Update from SATNAV Africa Joint Programme Office on PNT matters in Africa

62nd Meeting of the Civil GPS Service Interface Committee
September 19-20, 2022

Hyatt Denver at the Colorado Convention Center

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Presentation Content

About the SATNAV Africa Joint programme office

Outcomes of the survey on PNT Infrastructure and Technologies in Africa (an AUC study)

Initiatives towards SBAS implementation on the African Continent

About the SATNAV Africa Joint programme office

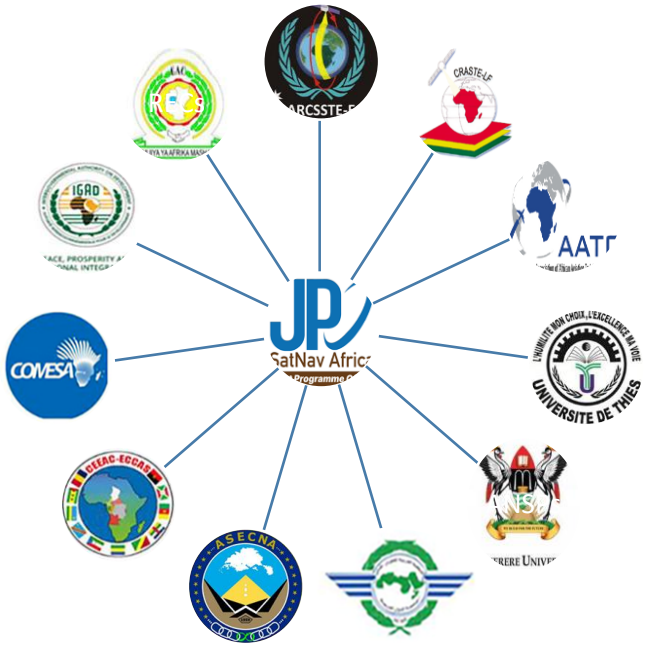
Governance

- Steering Committee Co-Chairs: AUC, EC
- Main beneficiaries
  - African Union & technical organisations (AFCAC, African Space family)
  - Regional Economic Communities
  - Air Transport users communities (ICAO, CAAs, ANSPs, airports, airlines)
  - Other sectoral organisations (maritime, agriculture, survey & mapping, etc.)
  - Capacity building & innovation frameworks (Training Institutions such Makerere University)
  - Space Agencies

Mission Statement

To coordinate and support the development of satellite navigation in key sectors in Africa, with aviation as the main driver.

Beneficiaries under working arrangements



African Union

Since **2013**, an outcome of Africa-EU cooperation on satellite navigation

European Union

About the SATNAV Africa Joint programme office

01

General Objective

Contribute to the development of satellite navigation in Africa in key sectors, with aviation as the main lever

03

Specific Objective

Consolidate the development of SBAS, as well as the adoption and use of GNSS services in Africa.

Business lines

02

Systems & services

Technical support and capacity building to accelerate the development of regional SBAS modules and the integration of SBAS into continental policies and planning

04

Markets & adoption

Support for the adoption and use of GNSS services and the development of associated applications and markets in Africa

About the SATNAV Africa Joint programme office

Institutional

- Regional SBAS modules concepts
- Concepts on legal and institutional aspects of GNSS in Africa

OUR ACHIEVEMENTS

Policy

- Support to Africa-EU cooperation frameworks on SBAS
- Support to national, regional & international planning mechanism on SBAS
- Advocacy for GNSS SBAS in Africa and global planning mechanisms

Technical

- SBAS & GNSS progamme management
- Programme and projects concepts (Operation concepts, Site surveys, GNSS monitoring, simulation, etc)
- Standardisation, normalization
- Studies on PNT infrastructure and Technology in Africa

Economic

- Market studies on GNSS in Africa covering all Africa regions
- CBAs, Business cases, impact assessments for all sectors

Capacity building

Workshops, training sessions, awareness sessions

Outcomes of the survey on PNT Infrastructure and Technologies in Africa (an AUC study)

About the Study

Through **Agenda 2063**: The Africa We Want, the African Union has identified space technologies as a critical tool that can boost Africa's economic growth and development and lead to the rapid transformation of the continent.

African Union Agenda 2063 → African Space Policy and Strategy → African Space Agency (AfSA)

Thematic focus areas

- Earth Observation
- satellite communication
- navigation and positioning
- Space Science and Astronomy

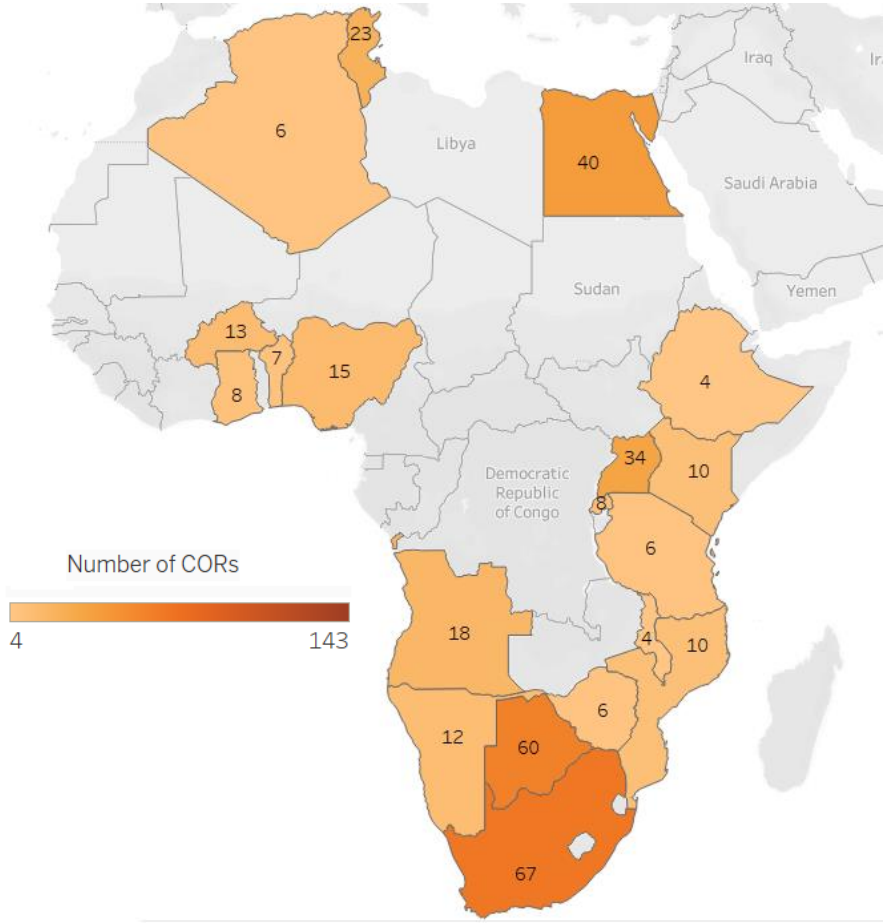
To coordinate and manage Africa's growing space activities at a continental scale, the African Union has passed the 2017 **African Space Agency Act**.

