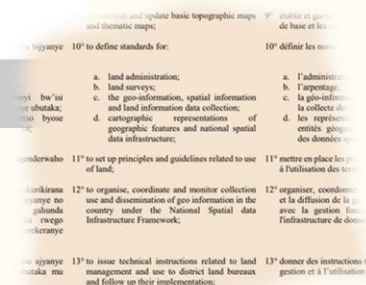
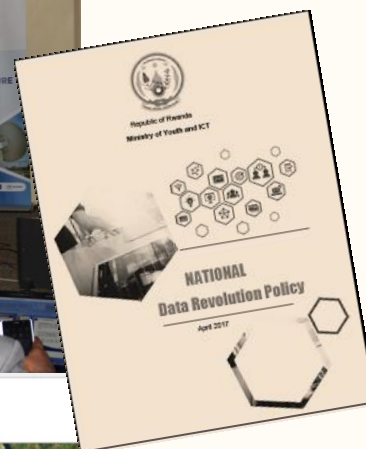
Data Revolution Policy, one of the key strategic recommendations to develop NSDI

4 — 2018-2019

Establishment of NSDI and Land use monitoring system

5 — November 2021

Rwanda SDI Hub launched





# Rwanda SDI Hub



# Tools and technology



**ArcGIS Desktop**



**ArcGIS Pro**



**ArcGIS Online**

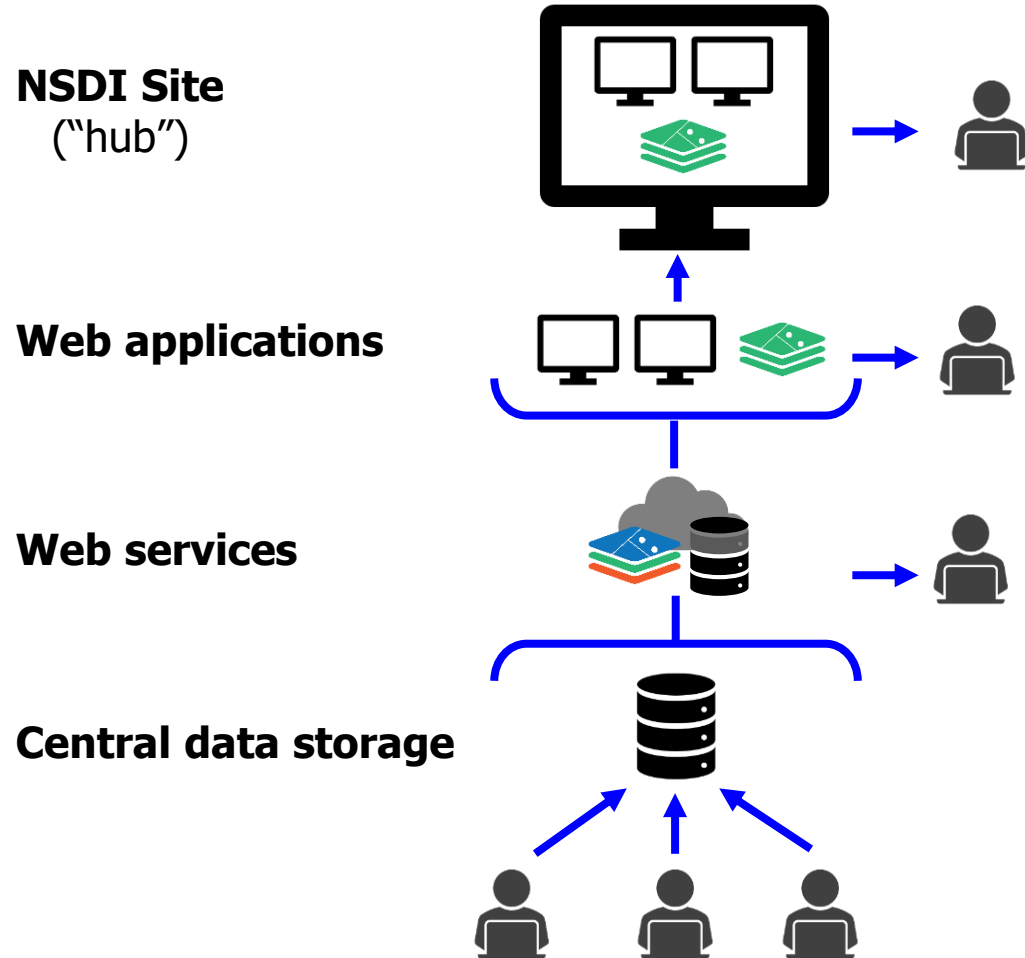


**ArcGIS Enterprise**

**Server**  
(hosted at the National Data Center)



# Structure





# Structure



<https://geodata.rw/portal/home/>



# NSDI –Overall System Architecture Overview

## Desktop Based Capabilities

### ArcGIS Desktop/ArcGIS Pro



#### System Administrator



### Key Features

Create and Manage users, and groups



Create and Publish data and web tools & maps



Manage data



Geo-spatial Analysis Tools



## ArcGIS Enterprise Web & Mobile Apps



ArcGIS Survey123, Workforce, Field Maps

## RLMUA/NSDI Data managers/operators



### Key Features

Data collection



Manage Data



Digital Mapping



Interactive Dashboards



Reporting



Data Analytics



Monitoring Tools



Geo-spatial data Visualization



Situation Awareness & Decision Making



Public



## Application Server

## Image Server



ArcGIS Web Adaptor

Portal for ArcGIS

ArcGIS Server

ArcGIS Data Store

PostgreSQL



Database Server



