# Geographic Locations of Web Servers under African Domains

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## ABSTRACT

The ccTLD (country code Top Level Domain) in a URL does not necessarily point to the geographic location of the server concerned. The authors have surveyed sample servers belonging to 60 ccTLDs in Africa, with regard to the number of hops required to reach the target site from Japan, the response time, and the NIC registration information of each domain. The survey has revealed the geographical distribution of server sites as well as their connection environments. It has been found that the percentage of offshore (out of home country) servers is as high as 80% and more than half of these are located in Europe. Offshore servers not only provide little benefit to the people of the country to which each ccTLD rightly belongs but their existence also heightens the risk of a country being unable to control them with its own policies and regulations. Offshore servers constitute a significant aspect of the digital divide problem.

## Categories and Subject Descriptors

C.2.3 [**Computer – Communication Network**]: Network Operations—*network management, network monitoring*

## General Terms

Management, Measurement, Experimentation, Legal Aspects

## Keywords

geographic location of servers, offshore server, ccTLD, Africa, digital-divide, traceroute, response time, number of hops, NIC registration information.

## 1. INTRODUCTION

As a part of activities under the Language Observatory project [3], which was planned primarily to provide means for assessing the usage level of each language in cyberspace [4], the authors have surveyed approximately 1600 websites that use ccTLDs of countries in the African Continent. We have used a traceroute command to measure the number of hops required to access each target site from the authors' university and the corresponding response time. In addition, we have applied Whois to the IP address of each server to derive the location information of each server (the country where the entity providing the server is located).


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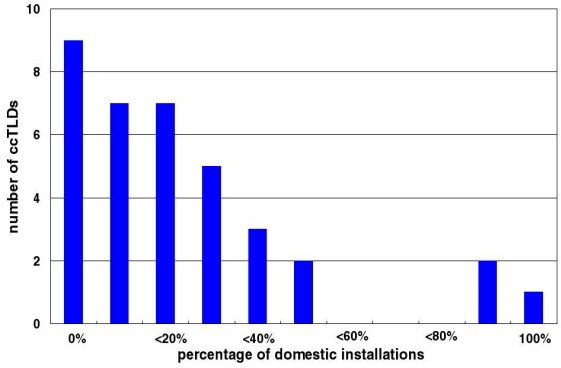


**Figure 1: Distribution of domestic installations of surveyed severs under African ccTLDs.**

## 2. MAJOR FINDINGS

### 2.1 Offshore Server Percentage

Of the 1600 servers used as samples in this survey, approximately 20% of them are located in the countries represented by the ccTLDs (hereafter referred to as "domestic installations"), and 80% are offshore. The distribution of domestic installations of surveyed servers under African ccTLDs is shown in Figure 1.

It is to be noted that nine domains have no domestic installations. Some of them, such as `io` (British Indian Ocean Territories) and `ac` (Ascension Island), are used for web hosting for marketing reasons. However, there are other ccTLDs with no clear mnemonic appeal. All told, the majority of African domains have fewer than 50% domestic installations. Even government sites are no exceptions. Several national government sites are located outside their countries. (For example, "A" in Figure 2 is the site for the Mali Ministry of Culture, located in Netherlands.)

### 2.2 Response Time and Number of Hops

The reason for installing servers offshore is most likely due to an inferior domestic telecommunications infrastruc-

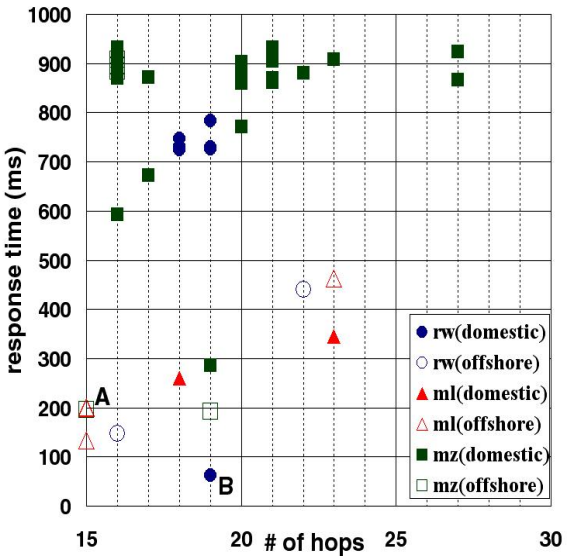


**Figure 2: Response time and number of hops from Japan to surveyed servers under African ccTLDs**

ture. In fact, there are significant differences in response time between servers installed domestically and those offshore.

In Figure 2, the horizontal axis represents the number of hops and the vertical axis the response time. The plots represent sample servers under the ccTLDs of three countries with different percentages of domestic installations: Rwanda (90%), Mozambique (31%), and Mali (12%). While the response time for access from the server of the authors' university to offshore servers installed in the United States is less than 200 ms, that for access to domestic servers in these three countries is usually over 600 ms – i.e., access to domestic servers experiences three times more delay than access to typical offshore servers.

This is most likely due to a restriction in the available bandwidth in the domestic portion of the link. Internet links from Japan reach IXPs in the African Continent via submarine cables, such as SAFE and SEAMEWE [1]. The number of hops to these IXPs is comparable to that to offshore servers. For example, "B" in Figure 2 represents Kigali RINEX, the IXP of Rwanda. However, the response time for access to domestic servers is very large in spite of the fact the number of domestic hops is relatively small.

## 2.3 Geographic Locations of Offshore Servers

Where are offshore servers located? In order to give a broad overview, Figure 3 shows "geographic centroids" of server locations in each ccTLD in a triangle whose points are Africa (partially including Asian or Oceanian countries), Europe, and North America. The size of a circle in the figure represents the number of sample servers in each ccTLD. We had expected that the choice between Europe and North America for the location of a server would be influenced by specific factors, such as historical relations and language. But in reality, no clear preferences have been identified, except that, as a whole, there is greater reliance on Europe. In terms of the ranking of non-African host countries, the highest is the Netherlands (452), followed by the U.S. (301) and

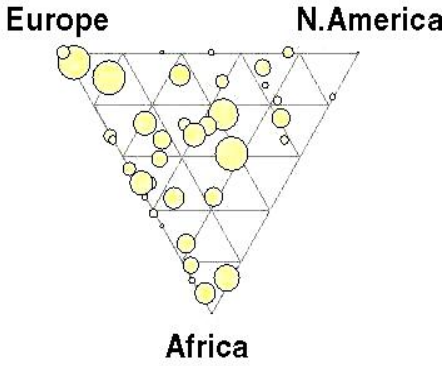


**Figure 3: Geographic centroids of surveyed servers under African ccTLDs**

the U.K. (102). Within the African Region, South Africa is the largest host with 113 offshore servers.

# 3. CONCLUSIONS

The delay in upgrading domestic telecommunications networks and the shortage of skilled server maintenance personnel are the likely background to the need to install even government servers offshore. However, offshore servers not only reduce the speed of access to these servers from the population within the country but also heighten the risk that domestic laws and regulations cannot be applied to network management for these servers. The questions, "who owns the domains?" or "To what extent redelegation of domain management be allowd?" [2] should be reinvestigated. Also, if this situation persists, it may disturb the growth of technical skills in the country. For these reasons, offshore servers constitute a significant aspect of the digital divide problem.

# 4. ACKNOWLEDGMENTS

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