The **African Space Agency (AfSA)** setup to promote and coordinate the implementation of the African space policy and strategy and conduct activities that exploit space technologies and applications

Survey on Technology and Infrastructure support PNT services on the Continent

An Environmental Scan of PNT infrastructure on the Continent

GNSS CORS and Precise Point Position (PPP) Ground Reference Stations



Distribution of GNSS CORS on the African Continent

Precise Point Position (PPP) Ground Reference Stations (Co-shared between Hexagon AB & OmniStar)

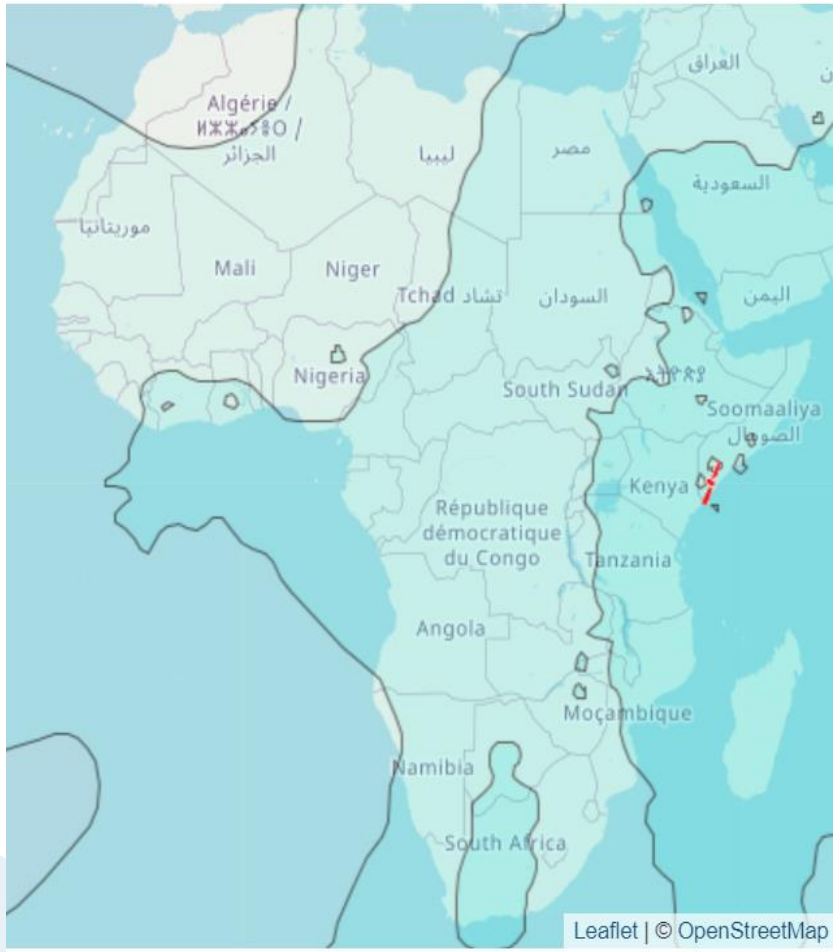
An Environmental Scan of PNT infrastructure on the Continent

Navigation Payloads (Supporting PPP/RTK services)

Name	Service	Stated performance	Supported Constellations	Method	Owned by	payloads
OmniStar	VBS	<1m	GPS	DGNSS	Trimble	IOR ((Elev: 19° Az: 39°), ESAT (Elev: 26° Az: 353°)
	HP	10cm (some parts of Africa not covered)	GPS	LR-RTK		
	XP	15cm	GPS	PPP		
	G2	<10cm	GPS + GLONASS	PPP		
Veripos	C2	5cm	GPS + GLONASS	PPP	Hexagon AB	IOR ((Elev: 19° Az: 39°) & AORE (Elev: 14° Az: 309°), 25E
	Apex	10-20cm	GPS	PPP		
	Apex²	5cm	GPS + GLONASS	PPP		
	Ultra	15cm	GPS	PPP		
	Ultra²	8cm	GPS + GLONASS	PPP		
	Standard	1m	GPS	DGNSS		
	Standard²	1m	GPS + GLONASS	DGNSS		
TerraStar	TerraStar D	10cm	GPS + GLONASS	PPP		
	TerraStar M	1m	GPS + GLONASS	DGNSS		
	TerraStar C	2-3 cm	GPS + GLONASS	PPP		
StarFix	HP	10cm	GPS	Phase DGNSS	Fugro	IOR ((Elev: 19° Az: 39°), ESAT (Elev: 26° Az: 353°) & AORE (Elev: 14° Az: 309°)
	G2	10cm	GPS + GLONASS	PPP		
	G2+	3cm	GPS + GLONASS	PPP		
	G4	5-10cm	GPS + GLONASS + BDS + Galileo	PPP		
	L1	1.5m	GPS	DGNSS		
	XP2	10cm	GPS + GLONASS	PPP		

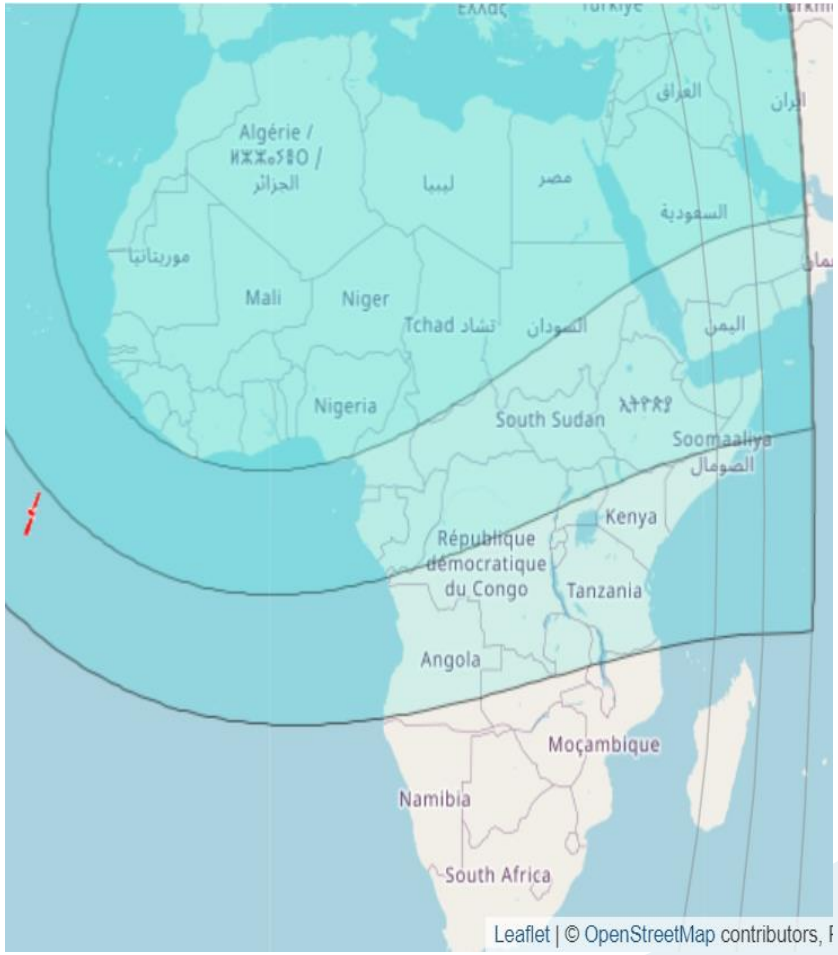
An Environmental Scan of PNT infrastructure on the Continent

SBAS Navigation Payloads



Reception details	
42°E — Nigcomsat 1R	
L-band Navigation payload L1 beam	
Distance to satellite:	35786.4km
Location:	0° 42°E
Elevation angle:	90°
LNB Tilt (skew):	NaN° ↻
True azimuth:	
Next Sun azimuth match at:	

Reception details	
25°W — AlComSat 1	
L-band Navigation beam	
Distance to satellite:	35786.4km
Location:	0° 25°W
Elevation angle:	90°
LNB Tilt (skew):	-90.00° ↻
True azimuth:	270°
Next Sun azimuth match at:	



NIGCOMSAT 1R GPS L1 & L5 SBAS Payloads Footprints

ALCOMSAT NAV SBAS Payload Footprints

An Environmental Scan of PNT infrastructure on the Continent

Stand Alone GNSS Reference stations (Monitoring of Tectonic Movements)

REGAT GPS Network

Egyptian Permanent GPS Network (EPGN)

Virunga Volcanoes Monitoring (KivuGNet) (EPGN)

Africa Array GNSS Network (EPGN)

HartRAO's Space Geodesy Programme (EPGN)

