IPv6 Deployment
Case of Sudan/SudREN

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Republic of the Sudan

Area  1,886,068 km²
Population  40.23 M
Language  Arabic
GDP  $179.5 B
Per capita  $4,834
Calling code  +249
ccTLD  .sd, السودان
Penetration  85%
Internet Users  9.98 M
IXP  7 ISPs Since 2011
Service Region  AfriNIC
Sudanese Experience Toward IPv6
Activities

✓ 1st IPv6 Workshop; 24 June, 2010
As a side event of AREGNET Meeting.
Activities

- 2\textsuperscript{nd} IPv6 Workshop; 1 August, 2010
- Formation of the SDv6TF.
Activities

✓ 3rd IPv6 Workshop; 1-4 November, 2010
2nd IPv6 Training.
Internet Governances day.

AfriNIC
Activities

✓ 4th IPv6 Workshop; 27 October, 2011
Evaluation of the IPv6 Deployment in Sudan on 10 Major Information Network Operator
Sudanese IPv6 Training Center
In Collaboration with NAV6 Malaysia
Activities

5\textsuperscript{th} IPv6 Workshop; 26-30 October, 2013
IPv6 Workshop for Yemeni Delegations
Activities

- MyREN IPv6 Workshop; 25 April - 7 May 2015

Advance IPv6 Training Workshops
Number of Session Organized 26

Total Number of Attends 1000+

CN6 Exam Taken 218

CNE6 Level Certified 204

Certified IPv6 Trainers 12
IPv6 Deployment

- Development of the National IPv6 Migration Plan (2011-2015)
- Participate on IPv6 Events (ITU, ICANN, AfriNIC, NAV6)
- Formation of the SDv6TF
- More than Twenty Six workshops are organized
- Collaborate with NAV6 in continuous training program
- Operators are IPv6 Enable/Ready.
- Hosting AfriNIC-17
IPv6 Assignment

http://afrinic.net/en/services/statistics/country-stats
Development in IPv6 Assignment

http://6lab.cisco.com/stats/
### IPv6 Traffic

<table>
<thead>
<tr>
<th>Code</th>
<th>Percentage</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>61</td>
<td>0.2%</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>62</td>
<td>0.2%</td>
<td>Saint Barthelemy</td>
</tr>
<tr>
<td>63</td>
<td>0.1%</td>
<td>Sudan</td>
</tr>
<tr>
<td>64</td>
<td>0.1%</td>
<td>Cyprus</td>
</tr>
</tbody>
</table>

Source: Akamai State of the Internet Report  

Sudanese Experience Toward IPv6
SudREN at a Glance

- Sudanese Research and Education Network, NREN of Sudan
- SudREN is licensed ISP dedicated to the Sudanese research and educational intuitions.
- 3 STM-1 (450 Mb) Total Bandwidth to the upstream providers,
- 100+ Member Institution are connected via Layer-3 MPLS VPN on Local carries providers (Sudatel, Canar),
- SudREN has its own Numbering resources from
  - 41.67.0.0/18
  - 197.251.0.0/17
  - 2c0f:fec8::/32
Resource Utilization

• SudREN has utilized about 90% of the 1st block and about 70% of the 2nd one.

• SudREN started to put a strategic plan in accordance with the National Migration Plan toward IPv6.
Migration Plan

Network Analysis:
Update the network inventory, key network equipment, servers, appliances and computers.

Define roadblocks:
Identify the main challenges and key issues that hinder the deployment of IPv6.

Workarounds:
Develop a transition plan with minimum impact on existing critical applications.

