

## **Stages of development of NRENs based on the Capability Maturity Model (Greaves <sup>1</sup>)**

NRENs come into existence through varied pathways, which can be characterized as either bottom-up evolution or a top-down big bang approach, or there can be a mix of both shades in between. This latter scenario can occur where a long gestation effort pushed by champions (bottom-up) is rewarded with a commitment by government, possibly aided by an external source of finances, to fund a national plan (top-down). The Capability Maturity Model is a measure of development designed for the software industry and Duncan Greaves of TENET applied it usefully to describe the typical stages of development of NRENs, mainly on the bottom-up approach but it can serve as a useful guideline as to where on the scale various NRENs in a region lie. A summary of the levels are given below and applied to the African NRENs in regional charts and a continental- wide map.

**Level 0: No NREN and no awareness of the need.** This occurs in countries where there are a number of factors at work, which inhibit the establishment of an NREN, such as lack of awareness of the nature and benefits of an NREN, lack of physical network infrastructure, or its high cost. The commodity Internet is seen as sufficient for the needs of the universities.

**Level 1: No NREN but a diffused consciousness of the benefits of establishing one.** A bandwidth shortage can lead to the formation of a “buying club” for purchasing bulk bandwidth from an ISP. **It is the beginning of a consortium that could be developed into an NREN.**

**Level 2: No NREN but a more structured conversation regarding one.** This is the stage at which the group of champions has a more focused view of what is required and begins to approach University management and government for support. It can be prompted by changed conditions, donor prompting, regulatory improvements, but it requires strong leadership to proceed to the next level.

**Level 3: No actual NREN but a formal commitment to proceed is achieved.** The consensus is formalized with signed MoUs between institutions promising to collaborate and recognized by government, but before a physical network is established. Staff in universities and ministries are still working on a voluntary basis at the planning stage. This is a delicate stage and progress needs to be seen to keep the consensus alive.

**Level 4: A formal NREN organization with services is established.** A legal entity with paid staff and power to make contracts and offer services. Connectivity is provided to members through contracts with providers for services, and a business plan and business model is being implemented. It remains vulnerable to predatory competition from commercial operators because it is not yet able to provide the advanced services that distinguishes it from an ISP.

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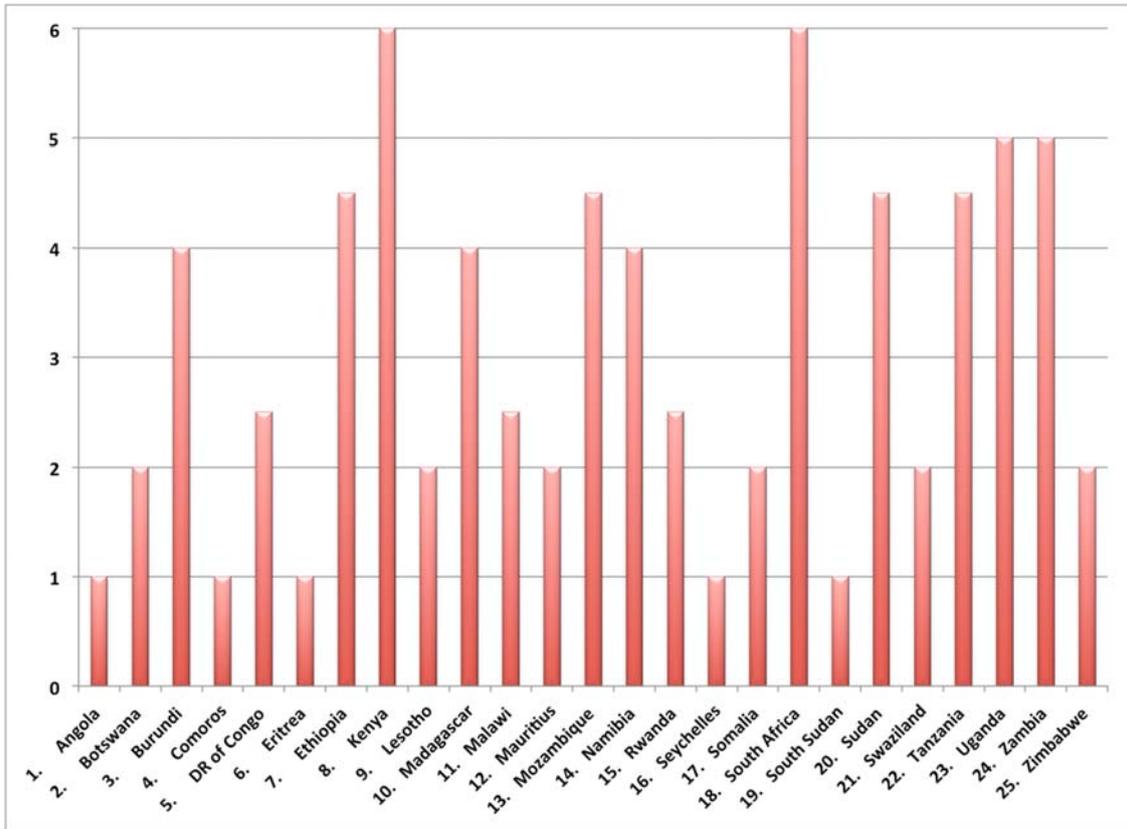
<sup>1</sup> [http://www.ubuntunet.net/sites/default/files/NREN\\_Capability\\_Maturity.pdf](http://www.ubuntunet.net/sites/default/files/NREN_Capability_Maturity.pdf)  
Duncan Greaves