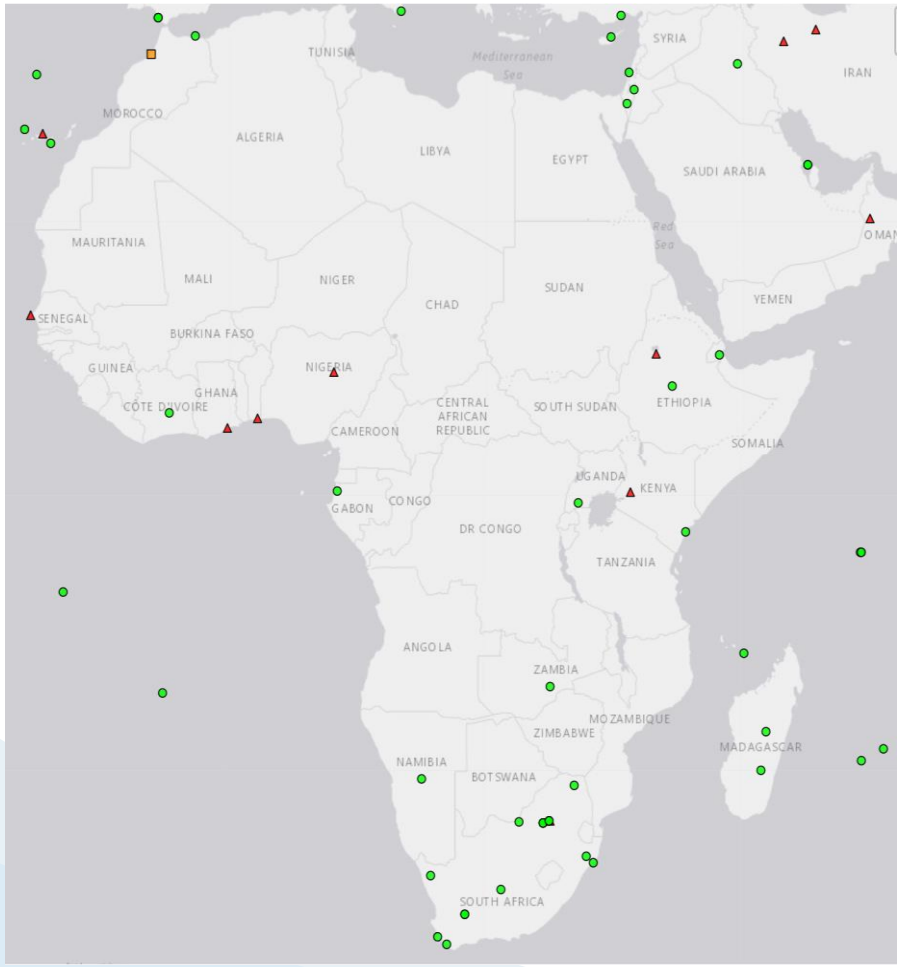
Initiative	State/region	Number of Stations
Africa Array GNSS Network	Pan-African (20 states)	26
HartRAO's Space Geodesy Programme	South Africa	9
Egyptian Permanent GPS Network (EPGN)	Egypt	24
Virunga Volcanoes Monitoring (KivuGNet)	Central Africa	16
REGAT (REseau Géodésique de l'Atlas) GPS network	Algeria	56

Other Networks

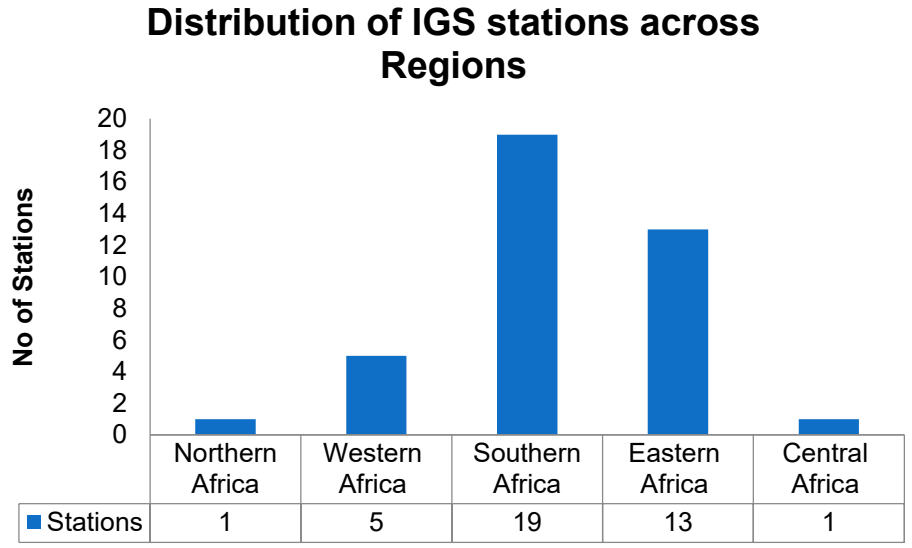
- ❑ The Horn Africa
  - Ethiopia Tectonics GPS Network
  - Eritrea GPS network
  - Afar GPS Network
- ❑ Malawi Rifting GPS Network

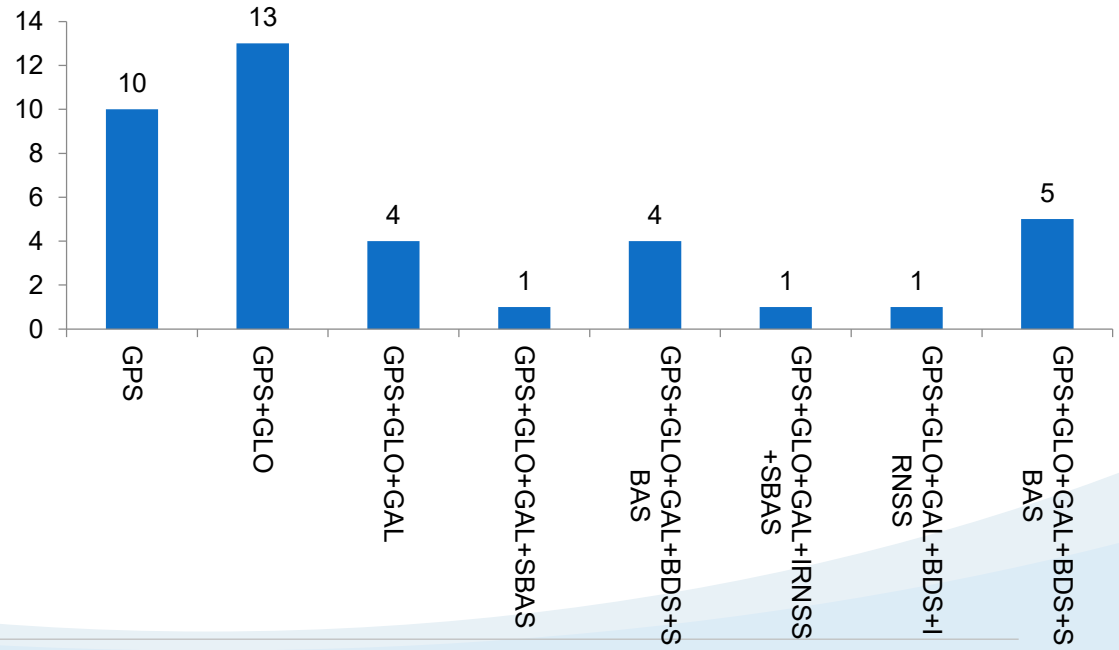
An Environmental Scan of PNT infrastructure on the Continent

Stand Alone GNSS Reference stations (IGS Network)



