

Cloud Computing  
**IN AFRICA**  
SITUATION AND PERSPECTIVES





# Cloud computing in Africa Situation and perspectives

*April 2012*



### **Acknowledgements**

This report has been prepared by an ITU expert Mr Slaheddine MAAREF from Tunisia Telecom and under the direction of the Regulatory and Market Environment Division IEE/BDT/ITU. We are grateful for his research and analysis which enabled the publication of this report.



**Please consider the environment before printing this report.**

© ITU 2012

All rights reserved. No part of this publication may be reproduced, by any means whatsoever, in part or in full, without the prior written permission of ITU.

## Table of contents

	<i>Page</i>
<b>Foreword</b> .....	<b>vii</b>
<b>Executive summary</b> .....	<b>viii</b>
<b>I. Introduction</b> .....	<b>1</b>
<b>II. Context of the study</b> .....	<b>1</b>
<b>III. Cloud computing: definitions and characteristics</b> .....	<b>2</b>
III.1 Definition .....	3
III.2 Characteristics of cloud computing .....	3
III.3 Description of the main cloud computing services .....	3
<b>IV. Legal framework of cloud computing</b> .....	<b>3</b>
IV.1 Governance in cloud computing mode .....	3
IV.2 Comparison between the cloud computing and conventional “hosted applications” modes .....	5
IV.3 Comparison between the cloud computing and “licensed software” modes .....	6
IV.4 Interoperability and reversibility in cloud computing .....	6
IV.5 Harmonisation des règles de protection de données .....	7
IV.6 Costs associated with adoption of the cloud computing model .....	7
IV.7 The situation of cloud computing in Africa .....	8
IV.7.1 At the ICT development level .....	8
IV.7.2 At the legal and regulatory levels .....	10
IV.8 Global analysis of the survey results .....	12
IV.9 Introduction and/or upgrading of regulations governing data protection .....	12
IV.10 Recommendations for ensuring effective regulatory progress in the field of cloud computing .....	13
IV.10.1 Monitoring of developments in the regulatory field .....	13
IV.10.2 Careful preparation of cloud computing outsourcing contracts .....	13
IV.10.3 Cross-border standardization and regulation .....	14
IV.10.4 Conformity with existing provisions .....	14
<b>V. Data centres: best practices for sustainable development</b> .....	<b>15</b>
V.1 Definition .....	15
V.2 Basic characteristics of a data centre .....	16
a Power supply .....	16
b Cooling systems .....	16
c IT equipment .....	16
d Network .....	17
V.3 Different types of data centre .....	17
a Geographic location and level of risk .....	17
b Levels of availability .....	17
V.4 Recommendations for the implementation of data centres .....	17

	<i>Page</i>
<b>VI. Proposal for training programmes .....</b>	<b>19</b>
VI.1 For players on the standardization and regulatory sides .....	19
VI.2 For players on the technical side .....	20
<b>VII. Methodology of the survey .....</b>	<b>20</b>
<b>VIII. Conclusion and Recommendations .....</b>	<b>21</b>
Recommendations.....	22
Recommendation 1: Effective regulatory progress .....	22
Recommendation 2: Maintain a regulatory watch.....	22
Recommendation 3: Careful preparation of cloud computing outsourcing contracts.....	22
Recommendation 4: Conformity with existing provisions.....	22
Recommendation 5: Qualities of data centres Establishment of data centres .....	23
Recommendation 6: Qualities of data .....	23
Recommendation 7: Introduction and/or upgrading of regulations .....	24
Recommendation 8: The launch of training programmes.....	24
Recommendation 9: Cross-border standardization and regulation .....	24
<b>IX. Presentations of the results of the survey and general analysis of responses .....</b>	<b>24</b>
<b>Q1 Is the introduction of cloud computing planned in your country? .....</b>	<b>26</b>
<b>Q2: If yes, what is the level of introduction of cloud computing services in your country? .....</b>	<b>27</b>
<b>Q3: What are the considerations that underlie the will to introduce cloud computing services in your country? Sort the following considerations from 1 to 9 by order of relevance (with 1 being the most relevant and 9 the least relevant) .....</b>	<b>30</b>
<b>Q4: What is the level of availability to broadband access services (ADSL, EDGE/3G, LS-FO (fibre-optic leased lines) in the country?.....</b>	<b>32</b>
<b>Q5: What is the bandwidth available in the market?.....</b>	<b>33</b>
<b>Q6: What is the availability of data centres in your country?.....</b>	<b>34</b>
<b>Q7: Are there government initiatives to promote cloud computing services?.....</b>	<b>35</b>
<b>Q8: Does your country have legislation on data protection? .....</b>	<b>37</b>
<b>Q9: If yes, is it necessary to revise this legislation related to data protection to promote cloud computing?.....</b>	<b>38</b>
<b>Q10: Do you have agreements on data protection with countries providing cloud computing services (USA, Europe...).....</b>	<b>39</b>
<b>Q11: What aspects of cloud computing need legislation coordination between countries and subregions?.....</b>	<b>40</b>
<b>Q12: Sort (from 1 to 5) the following services by order of importance for the development of cloud computing services in your country (a brief description of the services can be found in Annex 1) (1 the most important, 6 the less important).....</b>	<b>41</b>
<b>Q13: What are the cloud computing services offered by multinational companies (Google, Microsoft, IBM...) in your country? .....</b>	<b>43</b>
<b>Q14: What are the CC services developed and proposed by companies from your country?.....</b>	<b>44</b>
<b>Q15: What cloud computing services proposed by regional companies located in Africa are available in your country? .....</b>	<b>46</b>

	<i>Page</i>
<b>Q16: What is the experience of your country (good practices, success stories, lesson learned) regarding the implementation and use of cloud computing services? .....</b>	<b>47</b>
<b>Q17: Sort the possible barriers to the adoption of cloud computing (from 1 to 6, 1 the most important, 6 the less important).....</b>	<b>48</b>
<b>Q18: Sort (from 1 to 6) your cloud computing capacity building needs (seminars, workshops ...) based on following domains (1 the most important, 6 the less important):.....</b>	<b>50</b>
<b>Q19: Is the level of equipment's penetration of enterprises on PC / smartphones sufficient to ensure a wide usage of cloud computing services by professionals? .....</b>	<b>52</b>
<b>Q20: Concerning data centre security, which of the following issues need to be improved to ensure always-on access to good quality cloud computing services? By order of priority from 1 to 6 (1 the most important, 6 the less important): .....</b>	<b>53</b>
<b>Bibliography .....</b>	<b>55</b>





## Foreword

It is my pleasure to introduce the report of the study on cloud computing in Africa that was carried out at the beginning of 2012.

Within the Africa region, ICT development and uptake are proceeding apace, with cellular mobile penetration at 52 per cent, and 12.8 per cent of the population having Internet access, in early 2012.

However, the penetration rates for fixed and mobile broadband – barely surpassing 0.2 and 3.79 per cent, respectively – highlight the need for continued effort.

As in all parts of the world, cloud computing brings unquestionable benefits to the ICT sector. To harness these benefits to the full, there has to be a coherent regulatory framework guaranteeing transparency, data protection and respect for data integrity. It was against this background that the 12th Forum on Telecommunication/ICT Regulation and Partnership in Africa (FTRA 2011), held in Kigali (Republic of Rwanda) from 13 to 15 June 2011, adopted a recommendation calling for a study of the question in Africa. On the basis of a survey conducted among the countries concerned, the study constituted an in-depth analysis of the political, regulatory and technical issues of relevance to governments, regulators and the industry in Africa. The report puts forward recommendations advocating, on the one hand, the establishment of political and regulatory frameworks and appropriate training programmes to facilitate the advent of cloud computing, and, on the other hand, popularization of the technology.

I am pleased to make available to the membership a product which, in addition to meeting its demands, will also make a major contribution to ushering in the information society, with the prime objective being the achievement of broadband access for all the region's inhabitants.

Two of ITU's Sectors – Standardization and Development – collaborated closely on the preparation of this report.

I should also like to express my thanks to the African Telecommunications Union (ATU), to all the experts and to the administrations and companies to which they belong, for their very valuable contribution to the elaboration of this report.



Brahima Sanou  
Director  
Telecommunication Development Bureau (BDT)

## Executive summary

This study was launched at the initiative of ITU's Telecommunication Development Bureau and pursuant to one of the recommendations adopted by the 12th Forum on Telecommunication/ICT Regulation held in Rwanda in June 2011.

The essential value of this new way of using IT resources known as cloud computing resides in the fact that IT services, from the storage and processing of data to software applications, are now available and accessible to everyone, instantly, without commitment and on request.

For some African sub-regions, the cloud computing model has already come to represent a solution to IT under-equipment problems, and the trends indicate that this model is set for major development provided certain accompanying measures are taken in a timely manner.

The experience of African countries to date points to cloud computing technology being used at different levels according to the institutions concerned. Indeed, while a given administration may only now be preparing to introduce this new technology, it may well be the case that 50 per cent of the country's ICT operators have begun to implement or are already using it.

Where other economic operators are concerned, the banking and education sectors are the first to have adopted this technology in Africa.

In Tanzania and Rwanda, specific data centre projects are already operational or in the process of being set up. In Benin and Burundi, strategies are emerging for the introduction of cloud computing. For the other countries surveyed, the initiatives reported, although interesting, are in fact broader actions or programmes not specific to the cloud computing (regulatory frameworks for electronic transactions, outsourcing of business processes, technology parks).

At the regulatory level, it is to be noted that the majority of countries surveyed do not have data protection legislation or agreements with other countries in that regard.

In the interests of fostering the emergence of cloud computing technology, African countries advocate actions to upgrade and revise the corresponding legislations, in particular:

- transposition to the national level of sub-regional, regional or international texts on data protection;
- revision of the relevant legislation to take account of the status of cloud-hosted data;
- strengthening of legislation, codes of conduct and standards applicable to the ICT sector;
- clarification of relations between data centre managers, cloud computing and data protection.

Where training in regard to the cloud computing is concerned, the African countries surveyed expressed their priority requirements, relating in particular to the legal environment of cloud computing and technical considerations pertaining to networks, IT and the management of data centres.