**Level 5: First REN to REN international links are established.** The benefits include faster connectivity to remote academic resources and participation in the wider global and/or regional REN community.

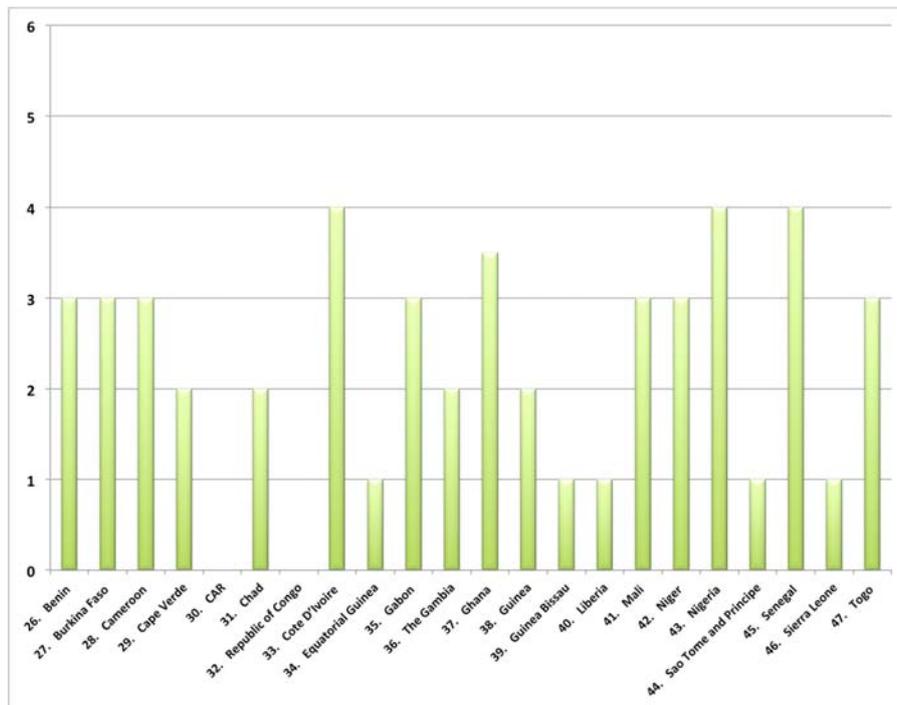
**Level 6: The NREN begins to offer REN specific advanced services.** This stage marks the full maturity of the NREN as it delivers value-added services specific to academic collaboration such as federated identity services, access to grid computing, science gateways, user-controlled lightpaths etc. This is where the NREN comes into its own.

