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INTERNATIONAL CIVIL AVIATION ORGANIZATION

Sixth Meeting of the APIRG Infrastructure and Information Management Sub-Group (IIM/SG6)

(Nairobi, 31 July – 3 august 2023)

Agenda Item 3 Achievements in CNS, AIM and MET

    3.2. Implementation of ASBU elements and Achievements of IIM Projects

    WP3.2D IIM SG COM 4 project "Integrated Aeronautical Telecommunications Infrastructure"

(Presented by IIM COM 4 Project)

SUMMARY
This working paper presents the current status of IIM SG COM 4 project "**Integrated Aeronautical Telecommunications Infrastructure**", updates the project stages and highlights the challenges encountered.
Action by the meeting in paragraph 3
REFERENCE(S):   ▪ Global Air Navigation Plan (GANP)   ▪ APIRG 25 Report   ▪ Manual for the ATN using IPS Standards and Protocols (Doc 9896)   ▪ Doc 7474
Related ICAO Strategic Objective(s): A – *Safety,* **B** – *Air Navigation Capacity*

1. Introduction:

1.1. The IIM COM 4 project aims to support the implementation of a seamless telecommunications infrastructure across the AFI region to ensure seamless and complete interoperability of CNS/ATM systems and services.

1.2. The project benefits all ESAF and WACAF States and covers the implementation of the following ASBU elements:

- **COM1/**B1/1 - Ground-Ground Aeronautical Telecommunication Network/Internet Protocol suite (ATN/IPS)

- **Other related ASBU A modules:**

  - **COM1/B2/1**- Air-Ground ATN/IPS

  - **COMS/B0/1**- CPDLC (FANS 1/A & ATN B1) for domestic and procedural airspace

- **COMS/B1/1-** PBCS approved CPDLC (FANS 1/A +) for domestic and procedural airspace

1.3. This paper aims to update the meeting with the progress made by the COM4 project team so far, in terms of achievement and way forward.

1.4. Project Objective:

The objective of the project is to develop an AFI interoperable integrated seamless and interoperable telecommunication infrastructure to support ATM, AIM, MET and other aeronautical telecommunication services.

1.5. Project scope:

- Develop an AFI interoperable seamless telecommunication infrastructure to support ATM, AIM, MET and aeronautical telecommunication services.
- Achieve interoperability among the AFI aeronautical VSAT networks.
- Develop and implement AFI ATN IPS backbone.
- Provide a common cybersecure IP based managed network and internet connectivity services based in ATN IPS across the AFI region and its adjacent regions.
- Provide an efficient support to operational data and potentially voice communications.

2. Discussions:

2.1. Baseline (2023) – Status of the ASBU implementation

2.1.1. The project is intended for all AFI States covered by ESAF and WACAF, the latter being involved in the AFISNET, NAFISAT and SADC networks. The status of implementation of the ASBU elements by these States in 2022 is provided in the table below.

COMI-B1	B1/1 - Ground-Ground Aeronautical Telecommunication Network/Internet Protocol suite (ATN/IPS)

2.1.2. In general, AFI states are still in the process of finalizing the implementation of the ASBU element COM1/B0/2 - Aeronautical Telecommunications Network/Open Systems Interconnection (ATN/OSI). This migration was made necessary to allow the transition from AFTN to AMHS.

2.1.3. In this transitional phase, interoperability is ensured at level 2 thanks to the installation of new modems/similar multiplexers equipped with ethernet interfaces on both sides.

2.1.4. AFISNET: The migration to IP other Frame Relay has beencompleted at ASECNA and Roberts FIR, it is quite advanced in Ghana and underway in Nigeria.

2.1.5. A major meeting of the AFISNET Supervisory Board is planned for this year in Nigeria, to validate the definition of the implementation options and to decide on the issue of funding and implementation planning.

2.1.6. SADC II: Re-engineering of SADC II network has been launched by agreed Member States and planned investments in network infrastructure, against a global aviation recovery forecast which is expected around 2023/2024, has been made available for the 2023/24 and 2024/2025 financial

years. The Network Service Provider roadmap includes two (2) timelines:

2.1.7. Short- and medium-term objectives (2023/2025)

2.1.8. • Long-term objectives (2026-2029).