## ArcGIS Enterprise NSDI GIS Technology



### APIs Integration Layer



Parcels



BPMIS



Infrastructure Data



Admin Zones



UDM



Smart City Project



Other National Geodata and Data Services



Third Party Content (i.e. satellite images)

### Data Sources

# Benefits

A word cloud centered around the word "Money". The word "Money" is the largest and most prominent, rendered in a dark grey serif font. Surrounding it are several other words in various sizes, colors (orange, teal, and grey), and orientations (horizontal and vertical). The words include "Harmonization", "Resources", "Standards", "Decision", "Time", "Data", "Smart", "Technology", and "Development".

Harmonization  
Resources  
Standards  
Decision  
Money  
Time  
Data  
Smart  
Technology  
Development





# Surveying in Rwanda

# Background

- 1 — 2009-2013  
Systematic land registration initiative and establishment of geodetic network
- 2 — 2017  
Introduction of Rwanda Organization of Land Surveyors
- 3 — 2018  
Elaboration of guidelines for cadastral Surveying by NLA
- 4 — 2024  
Transitioning from the submission of surveyed data via CDs to online submission through the Irembo platform and the ROLS app.





## Establishment of Rwanda CORS Network

- In 2013, Rwanda CORS Network was established with 8 CORS stations installed across the country
- In 2019, the Network was densified from 8 to 10 CORS stations