### **Some caveats: Nuances within levels**

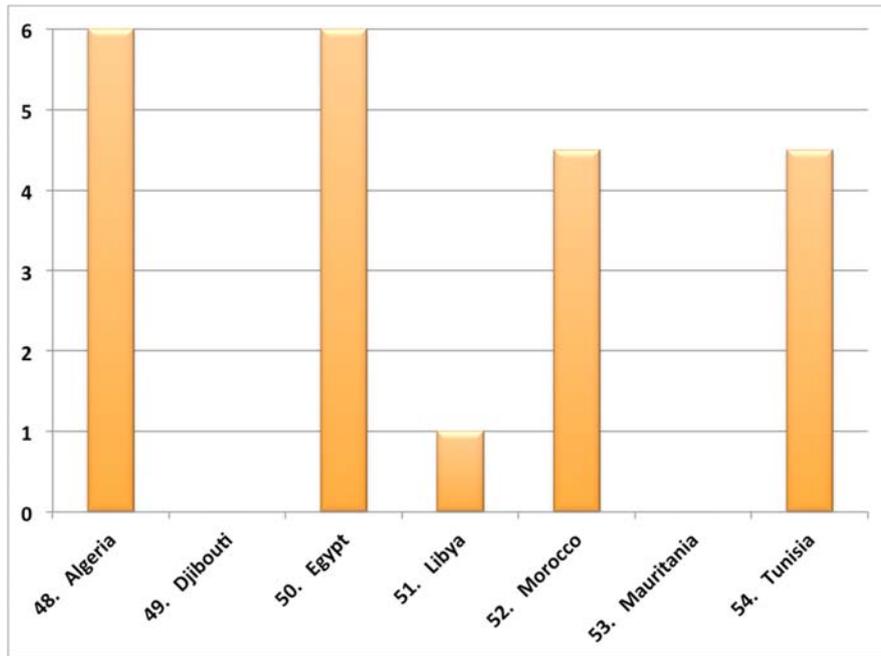
These levels are not watertight, as the stages of development of an NREN are more nuanced than the numbers suggest. Where the levels leak is often between levels 3 and 4 and between 4 and 5. To take the latter case, one NREN may have an advanced internal network but is not connected Internationally to another REN, while another NREN can have the international connection but have a less developed internal service. In these cases a 3.5 or a 4.5 may be the more appropriate grade. A similar situation may arise between levels 3 and 4 where an NREN is ready to implement an internal network but requires the seed funding from government to begin operating. Yet another variable is level of bandwidth provided by an NREN to member institutions. Given the very low capacity provided by VSAT systems for years, the expectations among universities can be quite low and the rules of supply and demand do not always apply. Very often it is a case of "if you don't expect much you don't demand more", or conversely, when offered a huge increase in bandwidth the demand can soar – a case of "if you build it they will come". Therefore, while a number of NRENs may have adequate connectivity and monitoring services in place, the actual bandwidth provided to institutions may be quite low compared to practice elsewhere. This situation will most likely change as bandwidth prices fall and usage rises, but it is yet another variable in the stages of development of an NREN. These more subtle variables are reflected in the numbers on the charts and in the color tones in the map, and comparable NRENs may achieve their level on different criteria.