The ICT sector in Africa is characterized by the very rapid development of mobile networks. At the same time, however, African countries are seeking solutions whereby they can catch up on the deployment of fixed infrastructure and high-speed networks.

Against this background, African business managers find themselves under ever-mounting pressure. The increasingly intense and often unbalanced competition between African businesses and those in the so-called developed world, coupled with the effects of successive global crises, are forcing all businesses to redouble their efforts to reduce operating costs, rationalize investments, boost productivity and foster innovation.

Cloud computing, considered by some to be the technological revolution of the twenty-first century, could go a long way towards resolving such issues, provided the corresponding technology is implemented on solid bases that inspire confidence in users both domestic and foreign.

To this end, African decision-makers are in agreement that a regulatory environment that adheres to international requirements in terms of personal data protection and data transfer security constitutes the main supporting pillar for successful development of cloud computing. Similarly, the deployment of high-quality data centres with ensured continuity of service, rapid accessibility and secure data storage in line with international standards constitutes the second pillar of cloud computing for Africa.

From the feedback received, it is clear that the market is active and that African players are already engaged in the cloud computing adventure. Those players now must aligning their regulations with international market requirements and training sufficient human resources to enable Africa to benefit from an opportunity that is particularly suited to its situation and capable of providing high-impact leverage to socio-economic development throughout the continent.

The conclusions drawn from the study could be summarized as follows:

The main characteristics of cloud computing, i.e. economies of scale (sharing) and flexibility/modularity of use, constitute opportunities for ICT development in Africa. However, these same characteristics, which translate into a very high concentration of resources and data in data centres and free public access, give rise to technical and legal situations that are highly complex.

Even so, given the associated cost reductions and flexibility, the migration to cloud computing is attracting many African users.

However, the absence of appropriate regulatory frameworks and lack of adequate competencies in Africa can expose the cloud computing model to major security risks which threaten its potential success within the continent.

The survey conducted within the framework of this study reveals that major concerns associated with data confidentiality, data protection and network reliability have yet to be dispelled.

The introduction of strategies aimed at upgrading legislative and regulatory frameworks and the launch of capacity-building programmes are strongly advocated in the interests of enabling African countries to rise to the challenge of a successful migration to cloud computing while maintaining conformity with international standards and with best practices in that sphere, thereby smoothing the way for Africa's integration into the worldwide digital economy.

In conclusion, the study presents recommendations related to regulation, the establishment of a regulatory watch, content outsourcing contracts on Cloud Computing mode, the implementation and quality of data centers, the training programs, the standardization and the cross-border regulation. The main objective of these recommendations is to ensure a harmonious and sustainable development of the technology in Africa.



## I. Introduction

The remarkable development of cloud computing in recent years is increasingly sparking the interest of Internet and IT users seeking to derive the greatest benefit from the services and applications available on line via the web in service-on-demand mode with per-usage billing. Cloud computing offers a new economic model for ICTs – a model which heralds new modes of investment in, and operation of, IT resources. With cloud computing, organizations, institutions and companies no longer need to invest heavily in such resources, which are of necessity limited and require burdensome and costly internal management, having instead the option to migrate to a cloud model enabling them to purchase or lease resources on line. This model frees them from internal management costs, the IT resources being administered by the cloud computing provider.

The availability of online services also frees users from the need to acquire hardware by paying instead for the resources used. This model has already been adopted by many companies, particularly small and medium-sized firms and very small firms.

Cloud computing also offers IT resource (hardware and software) modularity, with availability in terms of volume and time according to the customer's requirements and at its request.

In an economic context where companies are seeking to make the most from their investments and minimize operating costs, cloud computing is seen as the solution for tomorrow.

According to Gartner, cloud computing, with its exceptional 25 per cent growth rate, represented over USD 56 billion in 2009 and should account for USD 150 billion in 2013 (some 10 per cent of worldwide investment in the IT sphere). The same source reports that, in 2010, cloud computing took the lead position in terms of investment, ahead of Green-IT and virtualization.

In France, the consultancy firm Markess estimated, during the Eurocloud Congress in April 2010, that the French cloud computing market represented EUR 1.5 billion in 2009 and was expected to grow to EUR 2.3 billion by 2011.

A prerequisite for companies' successful adoption of cloud computing, with all its many benefits, is a prior understanding of this new phenomenon in IT services. In many cases, specific expertise has to be developed in the fields of data-centre administration and commercial relations before implementing the cloud concept.

As things stand, the inadequacy of legislative and regulatory frameworks containing appropriate guidelines is not conducive to the rapid adoption of cloud computing and establishment of a relationship of trust among stakeholders.

## II. Context of the study

The promotion of cloud computing is an important matter for policymakers and regulators worldwide, since the cloud computing holds out distinct benefits for governments, companies, service providers, industry and research.

To enable full enjoyment of these benefits, a coherent regulatory framework guaranteeing transparency, data protection and respect for data integrity has to be established.

Against this background, ITU/BDT organized the 12th Forum on Telecommunication/ICT Regulation and Partnership in Africa (FTRA 2011), held in Kigali (Republic of Rwanda) from 13 to 15 June 2011 under the theme "Cloud computing, development prospects of ICTs: Challenges and opportunities for policymakers, regulators and ICT operators".<sup>1</sup>

---

<sup>1</sup> FTRA report is available at : [www.itu.int/ITU-D/afr/events/FTRA/2011](http://www.itu.int/ITU-D/afr/events/FTRA/2011)

The forum served as an opportunity for participants to raise questions concerning the development of cloud computing in Africa. Those questions (as recorded in the final document of the forum) related mainly to:

- i) Data security.
- ii) Cost effectiveness for the following reasons:
  - No need for an expensive computer or protected storage system.
  - No IT maintenance costs.
  - No expensive software.
  - Cloud computing works via the Web, with access to services by means of a simple browser and, increasingly, with free operating systems.

However, other key prerequisites for cloud computing were identified:

- a) Good Internet connectivity.
- b) A sound software and hardware market.
- c) Applications need to be virtualized.
- d) Trust in the security of the systems used.
- e) Access, privacy, reliability and compliance in cloud computing.
- f) Liability and regulation in regard to cloud computing.
- g) Data location.

To this end, the forum recommended the launch of a reflection process on the opportunities at hand with a view to elaborating a coordinated and coherent approach to the adoption of cloud computing in Africa while minimizing the risks. In that regard, countries must adopt guidelines on:

- a) the strategy for the transition to cloud computing;
- b) capacity-building programmes;
- c) the harmonization of legislative and regulatory reference frames;
- d) the adoption of data-centre selection criteria;
- e) attracting investment and seizing business opportunities.

### III. Cloud computing: definitions and characteristics

“By 2012, 20 per cent of businesses will own no IT assets. Several interrelated trends are driving the movement toward decreased IT hardware assets, such as virtualization, cloud-enabled services, and employees running personal desktops and notebook systems on corporate networks.

The need for computing hardware, either in a data centre or on an employee's desk, will not go away. However, if the ownership of hardware shifts to third parties, then there will be major shifts throughout every facet of the IT hardware industry. For example, enterprise IT budgets will either be shrunk or reallocated to more-strategic projects; enterprise IT staff will either be reduced or reskilled to meet new requirements, and/or hardware distribution will have to change radically to meet the requirements of the new IT hardware buying points”<sup>2</sup>.

---

<sup>2</sup> Extract from a Gartner press release issued in January 2010.

### III.1 Definition

The following definition of cloud computing is a simplified extract from the definition produced by the National Institute of Standards and Technology (NIST) (United States) and the ITU Focus Group.

*“Cloud computing is a model for enabling network users’ on-demand access to a shared pool of configurable computing resources that can be rapidly provisioned and released to the client without direct service provider interaction.”*

### III.2 Characteristics of cloud computing

Cloud computing services have characteristics which distinguish them from other technologies:

- As a rule, cloud computing users do not own the IT resources they use, the servers they exploit being hosted in external data centres.
- Services are provided via the pay-per-use model or subscription model.
- The resources and services provided to the client are often virtual and shared among several users.
- The services are provided via the Internet.

With these characteristics, cloud computing technology is a new solution giving users the option to access software and IT resources with the desired flexibility and modularity and at very competitive prices.

### III.3 Description of the main cloud computing services

Cloud computing comprises five types of service:

- Infrastructure as a Service (IaaS): virtualized on-demand server, virtualized data centre, flexible on-demand storage space, flexible local networks (LANs), firewalls, security services, etc.
- Platform as a Service (PaaS): platform for cloud computing service provision (customer service management, billing, etc.)
- Software as a Service (SaaS): business applications, customer relations and support (CRM), HR, finance (ERP), online payments, electronic marketplace (for very small and small and medium-sized enterprises), etc.
- Communication as a Service (CaaS): audio/video communication services, collaborative services, unified communications, e-mail, instant messaging, data sharing (web conference).
- Network as a Service (NaaS): managed Internet (guaranteed speed, availability, etc.), virtualized networks (VPNs) coupled with cloud computing services, flexible and on-demand bandwidth.

## IV. Legal framework of cloud computing

### IV.1 Governance in cloud computing mode

Despite the fact that a number of questions remain unanswered in the areas of governance and regulatory conformity with respect to cloud computing, this new mode of IT resource utilization is developing at a rapid and sustained pace, chiefly on account of its ease of use and direct service accessibility via the Internet, and above all to the productivity gains and cost savings it enables.

From another perspective, it is a fact that the cloud computing environment, although relatively recent, assigns due importance to good governance and to the integrity of systems and data.<sup>3</sup>

However, questions remain as to the ability of companies having adopted cloud computing technology to continue to comply with all the standards of governance in force and applied to the classic business IT environment: Have regulatory principles been established specifically to protect cloud computing users? Which cloud computing services meet the best practice requirements and recommendations already established?

All these questions represent challenges not only for companies directly involved in the provision and use of cloud computing services, but also for governments and all other players involved in companies' affairs.