Final Plan:
Prepare a set of strategies covering IT equipment acquisition, new critical applications, manpower resource planning and network policies to prepare for fully enabled IPv6 Network.
Evaluation of IPv6 Readiness

IPv6 Enabled equipment in SudREN

- IPv6 Block is already assigned 2c0f:fec8::/32
- 50% of the POPs Routers
- 10% of Members Router
- 100% of Servers
- 60% of Applications
Deploying IPv6

Steps to deploy IPv6

- Enable IPv6 on the Gateways
- Enable IPv6 on SudREN internal Network
- Enable IPv6 for SudREN members

Gateway

Internal Network (DMZ)

Members’ VPN
IPv6 in the Gateways

- SudREN has a native IPv6 link to the internet via (Sudatel)

- Redundancy Tunnel is also available through

![Diagram of IPv6 in the Gateways]
IPv6 Addressing

New IPv6 Addressing plan goals

• Improving routing aggregation.
• Minding future growth with contiguous address space.
• Hierarchical allocation “universities & campuses”
• Recognizing directly from the IPv6 Address what location/environment a networks belongs to.
• Reflect the organization infrastructure..

Each member currently is assigned /48 IPv6 Address block, and reserved /40 for future demand.

SudREN started putting a strategy to extend its IPv6 block.
Achievements

SudREN Running IPv6

On June 10th 2014 SudREN completed its IPv6 preparation and started announcing its prefixes to the world following its peers and other service providers taking the next step in IP Addressing.

Readmore.

The Sudanese Research and Education Network (SudREN) is a specialized Internet Service provider dedicated to supporting the needs of the research and education communities within Sudan. SudREN is a non-profit entity operating under the umbrella of the Association of Sudanese Universities. All research and education institutions of Sudan are eligible to become members of SudREN.
# Achievements

<table>
<thead>
<tr>
<th>ASN</th>
<th>AS Name</th>
<th>IPv6 Capable</th>
<th>IPv6 Preferred</th>
<th>Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>AS37197</td>
<td>SUDREN</td>
<td>25.29%</td>
<td>23.64%</td>
<td>5,013</td>
</tr>
<tr>
<td>AS15706</td>
<td>Sudatel</td>
<td>0.04%</td>
<td>0.04%</td>
<td>217,367</td>
</tr>
<tr>
<td>AS36998</td>
<td>SDN-MOBITEL</td>
<td>0.01%</td>
<td>0.00%</td>
<td>391,288</td>
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<td>AS36972</td>
<td>MTNSD</td>
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<td>0.00%</td>
<td>212,481</td>
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<td>AS33788</td>
<td>KANARTEL</td>
<td>0.00%</td>
<td>0.00%</td>
<td>33,049</td>
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<tr>
<td>AS37211</td>
<td>MAX-NET-FOR-INTERNET-SERVICES</td>
<td>0.00%</td>
<td>0.00%</td>
<td>6,400</td>
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<tr>
<td>AS36892</td>
<td>IPTECH</td>
<td>0.00%</td>
<td>0.00%</td>
<td>781</td>
</tr>
<tr>
<td>AS54334</td>
<td>ROYA - Roya Hosting LLC</td>
<td>0.00%</td>
<td>0.00%</td>
<td>24</td>
</tr>
<tr>
<td>AS0</td>
<td>Reserved (ietf)</td>
<td>0.00%</td>
<td>0.00%</td>
<td>1</td>
</tr>
<tr>
<td>AS0</td>
<td>Reserved (ietf)</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>AS54334</td>
<td>ROYA - Roya Hosting LLC</td>
<td>0</td>
<td>0</td>
<td>24</td>
</tr>
</tbody>
</table>
Challenges

• Coordination with local upstream providers,

• IPv6 is not supported in some members’ routers,

• Limited Redundancy for IPv6 Connectivity in Our POPs,

• IPv6 is not fully supported in both POPs Firewalls.
Guidelines to the Implementation of National Integrated Strategic Plan to IPv6 Transition

Sami Salih, Jordi Palet Martínez, Latif Ladid, Sureswaran Ramadass

Abstract—The transition to IPv6 is having big time, since a considerable amount of Internet traffic is now carried over IPv6 packets. The transition process is no more an option to all ICT related businesses to reach transparently end-users who should not require updates or reconfiguration. To do so, a transition plan should be defined. The goal of the plan is to perform an efficient and smooth enough transition without interrupting the critical online services. This paper outlines the guidelines of an integrated strategic plan for the IPv6 transition nationwide for public administrations, and presents a case study of a country transition.

Index Terms—Dual-stack, ICT, Internet, IPv4, IPv6, Transition, Tunnel
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