**UbuntuNet Alliance - Levels of Development of NRENs in Eastern and Southern Africa (CMM)**

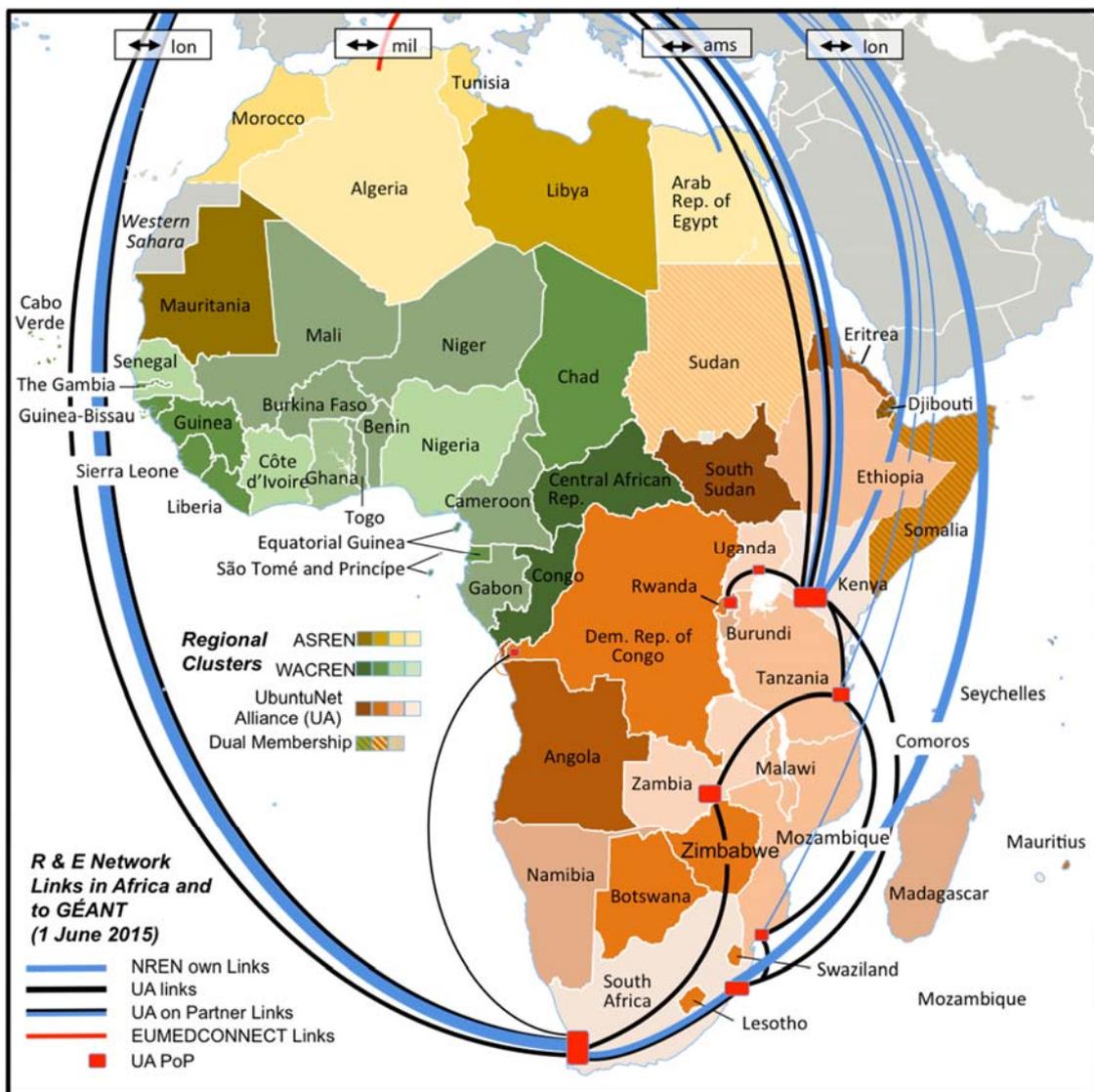


**West WACREN - Levels of Development of NRENs in and Central Africa (CMM)**



**ASREN – Levels of Development of NRENs in North Africa (CMM)**

## NREN status and International REN-REN Connectivity in Africa



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The map shows the status of the NRENs of Africa in regional clusters, color-coded as follows: ASREN (yellow), WACREN (green) and UbuntuNet Alliance (brown), with the lighter the color of the country indicating the more advanced the NREN is on the CMM scale, described on page X. A number of countries hold membership in two regional associations, because of their potential as points of interconnection between regions. Sudan, Somalia, Comoros, and Djibouti are members of ASREN and UbuntuNet Alliance, and DRC and

<sup>2</sup> The boundaries, colors, denominations, and other information shown on this map do not imply any judgment on the part of The World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Mauritania plan to apply for membership of WACREN while continuing to be members of UbuntuNet Alliance and ASREN respectively.

The connectivity links shown here relate only to REN-REN links between African NRENS with each other and with Europe. The European links terminate either at UbuntuNet Alliance Points of Presence (PoPs) in London (lon) and Amsterdam (ams), which in turn link to the GÉANT European backbone, or directly to GÉANT in Amsterdam (from Egypt), and Milan (mil - from Algeria). From these exchange points African NRENS can peer with all other NRENS globally, and transit to the commodity Internet.

***NB. All operational African NRENS can offer commodity Internet services to their members to a greater or lesser degree, mostly through a local ISP, but some have leased international capacity to exchange points in Europe and the Middle East. While these links are not shown on the map, due to space restrictions, they should not be underestimated in their contribution to teaching and learning in Africa, as the majority of digital learning resources are accessed through the commodity Internet.***

The black lines in the map refer to the UbuntuNet Alliance regional network and as of 1st June 2015 it has the following resources:

- Ten Points of Presences (PoPs), eight in the Eastern and Southern Africa (ESA) region and two in Europe, in London (lon) and Amsterdam (ams)
- A backbone covering seven countries in the ESA region
- A 2.18Gbps capacity between the ESA and European PoPs
- Two links along the east coast and two on the west.

The blue lines refer to the links of individual NRENS that are connecting directly to the European UbuntuNet PoPs:

- KENET(Kenya) – 2x STM-4, 1x STM-1, 1x STM-16 (approx. 3.9 Gbps in total). KENET also has an STM-16 (2.5 Gbps) link to commodity Internet at Fujairah in the United Arab Emirates (not shown)
- MoRENet (Mozambique) – 1x STM-1 (155Mbps)
- TENET(South Africa) – 1 x 10Gbps, 1 X 20 Gbps
- TERNET (Tanzania) – 1x SMT-1 (155Mbps)
- Egypt (EUN) direct STM-4 connection to GÉANT at ams.

The red line refers to the EUMEDCONNECT 622Mbps link between ARN, the Algerian NREN, and a GÉANT PoP in Milan (mil).

UbuntuNet peers (free exchange of traffic) with GÉANT in London and Amsterdam to exchange Research and Education traffic with GÉANT, member NRENS and with other regional RENs that peer with GÉANT .

It also has commodity Internet peering arrangements at the London Internet Exchange (LINX) and the Amsterdam Internet Exchange (AMS-IX) “settlement free” (no payment) and also at the NAPAfrica also settlement free. It also pays for some transit at LINX and AMS-IX.