2.1.9. NAFISAT: This network which has the same operator as SADC continues its gradual transformation through the establishment of newbilateral links between subscribers to the AFISNET and SADC networks.

2.2. AFISNET/NAFISAT/SADC Interoperability Issues:

a) Interconnect links are being upgraded to help eliminate outages caused by obsolete analog links carrying AFTN. However, the disparate satellite access methods employed by both sides remain a challenge. In summary, the same DATUM platform (MCPC/SCPC) is deployed at both ends to enable point-to-point cross-distribution of voice, AMHS and other ATN applications as needed and, finally, a harmonized digital IP interregional VSAT network This interoperability solution between the SADC, NAFISAT and AFISNET networks was concluded between ATNS and ASECNA in 2020. The interconnection links are in progress and have made it possible to eradicate service interruptions caused by outdated technology, but the disparate satellite access methods employed by and AFISNET remains a challenge. In summary, the same DATUM platform (MCPC/SCPC) is kept at both ends and the services will be migrated to IP. This will allow cross-distribution of voice, AMHS and other ATN applications as required and ultimately a harmonized digital IP inter-regional VSAT network for the implementation of the ASBUS COM1/B1/1 element ASBU Elements implementation status:

APIRG/25 Decision 25/13: Alignment of the APIRG Projects to the 6th Edition of the GANP
That: To promote the implementation of the ASBU elements applicable to the Region, the related APIRG Projects references be aligned with the GANP 6th edition groups,
Threads and elements as provided in Appendices 3F to this Report

b) According with appendix 3D ASBU applicable elements in CNS, the level of maturity is still on standardization.

c) The challenge now is to provide for a more modern, more efficient, cost-effective, and robust interoperable data communications network infrastructure, this is the main rationale of the COM04 project Achieving interoperability at Level 3.

d) Regarding the bandwidth requirement for certain applications, particularly in the AIM and MET fields and to prepare for the advent of SWIM, the work of our group will also be oriented towards the development of guidance material for the gradual introduction of terrestrial network based on optical fiber and internet for broadband applications. With this in mind, a collaborative approach between AFI states, on bilateral, or sub-regional bases will be necessary.

2.2.1. Ongoing Infrastructure improvements

a) **ESAF States:**
   - SADC Network including Angola, Botswana, Burundi, Democratic Republic of the Congo, Eswatini, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Rwanda, South Africa, United Republic of Tanzania, Zambia and Zimbabwe.
   - ISS 10-02 C-Band satellite at 359º E longitude from and between Air Traffic Service Centres

in the operational area. The following voice and data services are provided: Through SADC is moving to the SADC/2 VSAT Network consists of remote VSAT terminals providing data and voice communications via Frame Relay and IP satellite telecommunications links via the INTELSAT.

- In this period, network infrastructure management shall be rolled out in two-phases as follows:
  - ✓ 6.1 Phase I: Network life-extension - 2022-2024
  - ✓ 6.2 Phase II: Long-term Modernisation - 2025-2029
  - ✓ The following voice and data services will be provided:
  - ✓ The Network architecture is Mesh/MF-TDMA
  - ✓ Satellite: IS1002,23/23, 359deg E, 6MHz
- Connectivity:
  - ✓ • ATS/DS connectivity (FXS/FXO 2w with ACELP-CN 8kx2) – prepared to VOIP connectivity.
  - ✓ • AFTN connectivity (serial RS-232 with 9.6 kbps)
  - ✓ • ATN backbone connectivity (Ethernet IP with 64kbps)
  - ✓ • ATN tributary connectivity (Ethernet IP with 9.6kbps)
  - ✓ • Engineering speech [EOW] (FXS/FXO 2w with ACELP-CN 8Kx2) – prepared for VOIP connectivity.
  - ✓ • Data circuits for Engineering data (serial V.35 with 64 kbps)
  - ✓ AHMS issue Roll-out
  - ✓ The network service provider and network's readiness for the full-scale implementation of modern services such as AMHS calls for States to transition their AFTN services to AMHS. States are encouraged to share them
  - ✓ infrastructure development plans and readiness in this regard. The following AMHS services have been implemented in SADC.
  - ✓ Kinshasa and Bujumbura remain on IP AFTN. AMHS Lusaka Entebbe, Manizni, Gaborone Plaicance Johannesburg, Madagascar,