# CORS

## RWANDA GPS-CORS NETWORK

### Legend



CORS Station



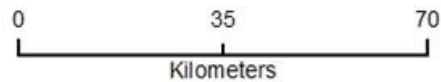
Lake



National Park



District Boundary





# The Rwanda Geodetic Network RGN

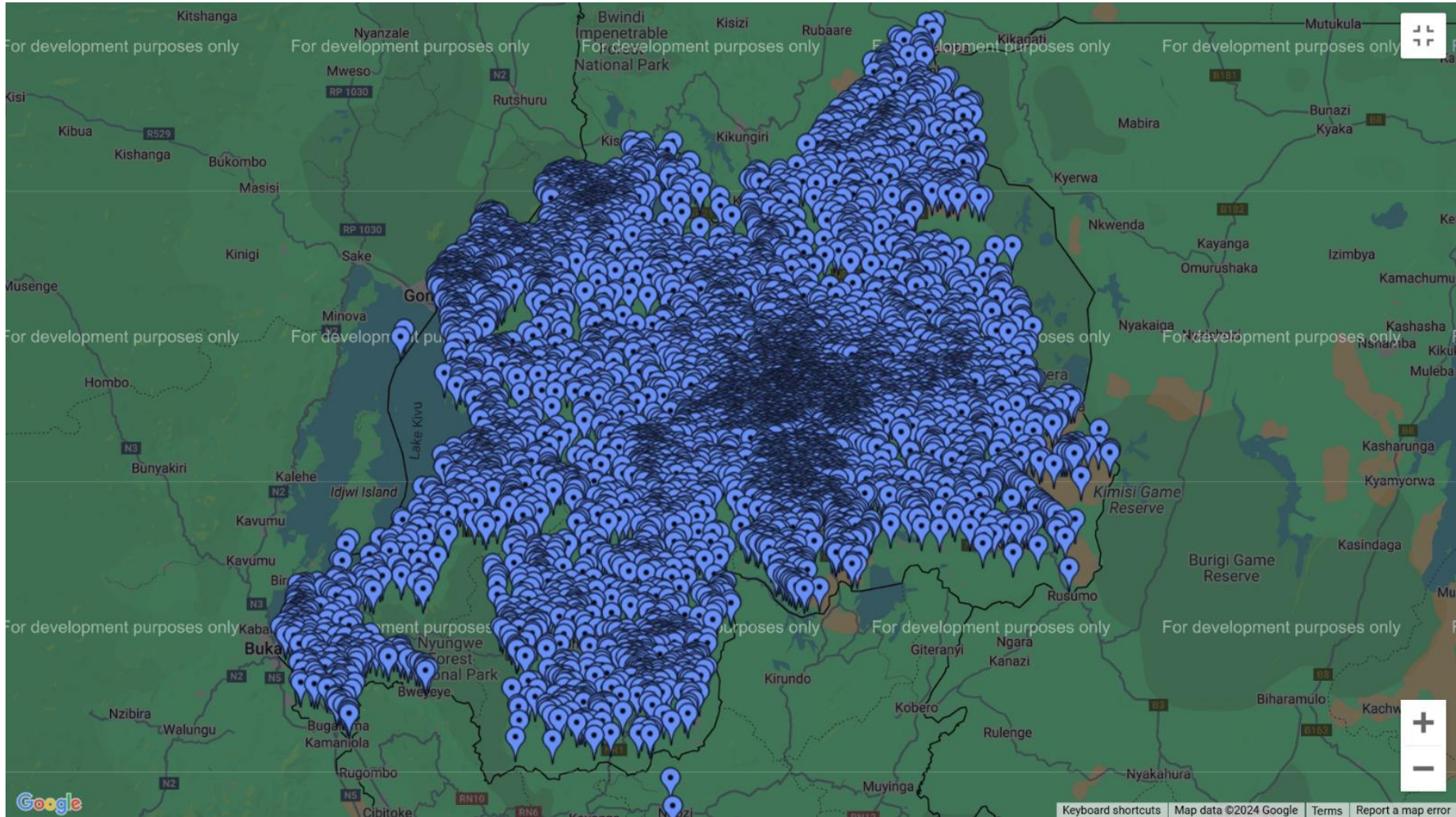
- A network of Continuously Operating Reference Stations (CORS) provide (GNSS) data in support of three dimensional positioning, meteorology, space weather and geophysical applications throughout the Rwanda, its neighboring countries .



Surveyors, GIS users, engineers, scientists, and the public at large that collect GNSS data use GNSS CORS data to improve the precision of their positions

- Access via mobile internet (3G/Ntrip)
- Different level of Accuracy :
  - Hz ~ 1cm– 5cm
  - VPPS ~0,1mm
- Different level of Services :
  - Single RTK, direct or Nearest Site
  - Network RTK (MAC, VRS,...)