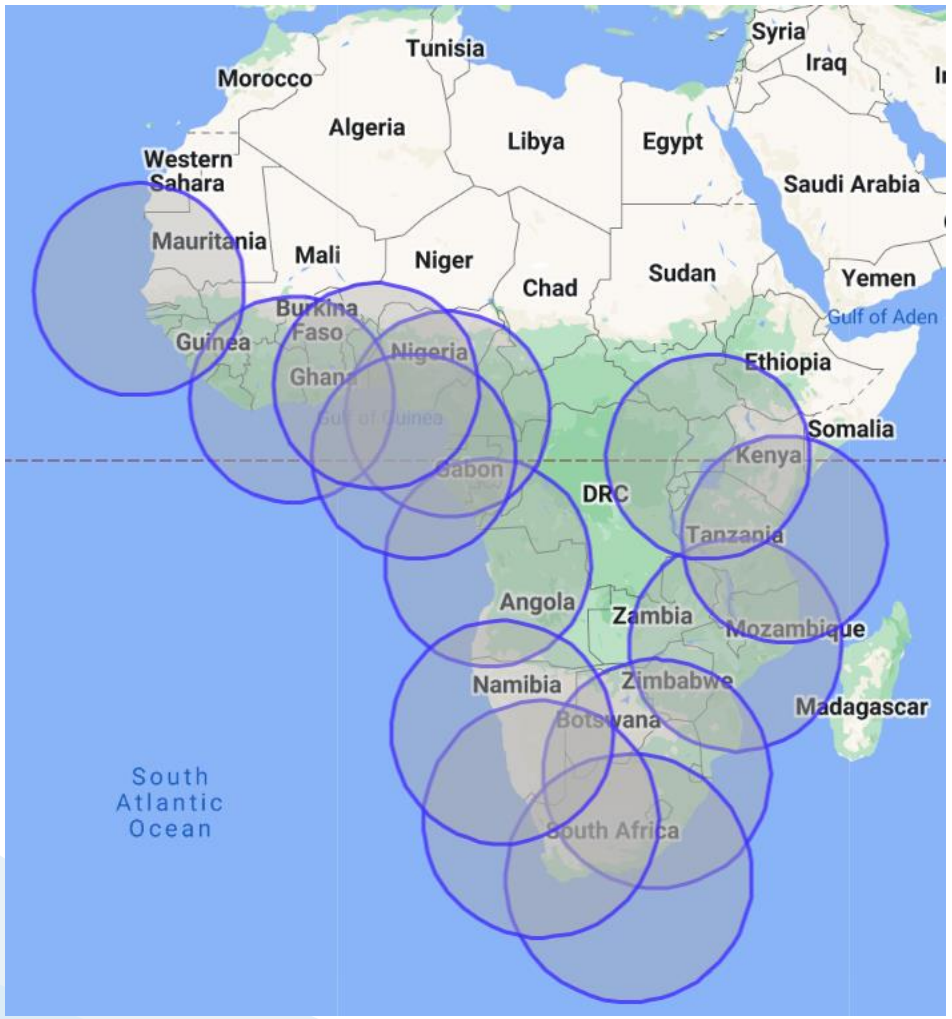
IGS (International GNSS Services) network of reference stations



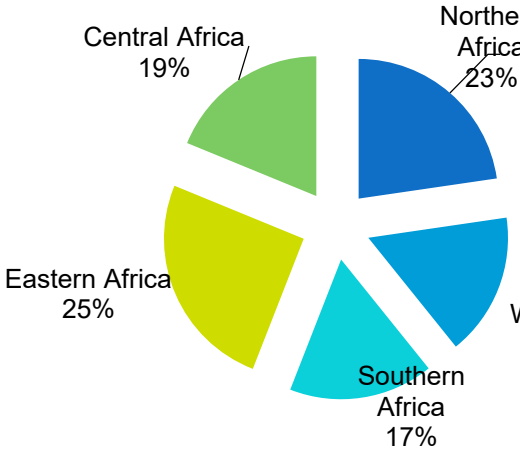


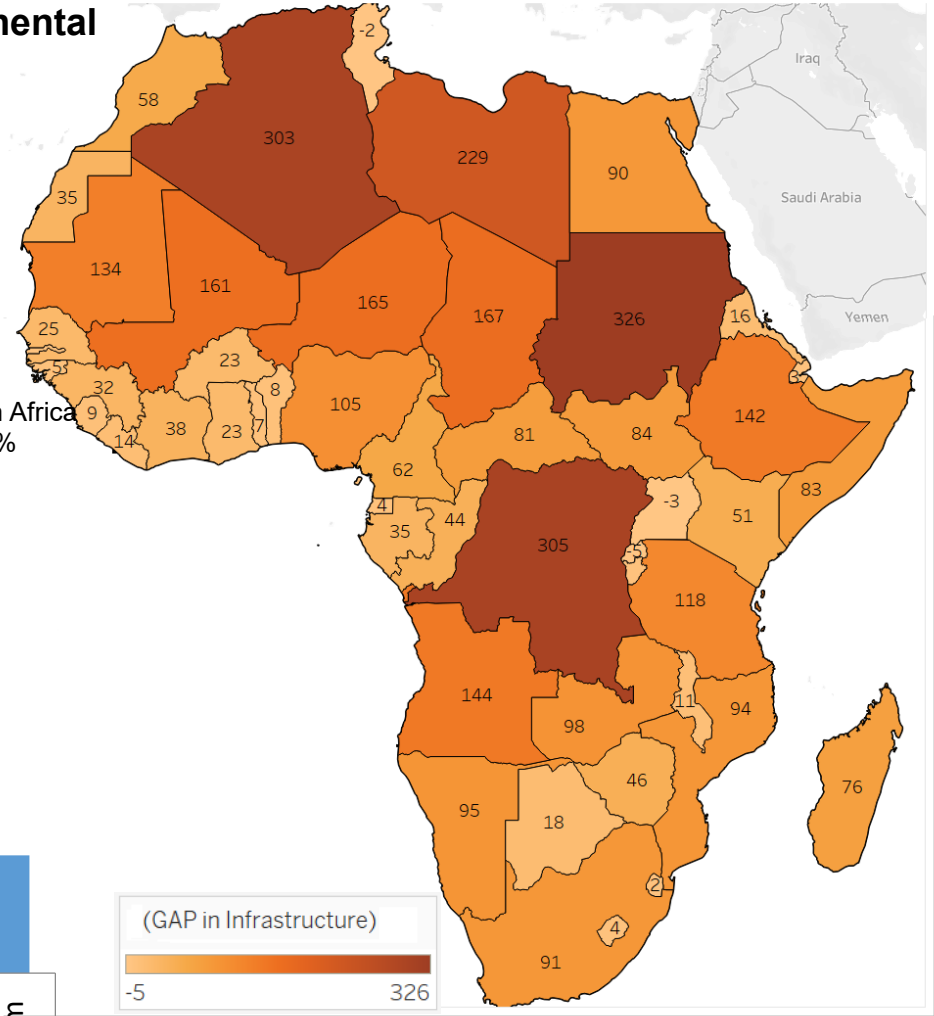
IGS network on the Continent used by the Scientific community mainly for research

Gaps analysis on PNT (infrastructure & Technology)

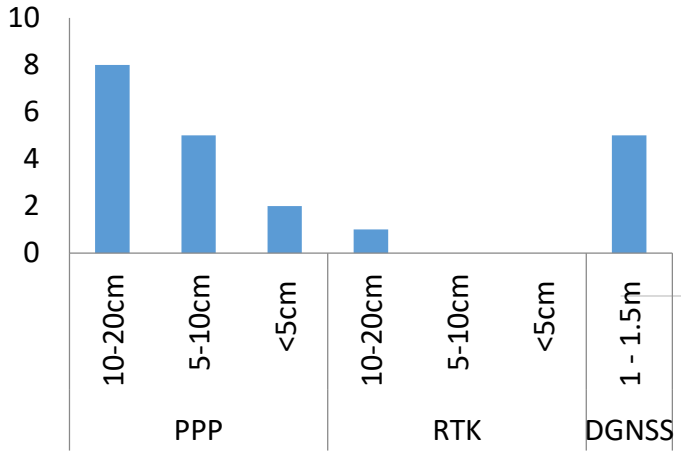


GAP in Infrastructure From a Continental Perspective





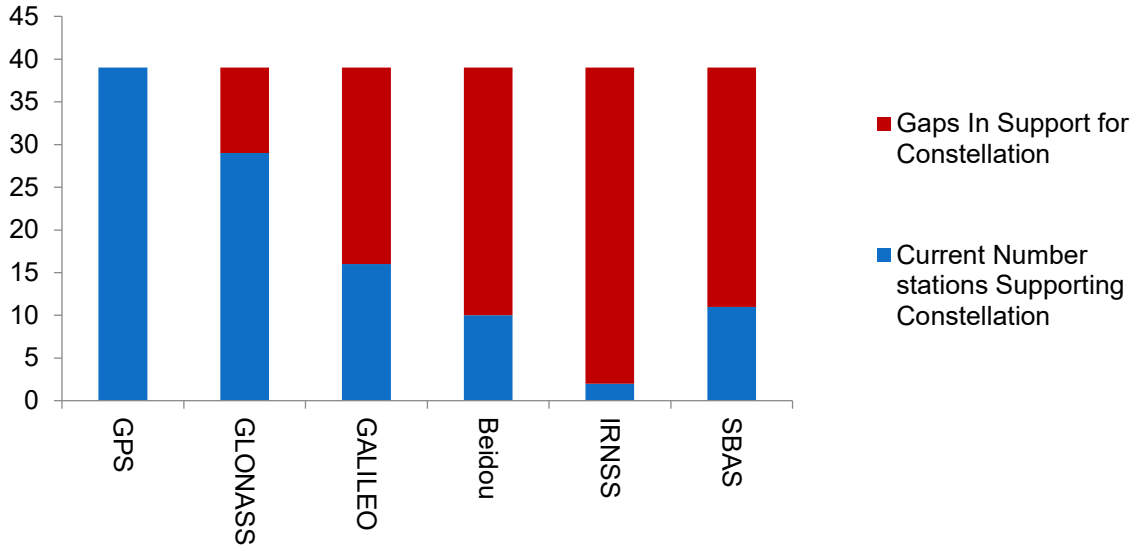
No. Services available for PPP, RTK & DGNSS