b) WACAF States

- The AFISNET reengineering is on progress:
- The Network current architecture is SCPC/MCPC et the future will be (Mesh / Star)
- Satellite: IS1002,20/20 and 23/23.
- Base band equipment's: Router/Switch/ Multiplexor
- Connectivity: ATS/DS, AFTN/AMHS, Surveillance Data, AIDC, MET

c) AHMS issue Roll-out

- The resumption of key activities such will complement the interconnection of AMHS systems, the implementation of AIDC, the surveillance data sharing, in line with the provisions of Annex 6 of the Memorandum of Understanding (MoU) concluded by the AFISNET Board on 6th April 2018; and
- The modernization and re-engineering of AFISNET, associated implementation challenges and recommendations to be presented to the Board to address these challenges, including
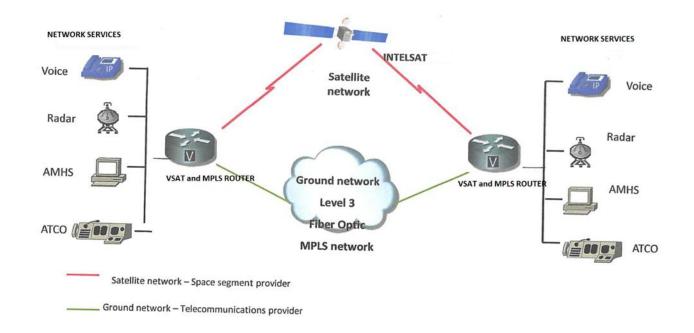
funding issues. It is based on both Frame Relay and IP network. The sites estimation and cost estimation have been realised during the last meeting Coordination meeting on the AFI Satellite Telecommunication Network (AFISNET), Accra, Ghana, 17-19 August 2022.

- The next meeting plan in Nigeria, will finalise and definitively validate the project, considering the issue of interoperability with the adjacent network, in the AFI region and also outside AFI region.
- The issue of the allocation of the band 3600-3800 Mhz to IMT using for RX in AFISNET Network remain a big challenge for AFISNET who will be migrate all RX frequencies up to 3900 Mhz to avoid interferences with 5G under deployment within several countries of the AFI region 3400-3800 Mhz.
- Comment on challenges on future global interoperability between ESAF and WACAF networks, in the framework of implementation of COM1/1/1 ASBU module element through the COM4 project.
- through the COM4 project.
- This re-engineering of the interconnection links ensured that service outages which were caused by outdated technology were eradicated, however the disparate satellite access methods employed by SADC/NAFISAT and AFISNET will be one of the main challenges to be addressed.
- The table below illustrates these concerns and the complexity of the stakeholder issues facing the region, which requires ANSPs to acquire the same modems and multiplexers to ensure interoperability for each application.