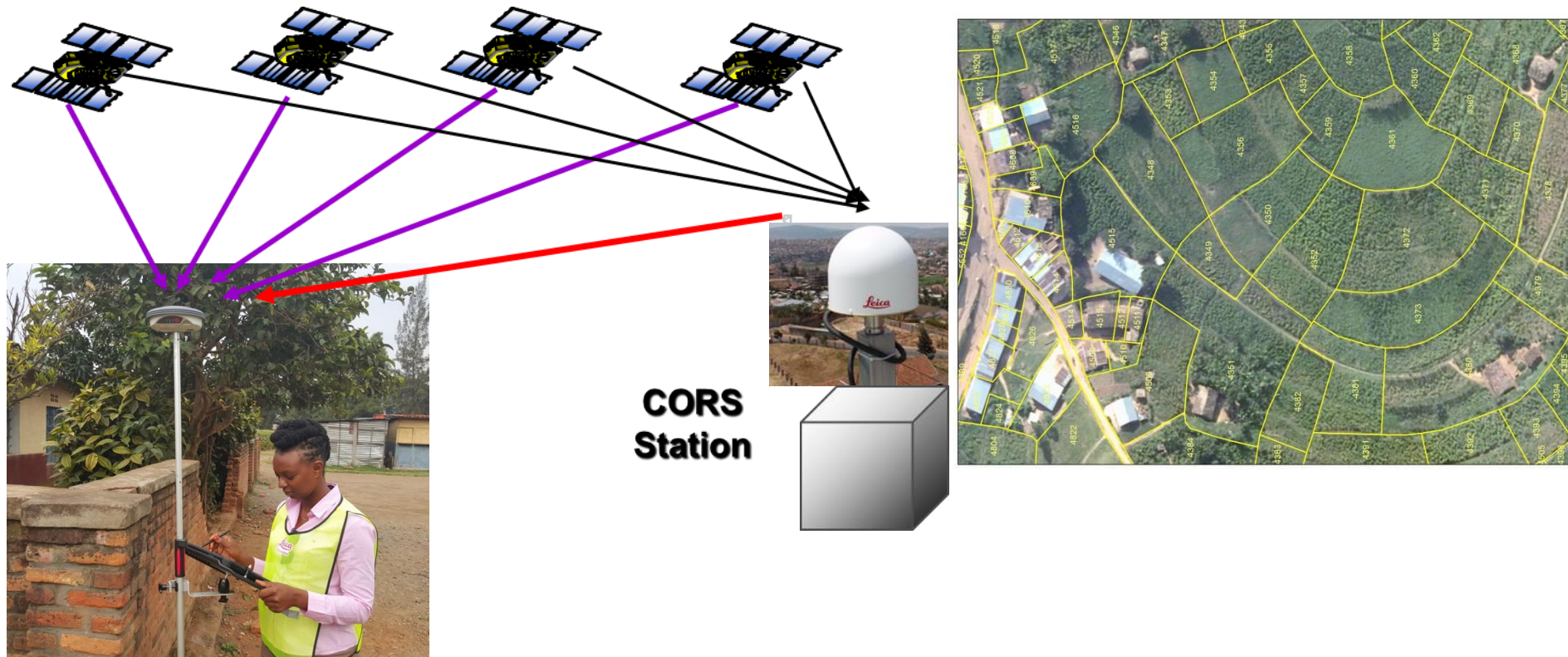
## Tochmap of RGN users ( Nov,8, 2024)