In this regard, some are of the opinion that cloud computing services are not yet capable of complying with best governance practices for business IT, justifying their pessimism by the fact that companies are unable to be responsible for controlling those able to access their data, or for the location in which those data are stored, given that one of the basic principles of cloud computing is that data may be posted or stored "anywhere in the world".

On the other hand, those involved in cloud computing maintain that the basic principle of this new technology is the integrity of its audit process, which guarantees conformity with the rules of good business governance. It is a process which requires that a trace be kept of all data components, regardless of whether the data are located in data centres belonging to the company itself or somewhere in the cloud.

However, questions remain as to the ability of the players in cloud computing to respond rapidly to the following requirements:

- Conformity with regular management performance assessment processes and with the rules of responsibility-sharing.
- Identification of incidents associated with system administration failures.
- The need to find rapid solutions to shortcomings in internal process controls.
- The need to establish good relations and more open channels of communication between all cloud computing players and the regulators.

From another angle, the cloud computing concept embodies a whole range of service types (IaaS, PaaS, SaaS, NaaS, CaaS) and several possible operational models (public and private Cloud), making it difficult to fix on a process or specific approach that it would suffice to apply in order to meet the regulatory requirements.

Nevertheless, cloud computing technology is constantly evolving, and questions relating to the conformity and alignment of the cloud computing environment with best practices in terms of enterprise governance are addressed by experts at the international level, with solutions being delivered on a regular basis.

This ongoing development enables organizations and companies adopting cloud computing to have fully secure access to cloud computing services in accordance with the requirements of good governance.

Among the initiatives aimed at helping companies with the successful deployment of cloud computing, we may cite the study carried out by Shared Assessments to evaluate risks associated with the cloud, published in October 2010 by The Santana FE Group (Evaluating Cloud Risk for the Enterprise).<sup>4</sup>

---

<sup>3</sup> The reader will find in the Bibliography an example of recommendations and best practices for the administration of cloud systems

<sup>4</sup> A Shared Assessment Guide, October 2010, published by The Shared Assessment Program [www.sharedassessments.org](http://www.sharedassessments.org)



This study includes a guide which proposes, among other things:

- An approach for assessing the risks inherent in the introduction of cloud computing, including a comparative review of the standards and audit processes associated with the IT environment, separated into two categories: (i) standards and processes considered stable and mature and which are applicable to cloud-based services; (ii) standards and processes recently brought into use and considered not yet sufficiently mature and capable of constituting a risk to the introduction of cloud computing.
- A case study outlining the evaluation and implementation of cloud computing technology by a major United States enterprise.

The following is a list of institutions and organizations that have launched initiatives having a significant impact on the development of cloud computing technology: *Cloud Security Alliance, Commission of the European Communities, European Network and Information Security Agency, Information Systems Audit and Control Association, National Institute of Standards and Technology, The Open Group / Jericho Forum, US Regulatory Agencies*. It is recommended that several sources be consulted before deciding on the adoption of a given conformity-related standard or process.

We would also cite the security-related findings of ITU-T's Focus Group on Cloud Computing, with the identification of a list of threats and requirements in the area of data protection and cloud computing security.

Finally, it is to be noted that the political world is in turn coming to appreciate the importance and urgent need for establishing regulations conducive to a successful transition to cloud computing. In this regard, and by way of an example, it is interesting to note the content of the recommendation made by the Congress of the Liberal Democrat Party to the British Government (in which it participates) in September 2011, concerning the adoption of cloud computing in England:

#### «Cloud Computing»<sup>5</sup>

*We have noted the growing popularity of cloud computing. It is clear that this new technology provides tremendous opportunities to streamline the use of IT, reducing costs and driving up efficiency.*

*However, cloud computing is an area where, if left unchecked, there is serious potential for abuse. Cloud Computing is only attractive if it embodies the principles on privacy and data ownership, access, project management and procurement.*

*We recommend that as a matter of urgency, the government consider the security issues involved with cloud computing, particularly regarding data location and segregation .”*

## IV.2 Comparison between the cloud computing and conventional “hosted applications” modes

IT systems based on the “hosted applications model” have for many years constituted the most widely-used mode of IT operation. This mode, which will continue to exist, is, despite having several features in common with cloud computing, fundamentally different to it from the business model standpoint.

One major difference between the two modes lies in the fact that, in the case of cloud, responsibility for security is entirely a matter for the cloud computing provider, whereas in the “hosted applications” mode, that responsibility is shared between the owner of the application and the host. Similarly, in cloud computing mode, an application may form part of a package of SaaS services, and its use, like that of the infrastructure which hosts it, is often shared with several other clients.

---

<sup>5</sup> Report of the Congress of the Liberal Democratic Party (England), September 2011

It nevertheless has to be borne in mind that with all models, responsibility in regard to the consequences and risks associated with use of the application lies neither with the host provider nor the cloud computing provider, but with the client having opted to outsource the administration and maintenance of the application in question.

### IV.3 Comparison between the cloud computing and “licensed software” modes

Although traditional licensed software providers are also interested in the cloud computing model (which enables them to expand their customer base by catering for customers previously unable to benefit from licensed software for reasons of cost and/or limited administrative and maintenance capabilities), it is noted that such providers are adopting the cloud computing model much more slowly than other providers, since for traditional software providers the cloud computing model represents a risk of cannibalization of a market they currently dominate thanks to licensed software.

Thus, if one compares the response of Internet players to software providers, it is clear that while an Internet provider may be engaged in aggressive development of cloud computing applications, in some cases putting them online free of charge, a software provider, with its vast customer base built up through the “licensed software” model, will be proceeding very cautiously, if not hesitantly where certain products are concerned.

### IV.4 Interoperability and reversibility in cloud computing

Although cloud-based offers are proliferating on the web and competition among cloud computing services is in full swing, the rules and standards governing cloud computing are not yet sufficiently mature to provide customers with conditions of use ensuring that they will not experience situations of blockage or dependency vis-à-vis the cloud computing providers.

Indeed, the data formats and interfaces of the applications used by a cloud computing provider cannot necessarily be used by the customer or by another provider.

What cloud-service users are hoping for is that relations between cloud computing providers and their customers can advance to the point at which there can be a change in cloud-service provider whenever one of the parties so wishes, without any penalty or loss of data.

Similarly, users want to be able to recover their data whenever they wish, without distortion or loss. As things stand, the arrangements for identification and marking of data in the cloud are rudimentary and unreliable.

Also to be borne in mind is that the regulations applicable in the territory in which the data are physically located may prove problematic when it comes to recovering disputed data.

All these considerations underline the need for, and relevance of, rules and standards enabling interoperability and reversibility in the world of cloud computing. Here again, it is evident that standardization is the prerequisite for creating the conditions needed to give users the necessary confidence for adopting cloud computing solutions. In which regard, we would refer to the findings of the ITU Focus Group on Cloud Computing with respect to identification of scenarios and cases studies for cloud computing interconnection<sup>6</sup>.

Achievement of this confidence goal calls for the adoption of an international coordination effort encompassing both the regulatory and technical aspects. The long-term development of cloud computing depends on this.

---

<sup>6</sup> [www.itu.int/en/ITU-T/focusgroups/Cloud/Pages/default.aspx](http://www.itu.int/en/ITU-T/focusgroups/Cloud/Pages/default.aspx)

#### IV.5 Harmonisation des règles de protection de données

Since 1995, a European directive on data protection has been in force in 25 countries, constituting the biggest coordination operation in this sphere to date. However, achievements in the field in terms of harmonization initiatives inspired by this directive remain more theoretical than practical, the impression being that companies are more concerned with protecting their positions on international markets than with protecting the personal data of those using their services.

With this situation in mind, the issue of harmonizing data protection rules is coming up more and more frequently in regional and international gatherings held to address the question of cross-border data flows.

In the interests of improving coordination, the European Union, in 2010, launched new studies on the protection of personal data with a view to updating Directive 95/46/EC of 1995 in the light of the new possibilities offered by cloud computing technology for the movement of data. The goal of the studies was to achieve a balance between the following two objectives:

- (1) *In accordance with this Directive, Member States shall protect the fundamental rights and freedoms of natural persons, and in particular their right to privacy with respect to the processing of personal data.*
- (2) *Member States shall neither restrict nor prohibit the free flow of personal data between Member States for reasons connected with the protection afforded under paragraph 1.*

In the report of this new study, presented in Brussels on 16 June 2011 in the form of an Opinion of the European Economic and Social Committee, it is stated that “the explosive development of new technologies is causing an exponential increase in the amount of on-line data processing which requires a parallel increase in personal data protection if large scale intrusion into personal privacy is to be avoided. The collection, merging and management of data from multiple sources need to be carefully circumscribed. The public sector holds many different files on aspects of the relationship between citizens and the state. Data collected should be the minimum required for each purpose and there must be a ban on assembling these various data into a “big brother” data base.

The recommendations emanating from the study are presented in the reference document “SOC/402, Personal data protection” published by the European Economic and Social Committee.

#### IV.6 Costs associated with adoption of the cloud computing model

All the experts now agree that the adoption of cloud computing offers tangible benefits in terms of flexibility and convenience. However, it cannot automatically be inferred from this that all the new economic models being ushered in by cloud computing systematically guarantee significant financial gains, whether for cloud providers or for cloud service users. The complexity of the cloud computing models thus far proposed is such that the corresponding economic analyses reach differing conclusions as to the costs involved and gains to be made following the adoption of a cloud computing model.

The migration to cloud computing often entails additional, unexpected costs, and although those costs are affordable and do not jeopardize the positive result of adopting cloud, some operations can turn out to be very costly, particularly if they are not prepared in a timely manner. For example, a one-off transfer of large volumes of data to or from the cloud can be very costly, as can the storage of data in the cloud over very long periods. Such an operation can represent a considerable outlay for a company, which may not be aware of this in the short term.

The frequent movement of data between company and cloud can also rack up the costs, particularly in terms of bandwidth consumption where transfer times are lengthy.

As things currently stand, then, and aside from long-term storage and the frequent consultation of large volumes of data, it is clear that the other cloud computing services – SaaS, PaaS, IaaS, CaaS – are providing their adherents with very significant gains by comparison with in-house solutions.