Sites		Services		New Equipment with IP capabilities			
AFISNET	SADC/NAFISAT	Currents	Futurs	Serial card (Qte)	FXS Card (Qte)	Multiplexor (Qte)	Modems (TX/RX)
Niamey	Tripoli	ATS/DS & AFTN	AIDC & AMHS	Two access port (1)	Four Access port (2)	NetPerformer 9230 (1)	DATUM M7 (TX/ RX)
	Addis Ababa	AFTN	AMHS				DATUM M7 (RX)
Ndjaména	Tripoli	ATS/DS & AFTN	AIDC & AMHS	Two access port (1)	Four Access port (2)	NetPerformer 9230 (1)	DATUM M7 (TX/RX)
	Khartoum	ATS/DS & AFTN	AIDC & AMHS				DATUM M7 (RX)
Brazzaville	Nairobi	AFTN	AMHS		Four Access port (2)	NetPerformer 8400 (1) NetPerformer 9230 (1)	DATUM M7 (TX/RX)
	Khartoum	ATS/DS	AIDC				DATUM M7 (RX)
	Luanda	ATS/DS & AFTN	AIDC & AMHS				DATUM M7 (RX)
	Kinshasa	ATS/DS & AFTN	AIDC & AMHS				DATUM M7 (RX)
	Johannesburg	AFTN	AMHS				DATUM M7 (RX)
Abidjan	Luanda	ATS/DS	AMHS	Two access port (1)	Four Access port (2)	NetPerformer 9230 (1)	DATUM M7 (TX/RX)
Diass	Luanda	ATS/DS	AIDC		Four Access port (2)	NetPerformer 9230 (1) NetPerformer 8400 (1)	DATUM M7 (TX/RX)
	Johannesburg	AFTN	AMHS				DATUM M7 (RX)
Antananarivo (Station AFISNET)	Johannesburg	ATS/DS & AFTN	AIDC & AMHS	Two access port (1)	Four Access port (2)	NetPerformer 9230 (1)	DATUM M7 (TX/RX)
Johannesburg (Station AFISNET)	Brazzaville	AFTN	AMHS		Four Access port (2)	NetPerformer 8400 (1) NetPerformer 9230 (1)	DATUM M7 (TX/RX)
	Antananarivo	ATS/DS & AFTN	AIDC & AMHS				DATUM M7 (TX/RX)
	Dakar	AFTN	AMHS				DATUM M7 (TX/RX)
Moroni	Seychelles	ATS/DS & AFTN	AIDC & AMHS		Four Access port (2)	NetPerformer 9230 (1) NetPerformer 8400 (1)	DATUM M7 (TX/RX)
	Dar Es Salam	ATS/DS	AIDC				DATUM M7 (TX/RX)
	Beira	ATS/DS	AIDC				DATUM M7 (TX/RX)
Pointe Noire	Cabinda	ATS/DS	AIDC		Four Access port (2)	NetPerformer 9230 (1) NetPerformer 8400 (1)	DATUM M7 (TX/RX)
	Luanda	ATS/DS	AIDC				DATUM M7 (TX/RX)
Bangui	Kinshasa	ATS/DS	AIDC	Two access port (1)	Four Access port (2)	NetPerformer 9230 (1)	DATUM M7 (TX/RX)

Comment: *The implementation of the ASBU modules required for the region will gradually overcome its constraints and achieve the required interoperability in a seamless and seamless manner through the boundary and intermediate routers that will be implemented in the AFI region as part of the deployment of the ASBU COM1/B1 module - Ground-Ground Aeronautical Telecommunication Network/Internet Protocol suite (ATN/IPS), whose expected operational and technical benefits in terms of cost and efficiency are invaluable.*

The figure below outlines the simplified infrastructure to which the region will need to evolve in the future.

NETWORK SERVICES

Voice — Radar — AMHS — ATCO — VSAT and MPLS ROUTER — Satellite network — INTELSAT — Ground network Level 3 Fiber Optic MPLS network — VSAT and MPLS ROUTER — Voice — Radar — AMHS — ATCO

NETWORK SERVICES

Satellite network – Space segment provider

Ground network – Telecommunications provider

2.3. Status of the implementation of the Action Plan of the project:

Deliverables	Task/activity	Status	Comments
D00 Description of the project.	Elaborate and consolidate the description of the project based on the alignment of the CNS Regional Projects with the ASBUs Modules and threads of the 6rth Edition of the GANP,		Taking account alignment of ASBU module during IIM/SG5 referred to the table with a preliminary identification of the applicability of the said Modules of the project
D01 Questionnaire analysis	Update and transmit the questionnaire to states and ANSPs		The questionnaire has been validated and is currently available in the ICAO websites of the ESAF and WACAF regional offices. He also invited the States that have not yet responded to the questionnaires to do so. Outside the States, the response to the questionnaire by the ANSPs in charge of the administration of the AFISNET sub-regional VSAT networks (ASECNA, NAMA, GCAA, Roberts FIR) and NAFISAT/SADC (ATNS) is required to have relevant elements. analysis
	Compile and analyse the replies to the questionnaire sent to States and organizations		