Horizontal Accuracy 10 cm and Vertical Accuracy 20 cm up to 1000 km from the reference station (ominstar)

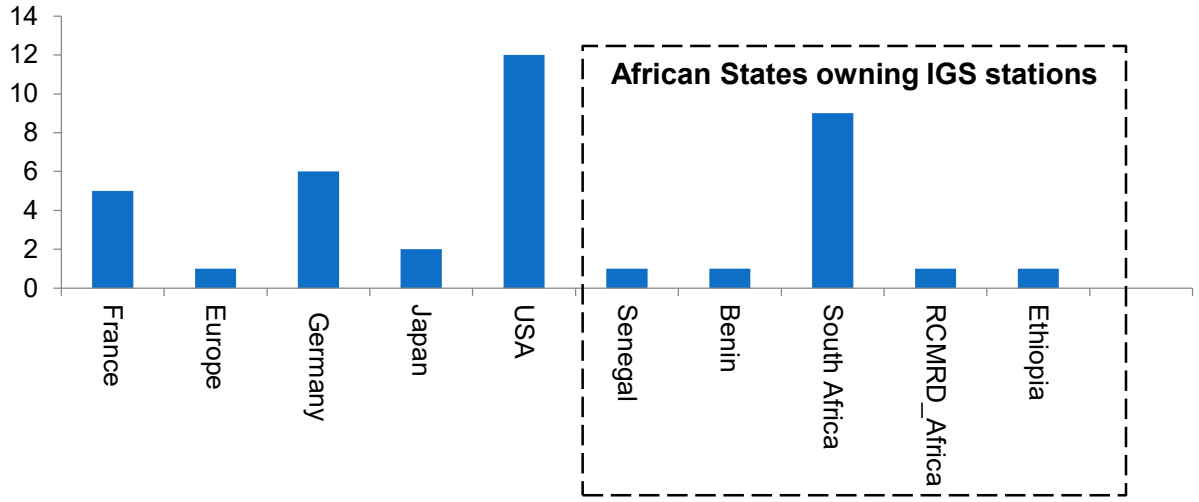
Gaps analysis on PNT (infrastructure & Technology)

Stand Alone GNSS Reference stations (IGS Network)

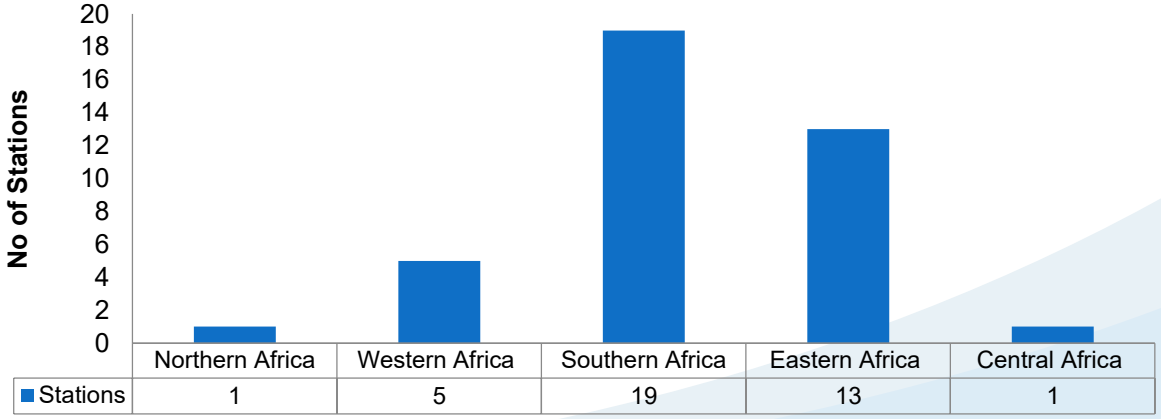


Constellation	Satellite Ephemerides	Satellite and Station Clocks	SV Range (RINEX)
GPS	YES	YES	YES
GLONASS	YES	NO	YES
GALILEO	NO	NO	YES
Beidou	NO	NO	YES
IRNSS	NO	NO	YES
SBAS	NO	NO	YES

Ownership of IGS References stations (Inside Africa vs Outside Africa)