## IV.7 The situation of cloud computing in Africa

In Africa, several cloud computing projects are already under way or under study. Of these projects, the most solid are the result of partnerships between international players and African economic operators.

The benefits to be derived from this advanced IT service appear to have convinced African players, and the indications are that the characteristics of cloud computing would be very appropriate to the African context. This would explain the interest shown by the various stakeholders, each of which is seeking to tap into those benefits as speedily as possible and get in at the beginning, in spite of the technical shortcomings and regulatory difficulties associated with the deployment of cloud computing technology.

Account also has to be taken, of course, of the circumstances specific to Africa, where the human, technical and financial resources that are available to, or within easy reach of, the African players often fall short of the requirements imposed by this new technology. It is therefore essential to implement training and institutional strengthening programmes within African countries. Proposals to that end are set out later in this study.

In an article recently published in the journal “Les Afriques”, Raphaël Nkolwoudou, Associate Counsel Azaniaway Consulting, explains that cloud computing is suited to the African continent by reason of the concentration of infrastructures, availability of IT competencies and ease of implementation. There is, however, one prerequisite, which is to speed up the development of electronic communication infrastructures. He adds that among the specific benefits of cloud computing in Africa, two in particular are liable to make a significant contribution to reducing the digital divide, namely:

- the ability to have immediate access to the latest innovations;
- the possibility for an organization to do away with heavy investment in infrastructure, particularly where computation centres are concerned, given the unreliability of the electric power supply in Africa.

An analysis of the technical difficulties facing cloud computing players in Africa is set out in Chapter V, dealing with data centres.

### IV.7.1 At the ICT development level

The situation in Africa is characterized by relatively favourable network infrastructure development with constantly improving international connectivity. In recent years, several international cables have made landfall on each side of the continent, favouring the growth of telephone and Internet traffic and the emergence of an ever-increasing number of data centres.

This development, initially driven by the very rapid expansion of mobile telephony, has been boosted by the high-capacity requirements stemming from the introduction of broadband technology. The resulting data exchanges on the different networks call for ever-expanding data storage capacities – something that can only be managed virtually, via the web.

However, all of this is not without problems, be they problems which hinder the normal operation of existing data centres or development of new ones.

A report produced by the Hedera Technology consultancy firm on the Internet in Africa points to shortcomings associated with poor quality of service due to under-investment in communication networks, making it difficult to abide by clauses guaranteeing quality levels and access speeds for cloud computing services<sup>7</sup>.

At the same time, the use of ICTs in Africa is continuing to produce exponential growth in this sector. With a young population that is set to double by 2050, we are still likely to see very positive ICT market growth rates in all African countries.

---

<sup>7</sup> [www.balancingact-africa.com/category/newsletter/newsletter-francais?page=4](http://www.balancingact-africa.com/category/newsletter/newsletter-francais?page=4)

Despite the constraints (lack of infrastructure, power-supply problems, etc.) that are hampering ICT development in some parts of Africa, the African cloud computing market appears, paradoxically, to be “benefiting” from those constraints, and the continent is experiencing the opening up of considerable opportunities where this new IT model is concerned.

The fact is that the major players in the international Internet and server industry spheres have already positioned themselves in the African market. In South Africa, new companies have opened two data centres, in Cape Town and Johannesburg. These represent an attractive opportunity for international companies, which see in them a very low-cost alternative to European centres.

A report published in January 2011 by the consultancy firm Balancing Act put at 112 the number of data centres within the continent, including 15 in South Africa, 11 in Egypt, Ghana and Nigeria, ten in Kenya and one in Tunisia. African companies such as Kenya Data Networks or Teraco (which operates data centres in Cape Town, Durban and Johannesburg) are contributing to the construction of new economic models, based on the use of entry-level products via the net.

Using the Teraco data centre based in Cape Town, the Internet access provider Webnow has launched a virtual server targeting small enterprises, for the price of 189 Rands (EUR 19) per month.

The Balancing Act report predicts that key African operators will soon be addressing the implementation of new services based solely on the cloud.

It was recommended to encourage adoption of the cloud Computing and the construction of data centres in Africa to reduce service access costs.

Increasing the physical proximity between cloud computing resources and end user will produce immediate savings in bandwidth budgets while accelerating access to cloud computing resources.

Despite the development of international data transmission links between Africa and the rest of the world, the costs associated with the bandwidth necessary for transferring "African data" to and from cloud computing resources located outside Africa (whether for storage or for data consultation purposes) are so high that it is more advantageous to construct data storage centres in Africa than to pay for accessing centres located tens of thousands of kilometres away from the continent. Consideration could be given to the charging of preferential, intra-African rates for the use of such data centres for data storage and consultation.

### **Lack of "maturity"?**

It may, however, still be a while before the bigger data players descend on Africa. They need water (for cooling the constantly active servers) and stable power sources, something that is not often guaranteed on the continent. According to Hennie Loubser, Microsoft general manager for west, east and central Africa, the company has no plans to build any data centres in Africa, there being a “certain amount of maturing” that needs to happen in the African business community before it embraces web-based services.

In the meantime, Microsoft is making its expertise and programs available to access providers, such as MTN, which are themselves offering a range of new services to companies. “Today in Ghana, Cameroon and South Africa, as part of their data subscription business MTN can now sell to that business not only that subscription, but, for an additional fee, provide that business with an e-mail service and a collaboration service all based on Microsoft technology,” says Loubser. A year ago, two other multinationals – US-based Citrix Systems and France Télécom – appointed regional directors responsible for cloud computing in Africa and the Middle East.<sup>8</sup>

---

<sup>8</sup> Based on excerpts from an article by Gemma Ware, The Africa Report, published by jeuneafrique.com in June 2011.

### IV.7.2 At the legal and regulatory levels

Cloud computing service users tend to ask questions regarding such legal issues as:

- In which country (or region) is the cloud computing service provider located?
- Is the infrastructure (i.e. are the data centres) located in that same country or region?
- Is the cloud computing service provider authorized to use an infrastructure located outside the country or region referred to in the contract?
- Where will the data be physically stored?
- Is the place of jurisdiction for the service contract the same as for protection of the data?
- Are any of the cloud computing services on offer outsourced either locally or elsewhere?
- What will happen to cloud-stored data upon expiry of the contract?

Where connectivity to the international telecommunication network is concerned, Africa has seen the arrival of several international cables on each side of the continent and the emergence of an increasing number of shared data processing centres. However, confidence in the prevailing legal systems in African countries remains at an unsatisfactory level in terms of data protection.

A consultation focusing on application of the European Directive on personal data processing and the free movement of data has been launched in the interests of addressing the issue of data transfer outside the European Economic Area (EEA).

One of the outcomes of that consultation was the adoption of the principle whereby the transfer of data outside the EEA is prohibited if the country of destination cannot ensure an adequate level of protection, this being subject to very specific exceptions.

The provisions governing the surveillance of data hosted in the United States, as laid down in the “Patriot Act”, are considered by several countries to constitute an infringement of freedom, this having led certain countries – for example Canada – to go so far as to prohibit public undertakings from storing data originating in Canada on servers hosted in the United States.

Despite its security aspect, deemed unacceptable by certain human rights defenders, this act is seen by various non-US cloud computing providers as an opportunity to develop their activities by offering cloud computing services that claim to avoid the storage of data on United States servers. This argument has not been used in Africa, but there is nothing to prevent it being taken as a basis for promoting the grounds for developing cloud computing in Africa.

The corollary to this decision was the establishment of a breakdown of the world's regions according to whether or not the level of protection is deemed adequate within the meaning of the European Union directive.

As things stand, the European Union acknowledges that an adequate level of protection exists in the following territories: Andorra, Argentina, Australia, Canada, Faroe Islands, Guernsey, Israel, Isle of Man, Jersey and Switzerland. Furthermore, United States companies having adhered to the Safe Harbor programme, resulting from the agreement concluded between the European Union and the United States Government, are deemed to be located within a space that guarantees an adequate level of protection (the “security sphere”). These companies can thus freely receive, on United States territory, personal data originating in the EEA. The list of United States companies having adhered to the Safe Harbor framework may be consulted on the programme's dedicated website at <https://safeharbor.export.gov/list.aspx>.

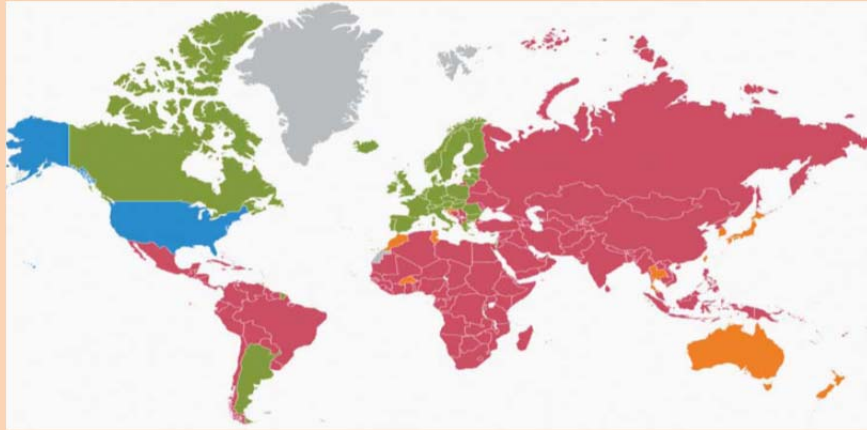
The following global classification shows the different regions of the world according to their level of data protection within the meaning of the European Union directive.

#### Classification of countries according to their level of data protection

This classification was drawn up by the Commission Nationale de l'Informatique et des Libertés (CNIL), France, pursuant to the European Directive on personal data processing, and was published in the work

by Jérôme Delacroix entitled Cloud Computing, feedback obtained in 2011 on behalf of Electronic Business Group, [www.ebg.net](http://www.ebg.net).

This classification shows that almost all African countries fall into the category considered by European analysts as corresponding to spaces that do not provide an adequate environment for the hosting and protection of data.