Deliverables	Task/activity	Status	Comments
D03 Costing of the project	Identify and budget the activities to be carried out relating to the implementation of the project	🟩	Project established and transmitted
D04 Report on Assessment of the current AFI VSAT networks with regard to regard to the ATM requirements	Technical workshop to review AFI VSAT currents network capabilities and ATN IPS solutions in other ICAO regions (COSECNA, CRV, ASIA, New PENS, Brazil) in line with the new information management concept.	🟨	Taking account, report of audit and/or another element available for AFISNET, NAFISAT/SADC, Spectrum issues (5G, etc.). Rather to develop regional guidelines and policy for harmonization and interoperability of applications and services as States or Organizations embark on the process of acquiring new systems or infrastructure.
D05 Report on assessment of the current and forthcoming need of services D06 Action plan to achieve interoperability and operationalization of AMHS/AIDC, VoIP services	Technical joint workshop on current and future ATM, AIM and MET service evolution and bandwidth requirements. Assess the current situation of network capabilities to support AMHS and AIDC applications. •Address the level of effective implementation of AMHS and AIDC capabilities in each AFI centres.	🟥	Coordination AIM and MET PTCs of relevant projects, with the facilitation of the secretariat. The approach is to assess if the regional or sub-regional level we manage to get the centres to carry out the operationalization of AMHS and AIDC under AMHS between adjacent centres with the means of the existing networks is relevant and meet the requested performance. In parallel, the goal is to examine the possibilities of developing the current networks according with the new ASBU elements COM1/B1/1 ATN IPS. He also recalled the situation of services on the existing networks AFISNET, SADC VSAT 2, NAFISAT and CAFSAT, including the delay in the implementation of new technologies available to date to support applications such as AMHS, AIDC and Following the IOT/POT tests carried out for migration to the AMHS, it was clearly established that the speeds of almost all current links will not allow data exchange in digital formats (IWXXM, FF-ICE, etc.). See COM Chart in Appendix

Deliverables	Task/activity	Status	Comments
			Transition of the current network to the forthcoming intranet based on network and IPS environment. SWIM, etc… This transition will take account the outcome of the technical workshop to review AFI VSAT currents network capabilities and ATN IPS solutions developed in other ICAO adjacent region. Overview of adjacent networks out of AFI region (NEWPENS, REDIGII, MEVAIII, CRV, etc.) and share all the ongoing initiatives on the deployment of high-speed terrestrial infrastructures and cloud environments to prepare for migration to information management such as SWIM. Discuss spectrum issues (5G, etc.) which have an impact on AFI VSAT networks and on actions taken or undertaken.

Deliverables	Task/activity	Status	Comments
D07 Drafting guidance material on study and design principle for new AFI Integrated Regional Telecommunication infrastructure based according with ASBU module COM1/B1- ATN /IPS.	Set up a technical team that will be responsible for developing standard guidelines that will allow each party to easily implement these guidelines. Stage 3-Visit and Benchmarking of Regional adjacent Networks based on ATN IPS Based on appropriate technology (VSAT, optical fiber, cloud, virtualization, etc.) •IP MPLS backbone architecture •IP address scheme definition Routing policy Addressing plan Assessment of the bandwidth requirements		To meet changing needs and technologies, focus on the implementation of ATN/IPS new service environments based on new standards of data management (SWIM concept), design the TOR and provide guidance materials in order to: Built around TCP/IP networks and resilient IT infrastructures, able to integrate, aggregate and synchronize operational data and metadata from various internal or external systems. Make this network infrastructure capable to: deliver related managed services such as the production of reliable statistics on performance levels provided in real time on critical systems in accordance with the requirements of the PBCS (RCP and RSP), but also to provide reliable input data to equally important related systems such as those relating to the invoicing of aeronautical charges, etc. Setup NOC/SOC global organization based on the bests practiced.
D08 Developing KPI tools of the AFI Integrated Regional Telecommunication Infrastructure	Developing KPI tools referred to standards Doc 9896 ATN IPS, DOC 10039 Manuel on SWIM Concept. EUROCAE ED137 VoiP, etc.		Tools for monitoring of operational KPI (Systems and Services) and security and cyberthreat assessment