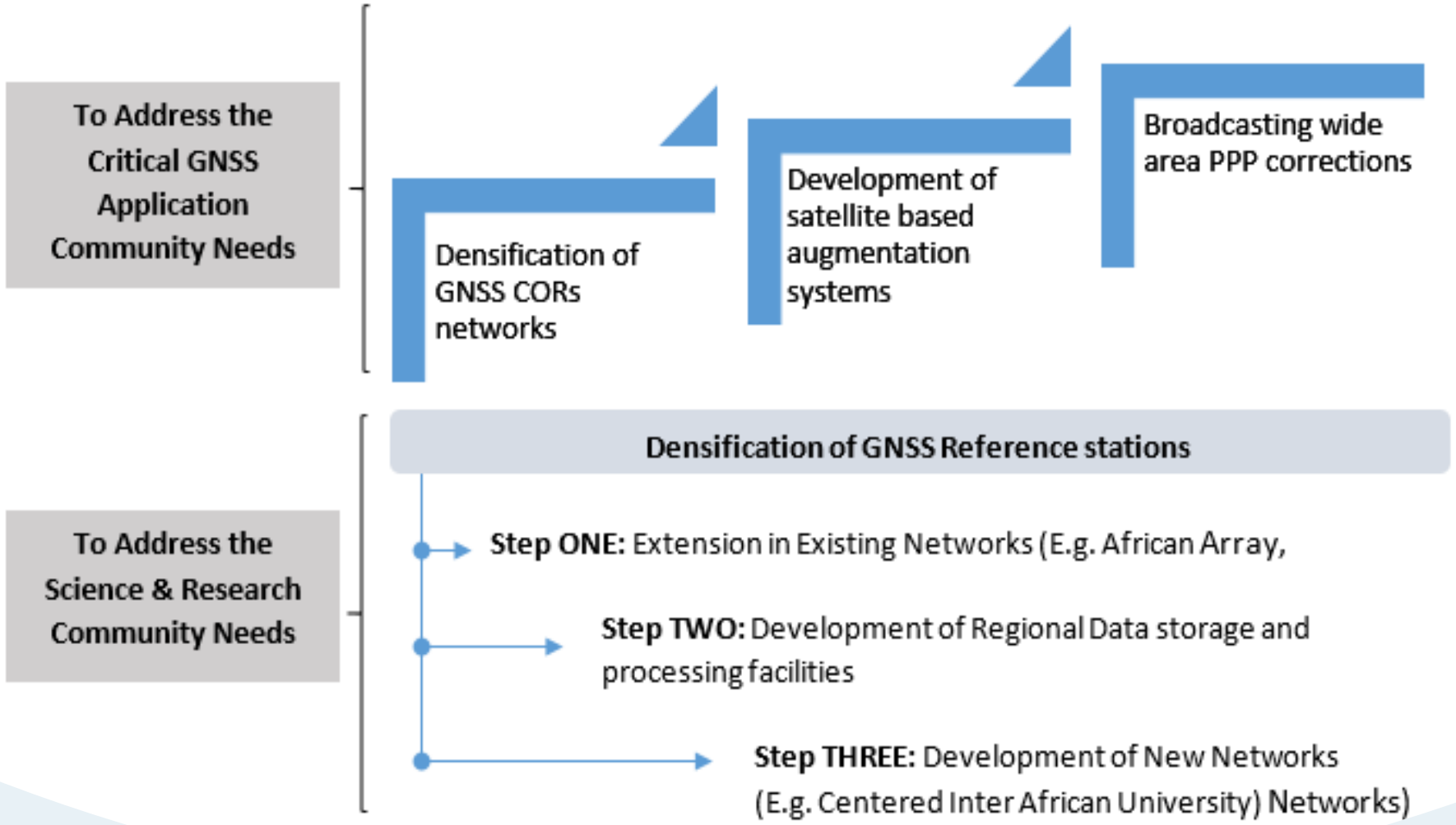


Distribution of IGS stations across Regions



Addressing the PNT Technology and Infrastructure Gaps

Proposed approach to addressing deficiencies identified during the study



Addressing the PNT Technology and Infrastructure Gaps

Proposed approach to addressing deficiencies identified during the study

Prioritv One: Densification of GNSS CORs networks

Step One

- **Priority Action 1.1:** Deployment of RTK services In line with African Population density distributions

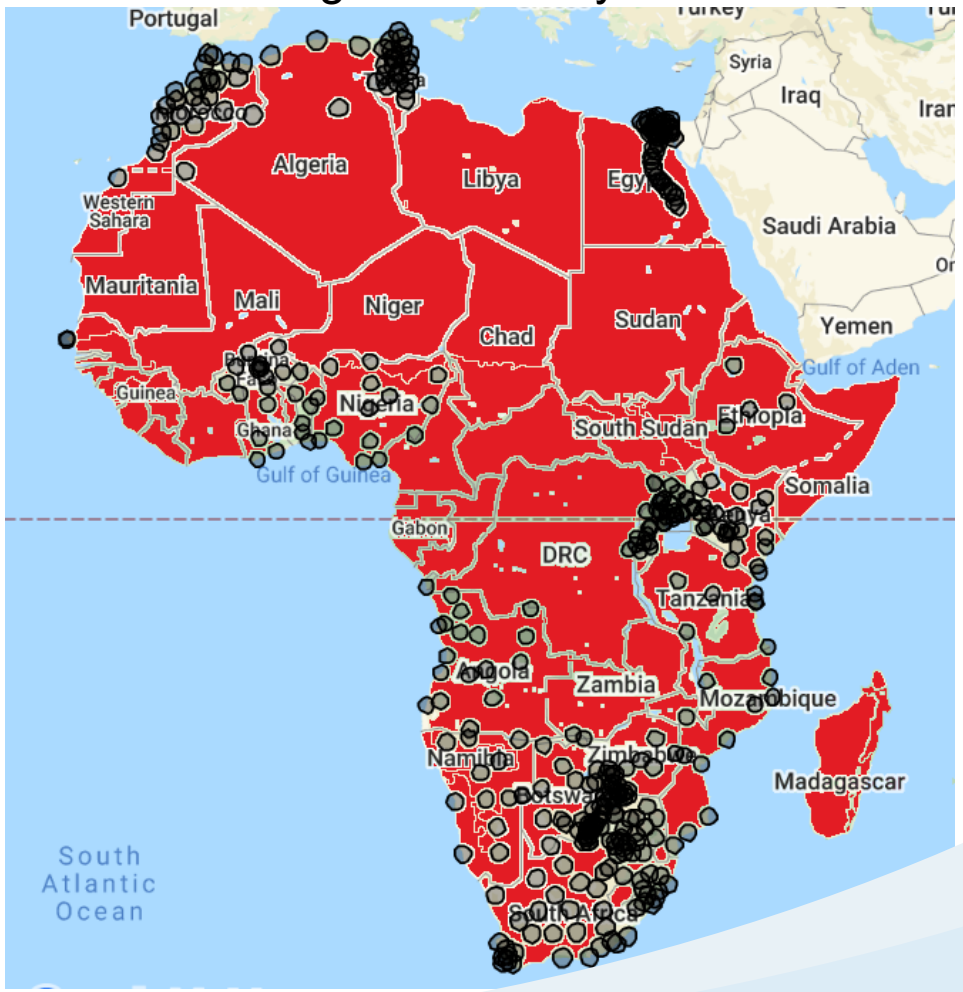
Step Two

- **Priority Action 1.2:** Migration from RTK based service to Network RTK (RTK Network densification)