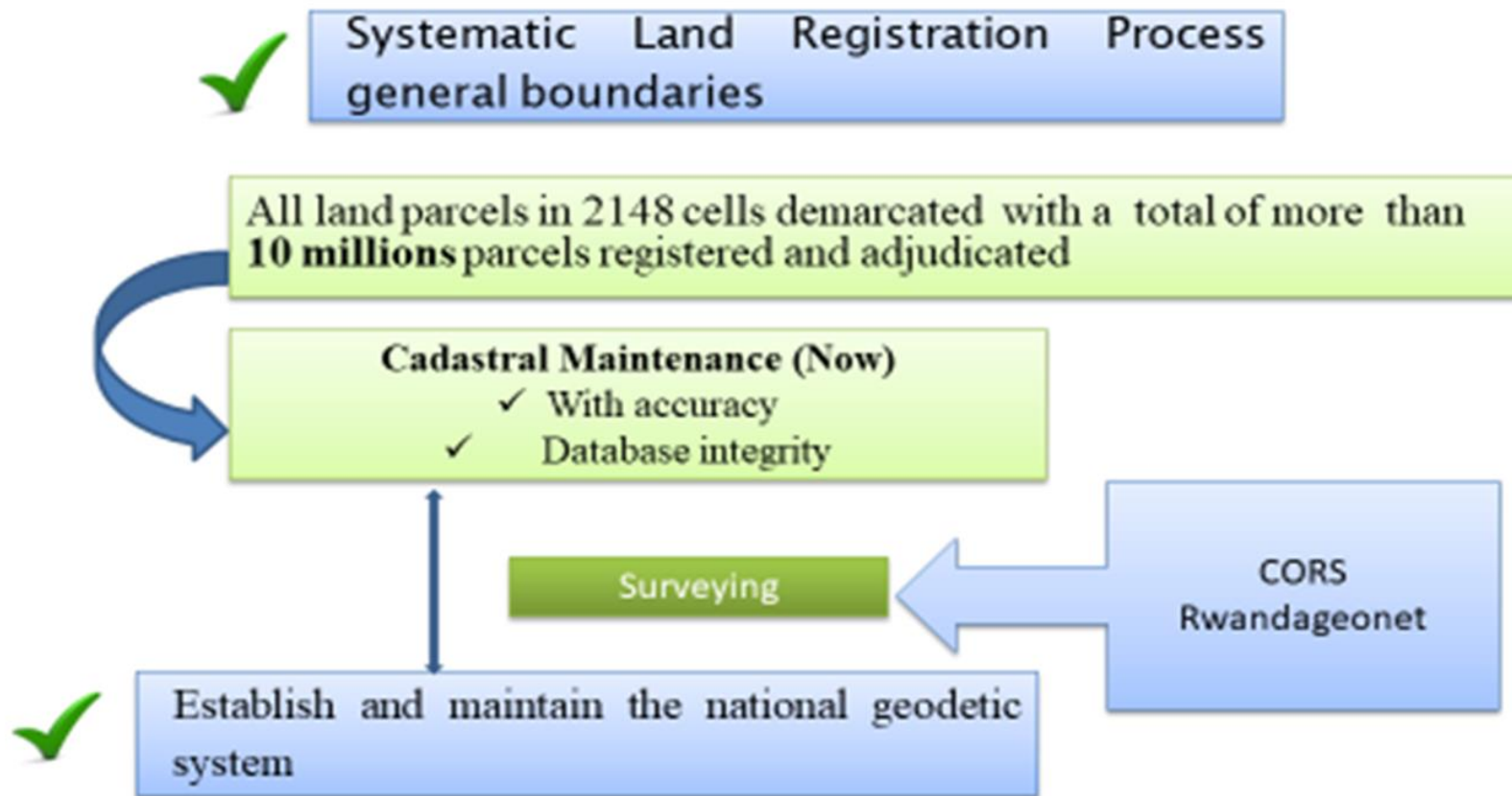
# CORS STATION

## MAKING SURVEYING AND MAPPING SERVICES

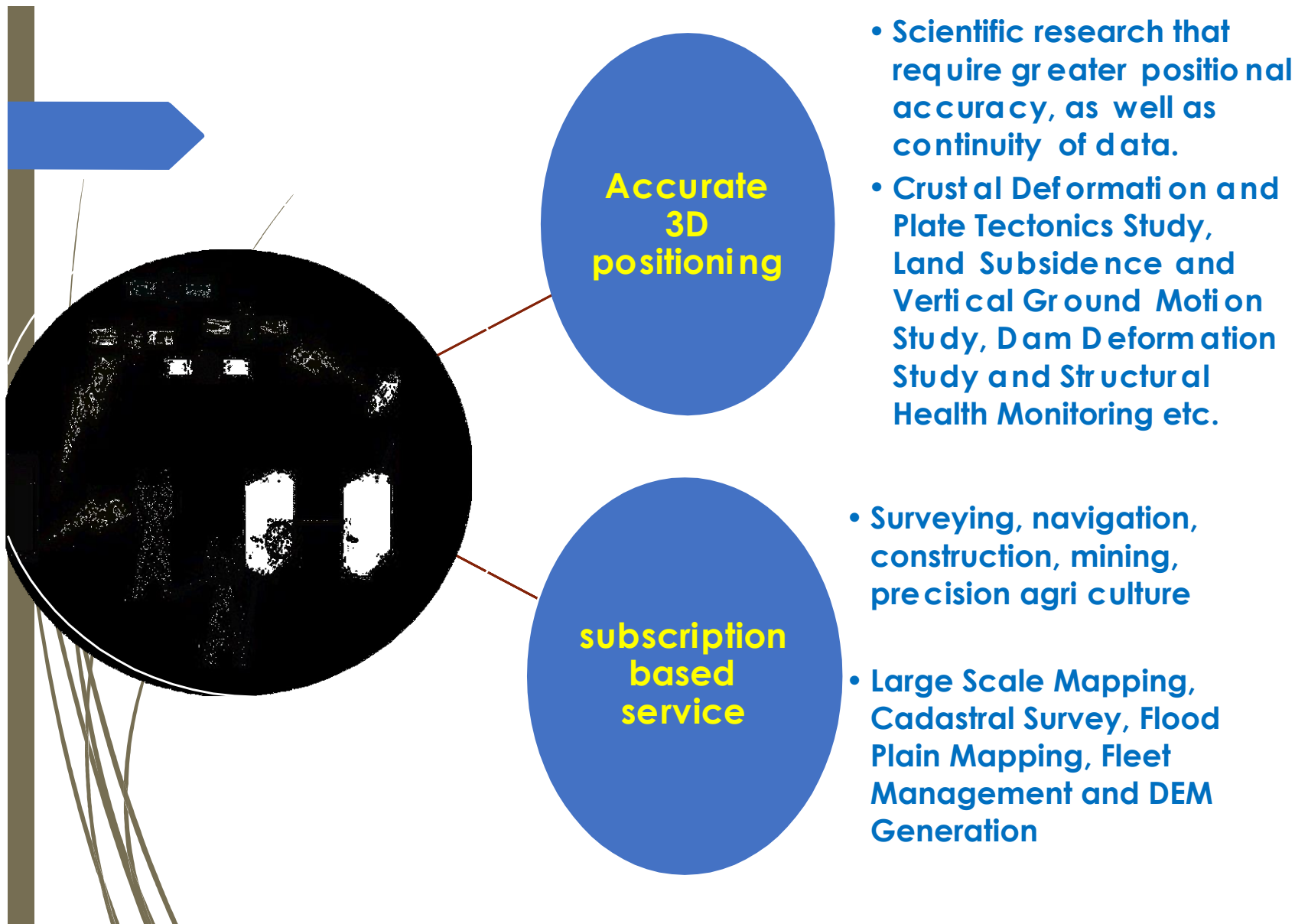