- █ Adequate level of data protection
  - █ Adequate level of data protection subject to certain conditions
  - █ Inadequate level of data protection (although countries do have a supervisory authority)
  - █ Inadequate level of data protection
- Source: [cnil.fr](http://cnil.fr)

Further information on European regulations governing personal data protection is contained in the CNIL document to be found at: [www.cnil.fr/fileadmin/documents/approfondir/dossier/international/panorama-legislation.pdf](http://www.cnil.fr/fileadmin/documents/approfondir/dossier/international/panorama-legislation.pdf)

It is to be noted in this regard that the Safe Harbor Agreement is the culmination of negotiations between the European Union and United States within a context characterized by a power imbalance between the two parties. In his paper “La gouvernance extérieure de l’Union européenne en matière de protection des données à caractère personnel” [*The external dimension of European Union regulatory governance on data protection law*], Valentin Callipel describes this agreement as “a negotiated response between the United States and European Union to the 1995 directive. It is a compromise, intended to reconcile the divergences between the two legal orders. It is optional and enables United States companies and organizations to adhere, on a voluntary basis, to the Safe Harbor principles. These principles are published by the United States Department of Commerce and were recognized by the European Commission in July 2000 as guaranteeing an adequate level of protection in terms of the directive.

This mechanism is atypically binding in its scope, with characteristics that reflect “a form of self-certification on a declaratory basis”, since no prior checks are conducted. However, the majority of United States companies engage the services of a third-party certifier such as the TRUSTe organization. If, at first sight, the mechanism appears to lack binding force, it is worth noting that any misrepresentation by a United States company may be actionable under the False Statements Act (18 U.S.C. § 1001). It is therefore a form of self-regulation based on the model used by the European Union which, despite its optional nature, has an incentive effect for companies wishing to do business with European Union Member States”.<sup>9</sup> African countries lacking the United States’ clout in the IT sphere could choose to negotiate with their partners agreements based on certification at various levels to enable African companies to rise progressively through the levels of protection, from physical protection up to and

<sup>9</sup> [www.lex-electronica.org](http://www.lex-electronica.org)

including the regulatory interception of data transiting their territories. However, such an approach calls for the adoption by ITU of standards to serve as the technical bases for the different classes of certification and the legal bases for the agreements to be concluded.

All these efforts thus call forth many others in the areas of security, anti-piracy measures and measures to combat the many varieties of cyberattack.

Despite this rather negative assessment of developing countries' capacity to offer an adequate data protection environment, the European regulations provide for exceptional situations whereby personal data can be transferred outside the EEA under very specific circumstances.

The following is a description of such exceptional situations:

- Either the person concerned, i.e. whose personal data are to be transferred, “has given his consent unambiguously to the proposed transfer”,
- or the transfer is “necessary” to the accomplishment of certain actions that will generally not be relevant in the cloud computing context since it is the provider and not the customer who will be effecting the transfers. These exceptions are, moreover, interpreted very narrowly by the national authorities responsible for data protection”.
- Thus, to enable its customers to abide by the Directive, a cloud computing service provider must use processing facilities located within the EEA, in a country providing an adequate level of protection, or in the United States in cases where Safe Harbor has been adhered to; or it must establish with its customer a model European Commission data transfer contract for other countries. Otherwise, the customer runs the risk of being penalized.

#### **IV.8 Global analysis of the survey results**

A detailed analysis of the survey is available at the end of the document.

African countries have thus far experienced cloud computing technology being used at different levels according to the institutions concerned. Indeed, while administrations are just now preparing for the introduction of this new technology, we find that 50 per cent of ICT operators have embarked upon its implementation or are already using it.

As for the other economic operators, we find that the banking and education sectors are the first to have adopted this technology in Africa.

In Tanzania and Rwanda, concrete data centre projects are already operational or in the process of being set up. In Benin and Burundi, strategies are emerging for the introduction of cloud computing. Where the other countries covered by the survey are concerned, the aforementioned initiatives, while of interest, take the form of broader actions or programmes that are not specific to the cloud computing (regulatory frameworks for electronic transactions, outsourcing of business processes, technology parks).

At the regulatory level, it is to be noted that the majority of countries surveyed have no legislation on data protection or agreements with other countries in that sphere.

#### **IV.9 Introduction and/or upgrading of regulations governing data protection**

With the defenders of civil and intellectual property rights becoming ever more demanding in terms of legal proceedings and of penalties to be imposed on those engaged in the illegal use of data worldwide, African countries that do not yet have regulations governing data protection will be unable to access the opportunities offered by cloud computing technology.

To remedy the situation, African countries need to implement strategies and launch institution-building programmes with a view to adapting the regulatory texts and setting up regulatory authorities capable of developing the requisite expertise.



Measures to upgrade and revise legislative texts are envisaged by a number of African countries, with the revision process covering among other things:

- transposition to the national level of sub-regional, regional and international texts on data protection (for the member countries of Economic Communities such as ECOWAS and UDEAC);
- revision of legislation to take account of the situation of data hosted in the cloud;
- strengthening of legislation, codes of conduct and standards in the ICT sector;
- clarification of relations between data centre managers, cloud computing and data protection.

Where training with respect to the cloud computing is concerned, the African countries surveyed expressed priority training requirements, particularly in regard to the legal environment of cloud computing and the technical aspects of networks, information technology and the management of data centres.

#### **IV.10 Recommendations for ensuring effective regulatory progress in the field of cloud computing**

To ensure an effective regulatory developments in the field of cloud computing, it is recommended to all African governments to adopt, as soon as possible, a new regulatory approach that takes account of the new context arising from the use of cloud computing and its impact on data security/confidentiality and personal data protection.

The regulatory strategy to be adopted to ensure the adoption of cloud computing with minimal risk must focus on the following:

##### **IV.10.1 Monitoring of developments in the regulatory field**

In the interests of remaining abreast of regulatory developments in the field of cloud computing and making an effective contribution to those developments so as to be fully prepared for emerging requirements associated with governance of the new cloud computing services, each player is expected to implement a programme for the monitoring of regulatory and legal developments. This programme should, as a minimum, include the following initiatives:

- Gathering and monitoring of laws, regulatory texts and standards relating to cloud computing services
- Analysis of the impact of obligations to abide by regulations and standards
- Updating of procedures for monitoring risks associated with non-conformity
- Elaboration of procedures for managing situations of non-conformity
- Follow-up, audit and documentation of incident management operations
- Provision for corrective measures as necessary.

##### **IV.10.2 Careful preparation of cloud computing outsourcing contracts**

The customer's loss of control over the data entrusted to the third party in a cloud computing environment can give rise to specific problems associated with the geographic dispersal of the data to multiple processing centres. This new context requires that legal experts establish provisions designed to afford the best possible protection to all concerned.

Contracts drawn up in a cloud computing environment should therefore contain robust clauses relating to data security and availability. In addition, the following aspects, among others, must be addressed:

- Network connection security
- Authentication of persons accessing data

- Data encryption
- Access to data
- Data backup
- Access traceability and traceability of data operations
- Entity certification and the cloud computing provider's security procedures
- Firm requirement for the provider to furnish information on security incidents
- Provision for regular testing of data recovery procedures and for fallback procedures in the event of service interruption.
- Conditions relating to contract termination.

### **IV.10.3 Cross-border standardization and regulation**

The number of entities working on the standardization of cloud computing is vast, making interoperability a key issue.

Those entities need to work in a coordinated manner to avoid considerable disparity among the standards adopted.

Proper coordination in regard to standards will ensure that users are able to move or transfer their data from one cloud computing provider to another.

In this regard, the role and work of the International Telecommunication Union, which seeks to achieve standardization on the broadest possible scale, are essential to all countries and to developing countries in particular.

To this end, it is recommended that African countries follow, and participate more actively in, the work being done by ITU's Standardization Sector in the field of cloud computing. Its Focus Group on Cloud Computing has completed its work with the production of seven deliverables covering the whole range of cloud computing activities, published in February 2012 as technical reports<sup>10</sup>:

- 1 Introduction to the cloud computing ecosystem: definitions, taxonomies, use cases, high level requirements and capabilities.
- 2 Functional requirements and reference architecture.
- 3 Infrastructure and network enabled cloud computing.
- 4 Cloud computing security, threat & requirements.
- 5 Benefits of cloud computing from telecom/ICT perspectives.
- 6 Overview of SDOs involved in cloud computing.
- 7 Cloud computing resources management gap analysis.

### **IV.10.4 Conformity with existing provisions**

At the same time, it is important, in addition to the contractual requirements associated with the specific features of cloud computing services, to ensure compliance with the regulatory texts and standards governing the following spheres:

- Mandatory terms and conditions in service outsourcing contracts.

---

<sup>10</sup> Further information on these activities may be found at: [www.itu.int/en/ITU-T/focusgroups/cloud/Pages/default.aspx](http://www.itu.int/en/ITU-T/focusgroups/cloud/Pages/default.aspx).

- General obligations with respect to quality control processes having implications for the level of service provided, personal data protection, data security and availability, and continuity of service.
- Obligations in regard to the keeping of necessary records and rules governing access thereto.
- General obligations in terms of the upkeep of processes and emergency plans to ensure the optimum management of incidents and service interruptions.
- Regulations governing data ownership, the geographic location of data (inside or outside the country), and obligations in terms of the making available (to the authorities) and disclosure of data.

On the business side, a company's adoption of the cloud computing model places it in a new type of relationship with its customers, which may now be both national and international.

In each situation, moreover, the legal obligations to be fulfilled by the company may be different. Cloud computing service users therefore tend to ask the following kinds of legal question:

- In which country (or region) is the cloud computing service provider located?
- Is its infrastructure (i.e. are the data centres) located in the same country?
- Is the cloud computing service provider authorized to use an infrastructure located outside the country of the contract?
- Where will the data be physically stored?
- Is the place of jurisdiction for the service contract the same as for protection of the data?
- Are any of the cloud services on offer outsourced either locally or elsewhere?
- What will happen to cloud-stored data upon expiry of the contract?
- Will the customer be able to control and monitor the location in which all its data are physically stored?
- Do cloud computing customers have any guarantees that their resources (hosted servers) are perfectly isolated and not shared?
- Once resources leased within the cloud computing are no longer required, what guarantee is there that the data will be totally erased before those resources are reallocated to other users?
- Which types of certification and authentication are applicable to the cloud computing model?