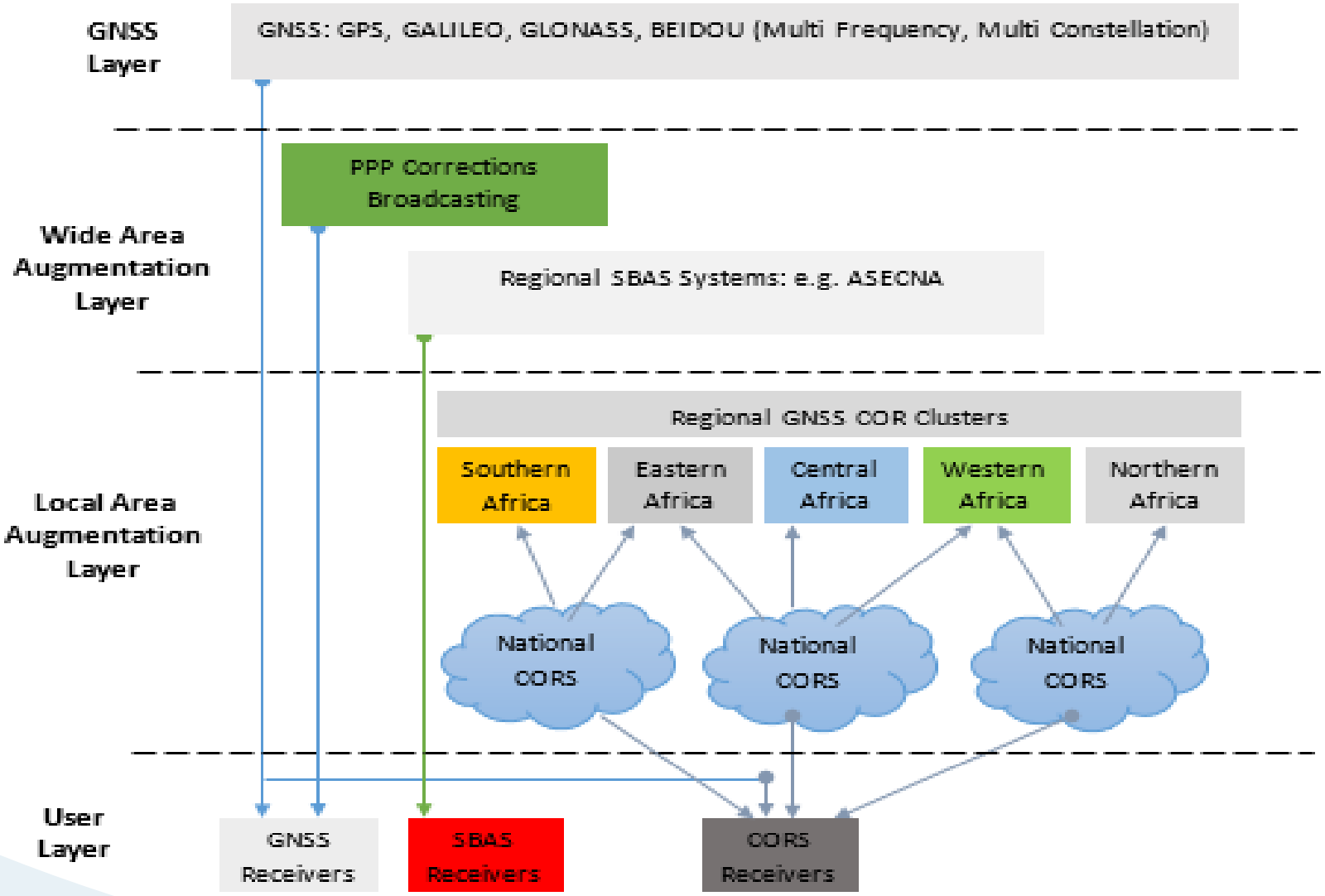
Step Three

- **Priority Action 1.3:** Regionalization of states' GNSS CORS networks

Priority Two: Development of satellite based augmentation systems



Addressing the PNT Technology and Infrastructure Gaps



How GNSS is used on the Continent

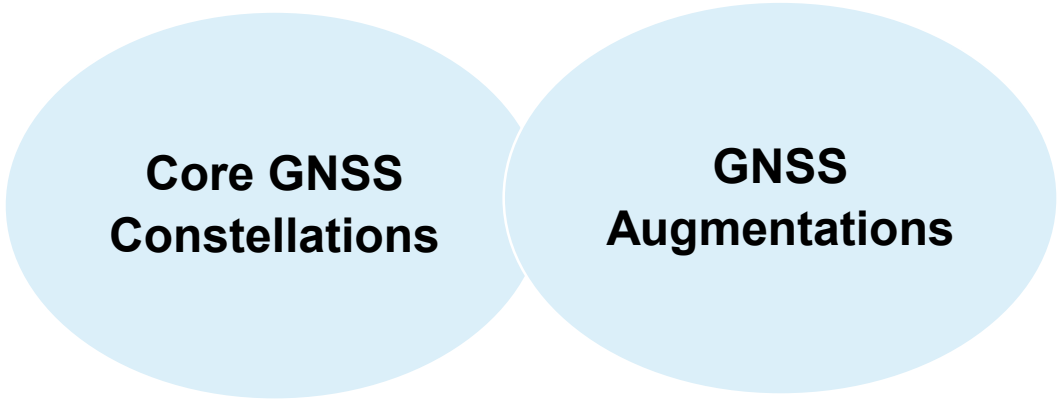
Vehicle tracking

Scietific Reasearch

Aviation (In support to ABAS + Baro VNAV application)

Geodesy

LBS (Location Based Services



GEO-Informatics (Survey & Mapping)

Precision Agriculture in Southern Africa

Coastal Maritime Navigation

On-going SBAS Initiatives, Programmes and feasibility studies on the African Continent

Key Actors in the development of SBAS on the continent

European Commission

African Union

PAN African

ASECNA Region

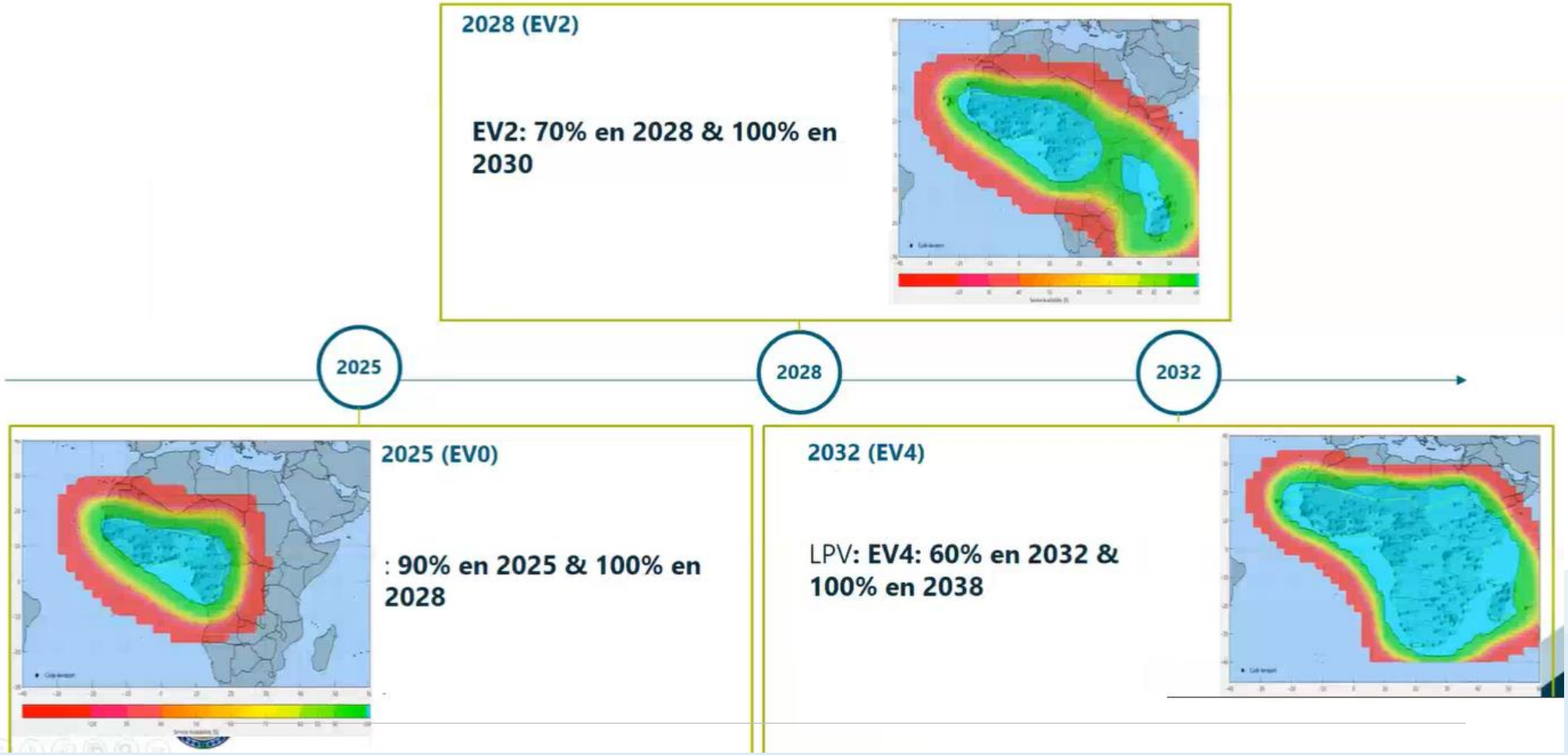
EGNOS V3 (European Neighborhood Policy-South)

Northern Africa

Continental Africa

ASECNA SBAS Programme :A-SBAS

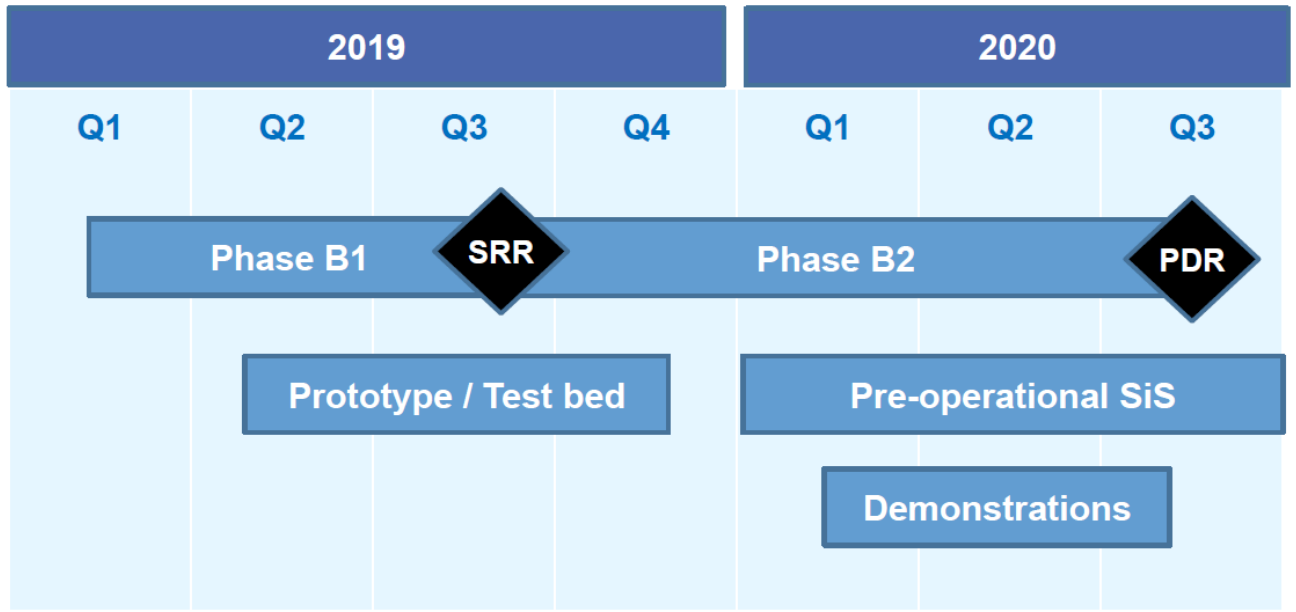
ASECNA is leading a comprehensive SBAS programme that foresees operational SBAS services from 2025, with a progressive coverage of the continent, to enhance PBN and ADS-B operations for all phases of flight.