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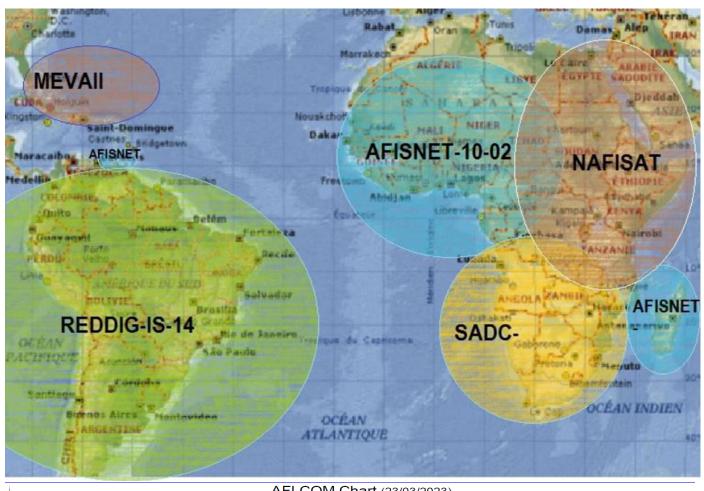| Deliverables	Task/activity	Status	Comments
D09 develop guidance material for implementation and a global security policy for a secured operation			Manual of ATN IPS implementation in the AFI region. • Setup basis procedures of installation and configuration of intra and inter domain router and terminals equipment • Establish procedures for cyberthreat assessment • Establish basis template of agreement for sharing information on cybersecurity, according with the SARPS, as a shared responsibility.
D10 develop guidance material on training and qualification of technical staff			Defined new profiles and expertise required, training and qualification requirement of Technical and operational staff.
D11 Develop AFI Communication Strategy			Team participation and Inputs, with support of stakeholders

3. Actions by the Meeting

3.1   The meeting is invited to:
  a) Take note of the progress made so far by the project team.

3.2   Draft Conclusion /Decision 6/xx: Develop an AFI interoperable seamless ATN IPS telecommunication infrastructure to support ATM, AIM, MET and aeronautical telecommunication services.
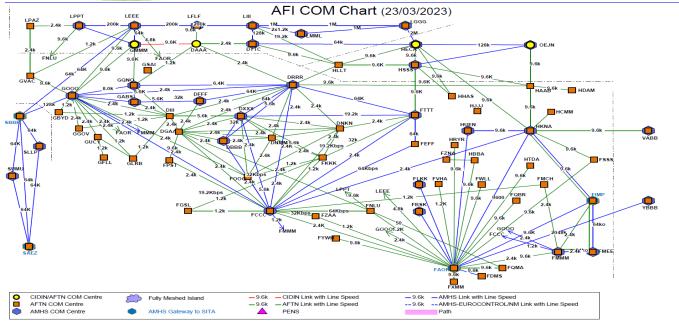
In view of the evolving operational needsand gaps in the delivery of data in digital formats in the AFI region, and in view of the delay in the implementation of the ATN/IPS, the meeting recommends that States:

  a) To finalize the planned re-engineering projects to accelerate the deployment of ATNIPS in the AFI region in a coordinated manner between the different ESAF and WACAF regions, involving the main VSAT network operators in the region.
  b) To deploy, without delay where possible, and on a bilateral basis and within the framework of interoperability between sub-regional networks, ATN applications such as:
    • Air Traffic Services (ATS) Inter-facility Data Communication (AIDC)
    • ATS Message Handling System (AMHS)
    • AMHS and Aeronautical Fixed Telecommunications Network (AMHS/AFTN) Gateway
    • Controller Pilot Data Link Communication (CPDLC)
    • Surveillance data sharing
    • Etc.