While there are no ready-made responses to these questions, each player in the new cloud environment must ensure that it has the necessary legal grounding to respond to such questions at any time, thereby instilling confidence in users and partners alike.

Many of the questions relate to issues requiring international cooperation and global agreements in order to avoid having inconsistent or contradictory legislative and regulatory frameworks and also ensure that users do not have to meet the differing legal requirements of each State.

It is also important to have sound collaboration among all players: regulators, policymakers, operators, academic institutions and industry.

## **V. Data centres: best practices for sustainable development**

### **V.1 Definition**

“A data centre is a site hosting all of the systems necessary to the operation of IT applications. It comprises all of the software and hardware infrastructures used in the IT and non-IT spheres. The IT sphere covers servers, storage bays and network equipment enabling both internal and external

exchanges. The non-IT sphere covers equipment used for the management, production and distribution of power and cooling. The term data centre refers to an IT site whose dimensions can vary considerably: from a room measuring a few square metres to over 10 000 m<sup>2</sup>.<sup>11</sup>

A data centre is always made up of three fundamental components:

- The infrastructure, i.e. the space and the equipment needed to support the data centre's operations. This includes power transformers, power supplies, generators, air-conditioning units, power distribution systems, etc.
- IT equipment comprising racks, servers, storage, cabling, system management tools and network equipment.
- Operating areas for the staff whose job it is to operate and, as necessary, maintain and repair the IT and non-IT systems.

## V.2 Basic characteristics of a data centre

### a Power supply

The most basic function in a data centre is the provision of electric power with the requisite output and stability for the IT equipment. This power supply has to be:

- adequate;
- of high quality;
- secure.

### b Cooling systems

The cooling system must:

- provide adequate cooling for the equipment;
- provide adequate cooling for the bays;
- integrate well with the bays.

### c IT equipment

For the purposes of processing, storing and routing data, the data centre contains a large number of cabinets housing the various IT components: application servers, storage servers and network elements.

- Application servers  
These are the machines on which the various software applications run.
- Storage servers  
Two storage techniques are commonly referred to:
  - Local storage: the data is stored on the server which uses it. This is known as direct-attached storage (DAS).
  - Dedicated storage: a number of machines are dedicated to the storage function, constituting what is known as a “storage array”.

---

<sup>11</sup> The above definition of a data centre and description of its characteristics are drawn from the sixth edition of [green book published by Syntec Numérique, entitled *Data centres et développement durable* [Data centres and sustainable development

## **d** Network

The network elements serve to route the data between users and servers. They chiefly comprise switches, routers, firewalls and load balancers and are physically connected to various types of media: optical fibre for long distances, copper network cabling, radio links, etc. These elements support quality of service (QoS) functions which enable them to manage several separate networks in a fully secure manner.

## **V.3** Different types of data centre

The role of the data centre has evolved within companies to acquire a criticality that is proportional to the value of the data it processes. Reliability and availability are two key missions of the data centre management. The design of the data centre thus includes two important phases: site selection and risk assessment.

### **a** Geographic location and level of risk

The geographic location of a site depends chiefly on criteria such as the quality and redundancy of the power distribution, presence of very-high-speed multi-operator network services, presence of qualified staff and absence of environmental risks.

The potential risks for a data centre fall into two major categories:

- Internal risks: malfunctioning of a technical component, human error, point of failure in the architecture.
- External risks: failure in the power supply networks, Internet connectivity issues, etc., climatic phenomena, sabotage and terrorist action.

An assessment of the probability and likely impact of each of these risks is made during the design of the data centre, and subsequently on a regular basis. The outcome of this analysis serves as the basis for the implementation of alternative solutions and elaboration of a disaster recovery plan.

### **b** Levels of availability

The Uptime Institute has defined four levels of availability, or “tiers”, ranging from Tier I (no redundancy) to Tier IV, at which critical applications can be hosted with 99.99 per cent availability.

The tier may be shown in the construction or hosting specifications as from a data centre's design phase. The choice of the centre's availability level will have a direct impact on its cost. Over 60 per cent of the investment budget may be associated with this rating.

**Tier I:** Availability rate = 99.67 %

**Tier II:** Availability rate = 99.75 %

**Tier III:** Availability rate = 99.98 %

**Tier IV:** Availability rate = 99.99 %

## **V.4** Recommendations for the implementation of data centres

To be able to host increasingly diversified ranges of products and services while remaining in conformity with the corresponding regulatory, commercial and technical requirements, tomorrow's data centres will need to be:

- service oriented:** capable of providing business players with the technological services they require, in a timely manner and at the right price;
- agile:** able to respond promptly to any changes or variations in customer requirements;

- c **automated:** capable of handling operational processes with less staff while adhering to best practices and honouring service level agreements;
- d **well protected:** capable of guaranteeing data availability and security, be those data active or archived, static or in transit;
- e **ecologically sound:** to minimize the energy expenditure, burden on the environment and use of non-renewable natural resources.

Furthermore, during the planning phase, it is important to define and optimize the target physical and logical architectures of the data centre. Those architectures will naturally depend on how the data centre is to be used in the future and will take account of the following considerations:

- **Opportunities for virtualization**

The mutualization and virtualization of servers enable cost reductions and, at the same time, efficiency and flexibility gains. With conventional, non-virtualized architectures, server exploitation rates are generally very low (in the order of 25 to 30 per cent), whereas with well-planned virtualization a company can achieve a high and sustainable return on investment.

- **Migration of older servers and installation of new physical servers**

Where older servers are migrated, this must be done with an eye to their ultimate replacement. When selecting new servers, a company is well advised to go for multiprocessor and multi-core servers capable of handling high traffic volumes at both the LAN and storage levels. Blade servers are an additional solution for reducing the data centre's physical size and energy bill.

- **Quality and reliability of the network infrastructure**

Particular attention must be paid to the availability and quality of internal and external networks inasmuch as a physical server hosting several virtual machines inevitably consumes more bandwidth than conventional servers. An under-dimensioned network is bound to cause QoS issues at the application level. This obstacle can be overcome through the creation of virtual networks.

- **Network storage opportunities**

Data volumes and the overall cost of storage can be reduced through the use of network storage solutions.

- **Tools and IT processes applicable to data centre management**

IT departments have to adapt to the cloud computing environment, to which end they must reconsider their provisioning, configuration management and system administration processes and opt for integrated tools capable of functioning on all material platforms and providing a unified overview.

A typical strategic plan for the launch of a data centre must therefore comprise at least the following actions:

- 1 Conduct an inventory (technical, commercial and regulatory).
- 2 Identify the commercial target and list the services to be offered in the data centre by category (IaaS, PaaS, SaaS, CaaS, NaaS), with a provisional schedule for the time-to-market of each service.
- 3 Estimate requirements in terms of space, racks, power, air conditioning, etc.
- 4 Draw up a projected business plan.
- 5 Design the services and their usage models.
- 6 Design the physical and logical architectures (layout, cabling, monitoring, connectivity, security, redundancy...).
- 7 Steer the implementation phase.

- 8 Deploy and integrate.
- 9 Provide the services (resources and competencies).
- 10 Monitor the services.
- 11 Administration and maintenance.
- 12 Manage customer relations and the support side.

## VI. Proposal for training programmes

The new business models and technical architectures that come with cloud computing constitute a fresh departure entailing a far-reaching transformation of software and IT service procurement practices.

The new models are giving birth to a new cycle which calls into question current approaches in regard to software development and acquisition, hosting, data centres and outsourcing.

This movement calls for a thorough mastery of the legal issues involved, strategic alignments between companies and management of complex IT infrastructures. New training programmes are therefore necessary to provide managers with a grasp of the legal issues associated with the cloud computing phenomenon and empower them to identify solutions to operational and governance issues arising in this new IT environment.

### VI.1 For players on the standardization and regulatory sides

#### Module 1: CLOUD COMPUTING – CONCEPTS, DEFINITIONS AND STANDARDIZATION

- Cloud computing: from the ASP (application service provider) to the XaaS model
- Outsourcing resources via web technologies
- Cloud computing standardization in ITU-T and other entities

#### Module 2: THE DIFFERENT WAYS OF USING CLOUD COMPUTING

- IaaS applications
- PaaS applications
- SaaS applications
- CaaS applications
- NaaS applications

#### Module 3: LEGAL AND OPERATIONAL ISSUES ASSOCIATED WITH CLOUD COMPUTING

- Data confidentiality
- Data ubiquity and compliance with national and international laws
- Quality of service and resource availability
- Loss of control over data and resources
- Reversibility of applications
- Dependency on the local and global telecommunication network

#### Module 4: CONTRACT ESTABLISHMENT PHASE

- Legal qualification and identification of regulatory texts applicable to cloud computing contracts
- Definition of services
- Delineation of responsibilities where various stakeholders are concerned

- Quality commitment: the service-level agreement (SLA)
- Customer-data protection
- Support in the form of data-hosting and service-management standards

## **VI.2 For players on the technical side**

### **Module 1: INTRODUCTION TO CLOUD COMPUTING**

- Basic elements of cloud computing
- Advantages and drawbacks of cloud computing
- Cloud computing – business model, products and services, stakeholders
- The virtualized architecture used in cloud computing

### **Module 2: CHARACTERISTICS OF CLOUD COMPUTING**

- Cloud computing – a breakthrough technology
- Factors driving the development of cloud computing
- Cloud computing products and services
- World leaders in cloud computing
- Risks of cloud computing

### **Module 3: DATA CENTRES**

- Basic data centre infrastructure
- Impact of the physical arrangement of equipment on the efficiency and availability of power and air-conditioning facilities
- Methods used to reduce power consumption
- Management tools for optimizing a data centre's performance
- How to measure performance indicators
- How to operate a data centre so as to optimize its use

### **Module 4: NETWORKS FOR THE CLOUD**

- Network infrastructure for the cloud
- Mobile and fixed access
- Internet and VPN access

## **VII. Methodology of the survey**

In order to make the point regarding the perspectives of the development of the Cloud and its impact on the regulatory environment, a survey, based on a questionnaire, was conducted in all South Sahara African countries. Twenty-five countries have responded

The purpose of the survey is to obtain structured information from stakeholders involved in the development of the ICT sector and aware of the opportunities that cloud computing represents for Africa. The results of the survey will serve to assist Member States in identifying the needs to be satisfied and obstacles to be removed in order to foster the emergence of cloud computing in Africa.