ASECNA SBAS Programme :A-SBAS

Activities Undertaken under the programme

- Phase B Studies to define the best system architecture to support the delivery of SBAS services:



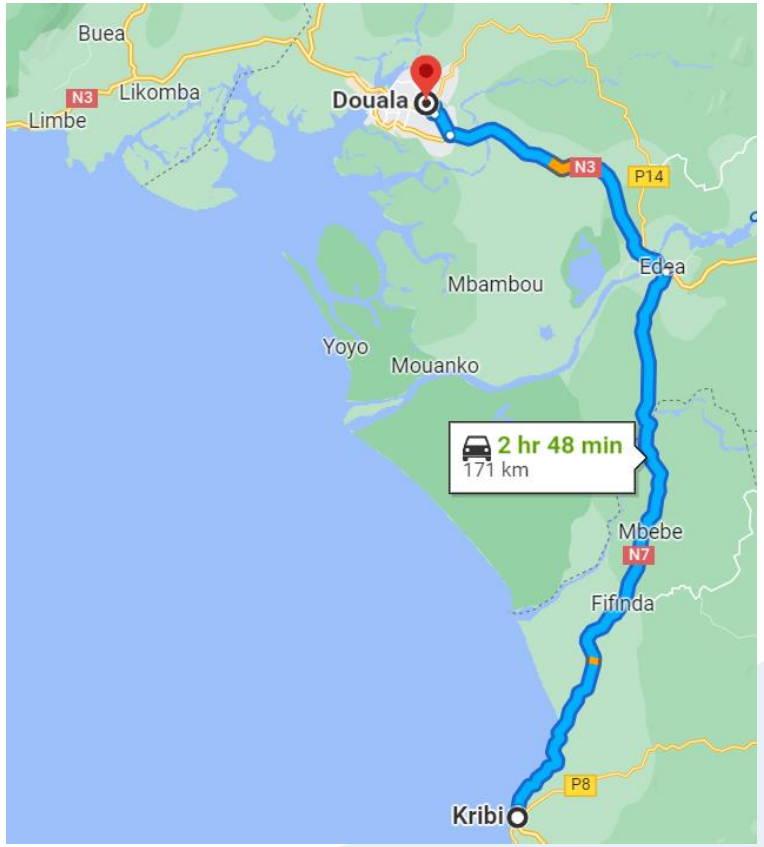
- Preparation of the implementation of Phase C and D Stages currently being undertaken
- Ongoing efforts for the ammendment of the ICAO annex 10 to include ANGA
- Securing PRN Codes for ANGA ongoing

ASECNA SBAS Programme: A-SBAS

Activities Undertaken under the programme (SBAS Demonstration)

The objective of the demonstration was to foster the adoption of SBAS technology and the following Field Demonstrations were undertaken.

- SBAS flight demonstration carried out at Lome international airport (TOGO) during the 27th January, 2021
- Helicopter demonstration (PinS: point-in-space) flight between Douala and Kirbi in Cameroon on 2nd June 2021
- Demonstration of PPP (precise point positioning) services delivered through SBAS was carried out in Brazzaville (Republic of Congo) during 6th july to 9th july 2021. It involved mapping of the a national stadium (stadium Alphonse Massamba-Debat) using a dual-frequency receiver supporting GPS and Galileo)

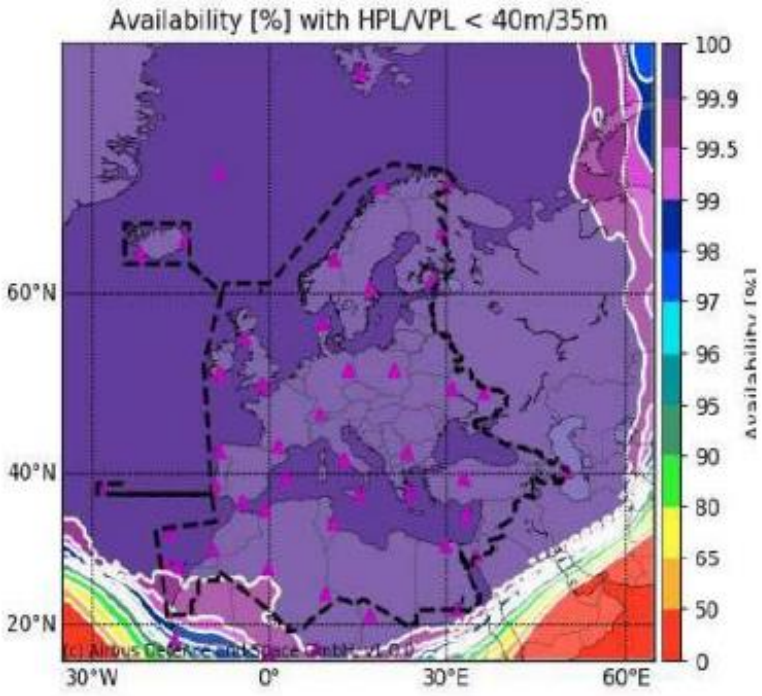


EGNOS V3 (European Neighborhood Policy-South)

- Under the EGNOS V3 development, EU Agency for the Space Programme (EUSPA) plans on expanding the EGNOS services in European Neighbourhood Policy South countries (ENP-South)

- In principle, the ENP-South region covers ten non-EU Mediterranean countries: **Algeria**, **Egypt**, Israel, Jordan, Lebanon, **Libya**, **Morocco**, Palestine, Syria and **Tunisia**.

- European Satellite Services Provider (ESSP) working on the further expansion of the EGNOS services in ENP-South



Foreseen EGNOS V3 Coverage

AU Continental CBA study on SBAS implementation

Background to the CBA study

AFI GNSS Strategy (ICAO APIRG) identifies SBAS as a key enabler of PBN operations

- Decision adopted by the AU Member States in 2017 and in line with the APIRG/22 conclusion 22/39, tasked the African Union Commission (AUC) to conduct a continental cost-benefit analysis (CBA) on SBAS introduction in the region, considering existing initiatives
- Assess the SBAS economic attractiveness for the continent, to support the decision-making process by States and Stakeholders on the best implementation options, and enable update of the AFI GNSS strategy accordingly
- Specific focus on the aviation sector, evaluating the operational, safety, environmental, social benefits as well as the costs of SBAS implementation for all aviation stakeholders

AU Continental CBA study on SBAS implementation

AFCAC (AU's designated institution responsible for enabling a robust African aviation industry mandated to undertake the study, which was Completed on May 2022

Study Demonstrated high economic attractiveness of SBAS implementation across the whole aviation sector

Airlines: The SBAS business case is highly profitable and attractive, with positive values in all the evaluated financial indicators

Ground-side users (ANSPs, airport operators and SBAS service provider): The business case is profitable as well .

The socioeconomic impact of SBAS monetised and included in the economic results of the CBA; emphasis on the environmental impact of the SBAS implementation revealed a very positive carbon footprint

Conclusive Remarks

- SATNAV Africa JPO is grateful with the opportunity provided to take part in the 62nd Meeting of the Civil GPS Service Interface Committee

- The SATNAV Africa JPO is currently the only continental wide programme concerned with monitoring developments within the satellite navigation domain as such can be a good source of exchanging information on the use of GPS

- We look forward to having any future cooperation with the Civil GPS Service Interface Committee

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Thank You