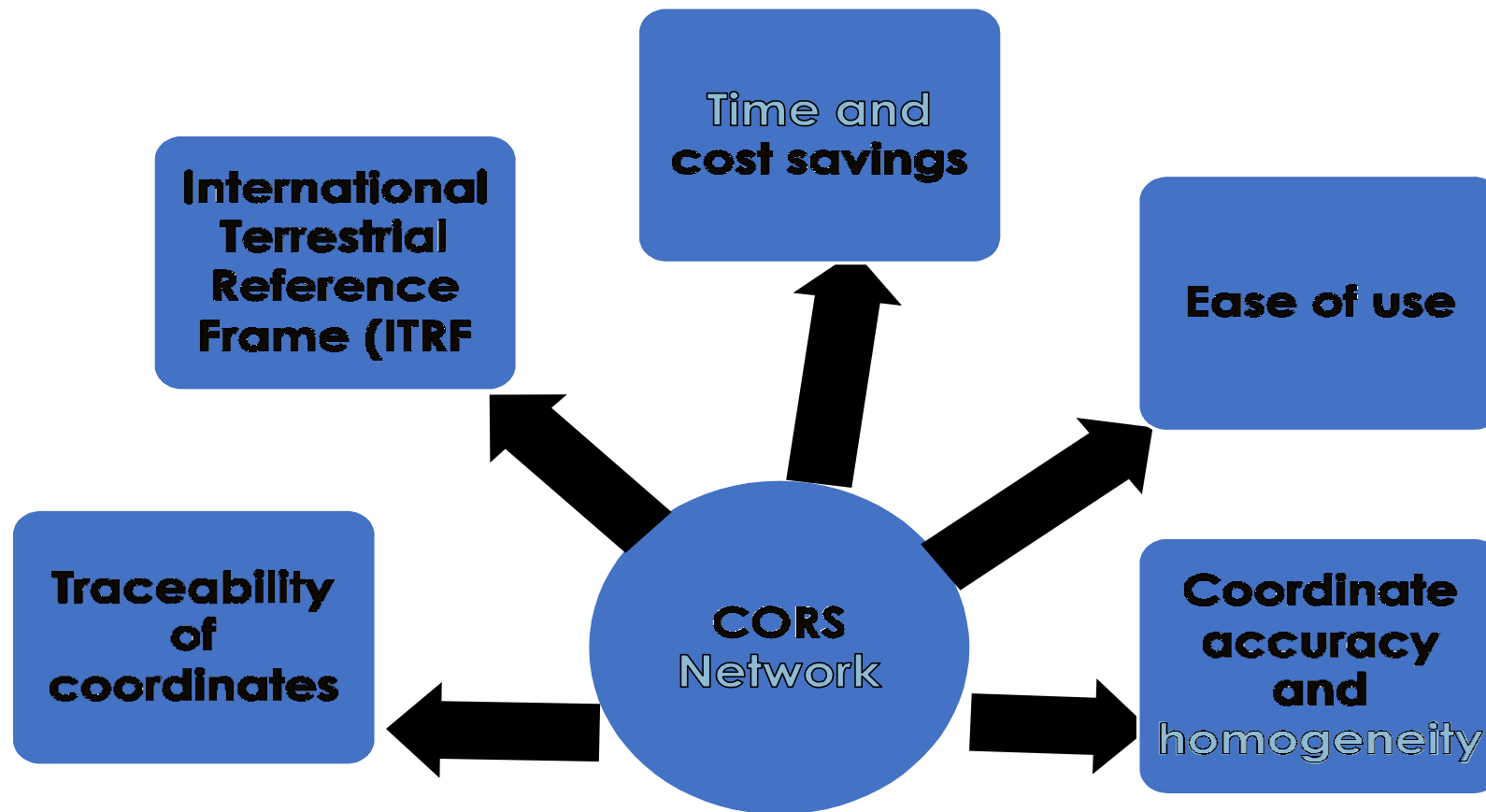
# CADASTRAL MAINTENANCE



# USAGE OF CORS IN RWANDA



# Benefits