c) Implement the actions planned within the framework of the work program defined in the framework of this project in order to provide the regional with the necessary guidance material necessary for the effective and coordinated implementation of new ATN IPS network of the AFI region.
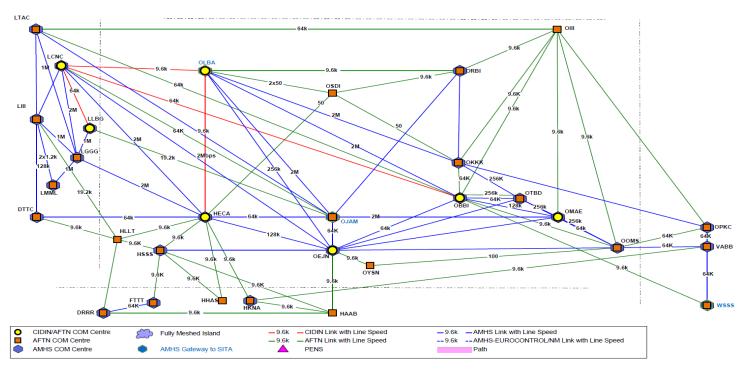
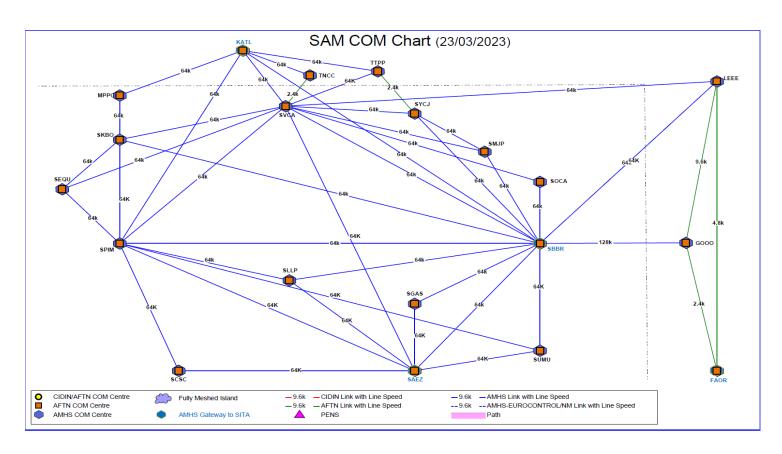# APPENDIX 1- AFI NETWORK COVERAGE AND COM CHART

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MID COM Chart (23/03/2023)

SAM COM Chart (23/03/2023)

Appendix 2 –Minimum bandwidth requirement for exchanges of IWXXM data through AMHS links

Site1	Site2	Current bitrate [kbps]	Future Throughput [Kbps]	Comments
Malabo	Brazzaville	19,2	64	NOC Sense --> BCC of attachment
Accra	Niamey	19,2	64	NOC Sense --> BCC of attachment
Lagos	Niamey	19,2	64	NOC Sense --> BCC of attachment
Libreville	Brazzaville	64,0	64	NOC Sense --> BCC of attachment
Brazzaville	Niamey	64,0	128	BCC Sense-->BCC
Niamey	Dakar	64,0	128	BCC Sense --> BRDO
Roberts	Dakar	64,0	64	NOC Sense --> BCC of attachment
Abidjan	Dakar	64,0	64	NOC Sense --> BCC of attachment
Brazzaville	Dakar	64,0	128	BCC Sense --> BRDO
Antananarivo	Dakar	64,0	128	BCC Sense --> BRDO
Moroni	Antananarivo	64,0	64	NOC Sense --> BCC of attachment
Brazzaville	Antananarivo	32,0	128	BCC Sense-->BCC
Pleasure	Antananarivo	64,0	64	NOC Sense --> BCC of attachment
Bissau	Dakar	19,2	64	NOC Sense --> BCC of attachment
Bamako	Dakar	32,0	64	NOC Sense --> BCC of attachment
Banjul	Dakar	19,2	64	NOC Sense --> BCC of attachment
Ouagadougou	Niamey	32,0	64	NOC Sense --> BCC of attachment
Cotonou	Niamey	32,0	64	NOC Sense --> BCC of attachment
Nouakchott	Dakar	64,0	64	NOC Sense --> BCC of attachment
Ndjamena	Niamey	64,0	64	NOC Sense --> BCC of attachment
Bangui	Brazzaville	64,0	64	NOC Sense --> BCC of attachment
Sao Tome S.	Brazzaville	64,0	64	NOC Sense --> BCC of attachment
Saint Denis	Antananarivo	64,0	64	NOC Sense --> BCC of attachment

Duala	Brazzaville	19,2	64	NOC Sense --> BCC of attachment
Lomé	Niamey	64,0	64	NOC Sense --> BCC of attachment
Antananarivo	Johannesburg	19,2	128	BCC Sense --> BRDO (future)
Dakar	Johannesburg	19,2	128	BRDO-->BRDO sense (future)