The questionnaire was drawn up in December 2011 and transmitted by e-mail to the countries of the Africa region. Its distribution and the follow-up of the responses were carried out by the Regulatory and Market Environment Division of ITU's Telecommunication Development Bureau.

The questionnaire used for the survey covers the following:

- a Degree to which cloud computing has been introduced
- b Availability of high-speed access services
- c Degree to which data centres have been developed
- d Data-centre security
- e Government initiatives fostering the emergence of cloud computing services
- f Data-protection legislation
- g Legislative coordination between African countries in regard to cloud computing
- h Factors motivating the introduction of cloud computing services
- i Cloud computing services developed and offered by domestic entities operating in Africa
- j African experiences in the field of cloud computing (best practices, success stories)
- k Factors that may constitute obstacles to adoption of the cloud
- l Training requirements in regard to cloud computing

## **VIII. Conclusion and Recommendations**

The ICT sector in Africa is characterized by the very rapid development of mobile networks. At the same time, however, African countries are seeking solutions whereby they can catch up on the deployment of fixed infrastructure and high-speed networks.

Against this background, African business managers find themselves under ever-mounting pressure. The increasingly intense and often unbalanced competition between African businesses and those in the so-called developed world, coupled with the effects of successive global crises, are forcing all businesses to redouble their efforts to reduce operating costs, rationalize investments, boost productivity and foster innovation.

Cloud computing, considered by some to be the technological revolution of the twenty-first century, could go a long way towards resolving such issues, provided the corresponding technology is implemented on solid bases that inspire confidence in users both domestic and foreign.

To this end, African decision-makers are in agreement that a regulatory environment that adheres to international requirements and standards in terms of personal data protection and data transfer security constitutes the main supporting pillar for successful development of cloud computing. Similarly, the deployment of high-quality data centres with ensured continuity of service, rapid accessibility and secure data storage in line with international standards constitutes the second pillar of cloud computing for Africa.

The feedback received shows that the African market is ripe for the development of cloud computing. African stakeholders now need assistance in aligning their regulations with international market requirements and standards and training sufficient human resources to enable Africa to benefit from an opportunity that is particularly suited to its situation and capable of providing high-impact leverage to socio-economic development throughout the continent.

## Recommendations

### **Recommendation 1: Effective regulatory progress**

In order to ensure an effective regulatory developments in the field of cloud computing, it is recommended to all African governments to adopt, as soon as possible, a new regulatory approach that takes account of the new context arising from the use of cloud computing and its impact on data security/confidentiality and personal data protection.

### **Recommendation 2: Maintain a regulatory watch**

In the interests of remaining abreast of regulatory developments in the field of cloud computing and making an effective contribution to those developments so as to be fully prepared for emerging requirements associated with governance of the new cloud computing services, each player is expected to implement a regulatory and legal watch programme comprising, as a minimum, the following initiatives:

- Gathering and monitoring of laws, regulatory texts and standards relating to cloud computing services
- Analysis of the impact of obligations to abide by regulations and standards
- Updating of procedures for monitoring risks associated with non-conformity
- Elaboration of procedures for managing situations of non-conformity
- Follow-up, audit and documentation of incident management operations
- Provision for corrective measures as necessary.

### **Recommendation 3: Careful preparation of cloud computing outsourcing contracts**

Ensure that contracts drawn up in a cloud computing environment contain robust clauses in respect of data security and availability, in addition to which the following considerations need to be addressed:

- Network connection security
- Authentication of persons accessing data
- Data encryption
- Access to data
- Data backup
- Access traceability and traceability of data operations
- Entity certification and the cloud computing provider's security procedures
- Firm requirement for the provider to furnish information on security incidents
- Provision for regular testing of data recovery procedures and for fallback procedures in the event of service interruption.

### **Recommendation 4: Conformity with existing provisions**

In addition to the contractual requirements associated with the specific features of cloud computing services, account has to be taken of the regulatory texts and standards governing the following spheres in the countries concerned:

- Mandatory terms and conditions in service outsourcing contracts.
- General obligations with respect to quality control processes having implications for the level of service provided, personal data protection, data security and availability, and continuity of service.

- Obligations in regard to the keeping of necessary records and rules governing access thereto.
- General obligations in terms of the upkeep of processes and emergency plans to ensure the optimum management of incidents and service interruptions.
- Regulations governing data ownership, the geographic location of data (inside or outside the country), and obligations in terms of the making available (to the authorities) and disclosure of data.

### **Recommendation 5: Qualities of data centres Establishment of data centres**

In order to significantly reduce the costs of bandwidth and also to improve the speed of access to Cloud computing resources, it is strongly encouraged the adoption of Cloud computing and the establishment of data centres in Africa. This will reduce the costs of access to services and improve service quality. Preferential tariffs within Africa could be considered for the storage and retrieval of data in these data centres.

### **Recommendation 6: Qualities of data**

To be able to host increasingly diversified ranges of products and services while continuing to abide by the corresponding regulatory, commercial and technical requirements, tomorrow's data centres will need to be:

- **service oriented**: capable of providing business players with the technological services they require, in a timely manner and at the right price;
- **agile**: able to respond promptly to any changes or variations in customer requirements;
- **automated**: capable of handling operational processes with less staff while adhering to best practices and honouring service level agreements;
- **well protected**: capable of guaranteeing data availability and security, be those data active or archived, static or in transit;
- **ecologically sound**: to minimize energy expenditure, burden on the environment and use of non-renewable natural resources.

A typical strategic plan for the launch of a data centre must comprise at least the following actions:

- 1) Conduct an inventory (technical, commercial and regulatory).
- 2) Identify the commercial target and list the services to be offered in the data centre by category (IaaS, PaaS, SaaS, CaaS, NaaS), with a provisional schedule of the time-to-market of each service.
- 3) Estimate requirements in terms of space, racks, power, air conditioning, etc.
- 4) Draw up a projected business plan.
- 5) Design the services and their usage models.
- 6) Design the physical and logical architectures (layout, cabling, monitoring, connectivity, security, redundancy...).
- 7) Steer the implementation phase.
- 8) Deploy and integrate.
- 9) Provide the services (resources and competencies).
- 10) Monitor the services.
- 11) Administration and maintenance.
- 12) Manage customer relations.

- 13) Manage the support side.

### **Recommendation 7: Introduction and/or upgrading of regulations**

In order to permit African countries to have appropriate regulations governing data protection and be unable to access the opportunities offered by cloud computing technology, it is recommended to implement strategies and launch institution-building programmes with a view to adapting the regulatory texts and setting up regulatory authorities capable of developing the requisite expertise. Measures to upgrade and revise legislative texts will cover among other things:

- transposition of the national level of regional and international texts on data protection (for the member countries of regional economic groupings such as ECOWAS and UDEAC);
- revision of legislation to take account of the situation of data hosted in the cloud;
- strengthening of legislation, codes of conduct and standards in the ICT sector;
- clarification of relations between data centre managers, cloud computing and data protection.

### **Recommendation 8: The launch of training programmes**

In order to grasp the legal challenges arising from the move towards cloud computing and identify solutions to operational and governance issues in this new IT environment, new training programmes need to be implemented.

#### **Proposed training modules for players on the standardization and regulatory sides**

Module 1: Cloud computing concepts, definitions and standards

Module 2: The different ways of using cloud computing

Module 3: Cloud computing – legal and operational challenges

Module 4: The contract establishment phase

#### **Proposed training modules for players on the technical side**

Module 1: An introduction to cloud computing

Module 2: Characteristics of cloud computing

Module 3: Data centres

Module 4: Networks for the cloud

### **Recommendation 9: Cross-border standardization and regulation**

Taking in consideration the high numbers of entities working on standardisation issues, it is recommended that African countries follow, and participate more actively in the work being done by ITU's Standardization Sector in the field of cloud computing. In addition, it is suggested that entities dealing with standardisation, work in a coordinated manner to avoid considerable disparity among the standards adopted. In this regard, the role and work of the International Telecommunication Union, which seeks to achieve standardization on the broadest possible scale, are essential to all countries and to developing countries in particular.

## **IX. Presentations of the results of the survey and general analysis of responses**

The experience of African countries to date points to cloud computing technology being used at different levels according to the institutions concerned. Indeed, while a given administration may only now be preparing to introduce this new technology, it may well be the case that 50 per cent of the country's ICT operators have begun to implement or are already using it.

Where other economic operators are concerned, the banking and education sectors are the first to have adopted this technology in Africa.

In Tanzania and Rwanda, specific data centre projects are already operational or in the process of being set up. In Benin and Burundi, strategies are emerging for the introduction of cloud computing. For the other countries surveyed, the initiatives reported, although interesting, are in fact broader actions or programmes not specific to the cloud computing (regulatory frameworks for electronic transactions, outsourcing of business processes, technology parks).

At the regulatory level, it is to be noted that the majority of countries surveyed do not have data protection legislation or agreements with other countries in that regard. Urgent solutions to those shortcomings need to be found to enable the countries in question to derive optimum benefit from this technology.

Actions to upgrade and revise legislative and regulatory frameworks are proposed by African countries, in particular:

- transposition to the national level of regional or international texts on data protection;
- revision of the relevant legislation to take account of the status of data hosted in the cloud;
- strengthening of legislation, codes of conduct and standards applicable to the ICT sector;
- clarification of relations between data centre managers, cloud computing and data protection.

Where training in regard to the cloud computing is concerned, the African countries surveyed expressed priority requirements in regard to the legal environment of cloud computing and technical considerations relating to networks, IT and the management of data centres.