of CORS Network



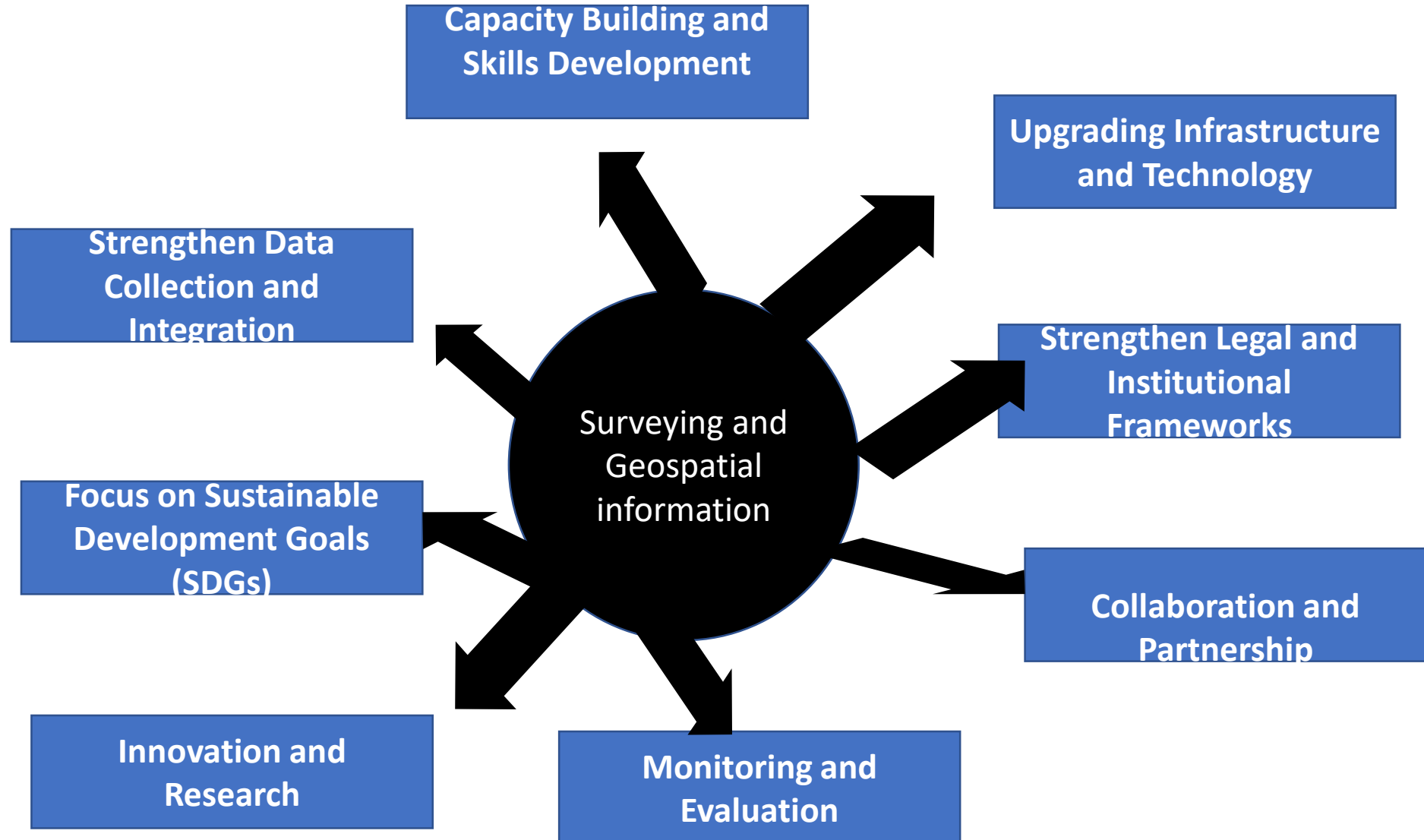


## CHALLENGES OF CORS NETWORK



- ☐ Mobile Internet coverage
- ☐ Power supply
- ☐ Maintenance

# Future Perspectives





# Thank You

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