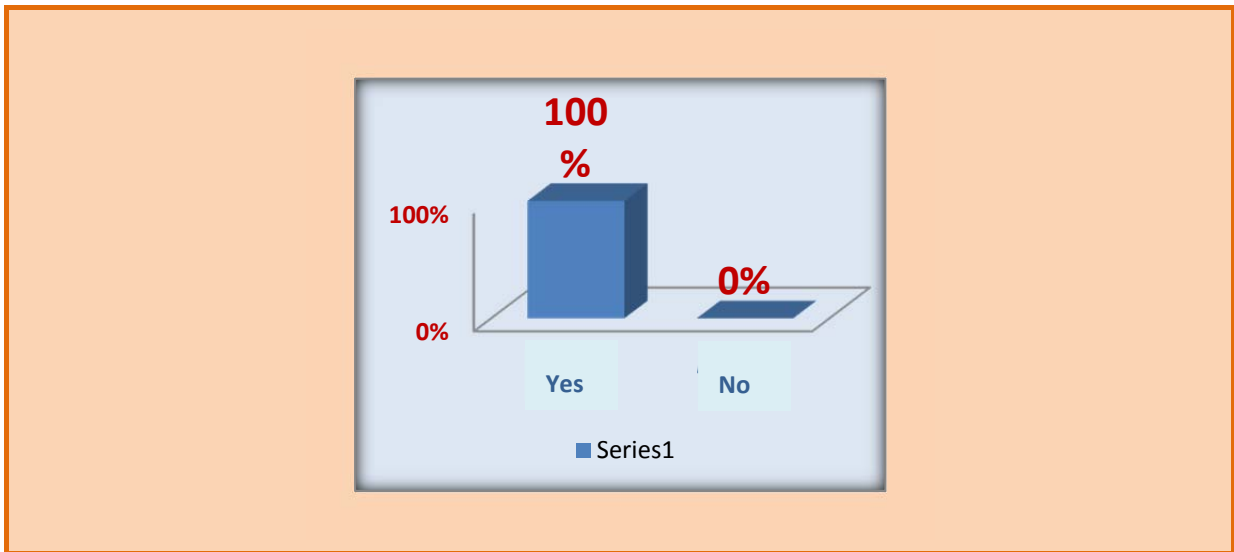
The following is a detailed presentation of the replies to each of the survey questions.

**Q1 Is the introduction of cloud computing planned in your country?**

- Yes
- No

The replies to Q1 were as follows:

YES	NO
100%	0%



**Comment:**

All the countries surveyed gave the same reply: they all envisage the introduction of cloud computing. It can therefore be concluded that all African countries are favourable to and are awaiting the introduction of this technology in one way or another.

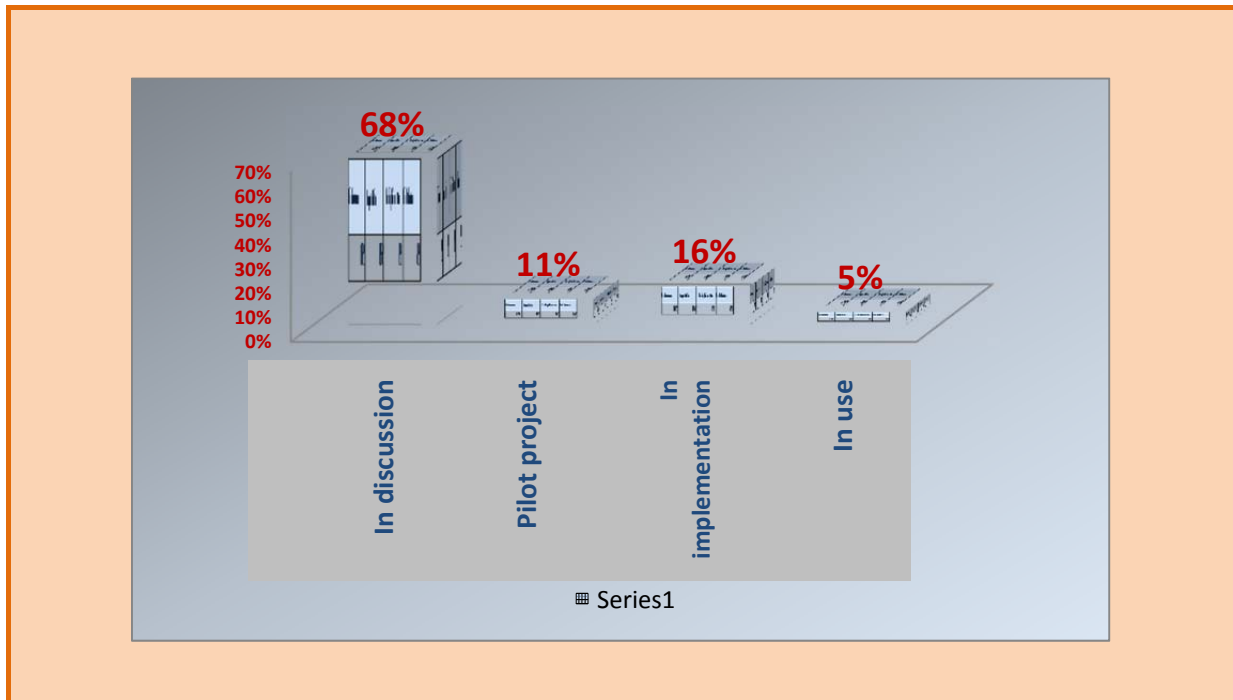
**Q2: If yes, what is the level of introduction of cloud computing services in your country?**

**1 At the level of the Administration:**

- In discussion
- Pilot project
- In implementation
- In use

The replies to Q2 were as follows:

<i>In discussion</i>	<i>Pilot project</i>	<i>In implementation</i>	<i>In use</i>
68%	11%	16%	5%



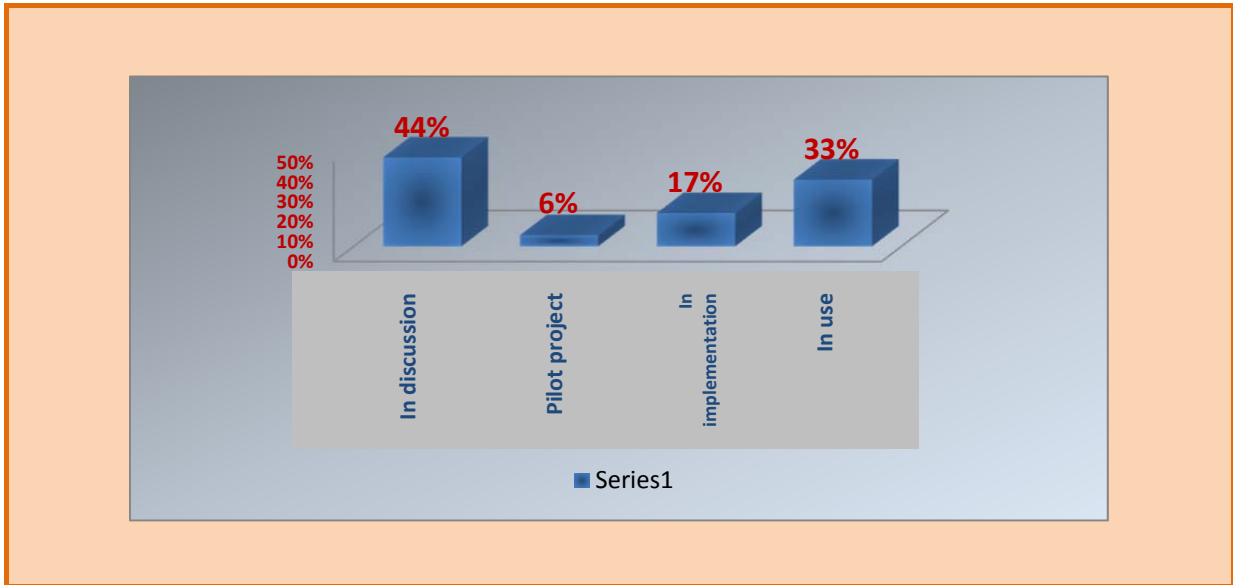
**Comment:**

In over two-thirds (68%) of the countries surveyed, the administration is at the stage of studying the introduction of cloud computing. It is, however, important to note that in the remaining one-third of the countries having responded, cloud computing technology is already in use or in the course of being implemented. This result confirms the trend towards development of the cloud computing in African administrations.

**2 At the level of ICT operators:**

- In discussion
- Pilot project
- In implementation
- In use

The replies to Q2/2 were as follows:



**Comment:**

Cloud computing technology is already used by 33% of the African country operators surveyed, while 23% of those operators have embarked upon its implementation. We thus see that African operators are ahead of administrations in this sphere.

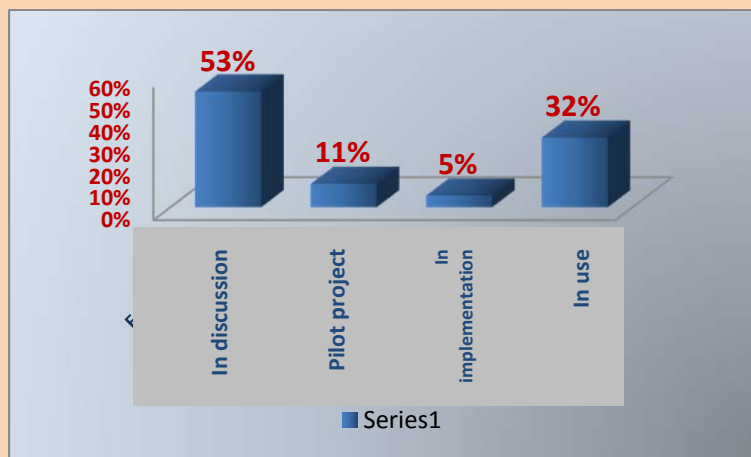


**3 At the level of economic operators (big companies, banks,...):**

- In discussion
- Pilot project
- In implementation
- In use

The replies to Q2/3 were as follows:

<i>In discussion</i>	<i>Pilot project</i>	<i>In implementation</i>	<i>In use</i>
53%	11%	5%	32%



**Comment:**

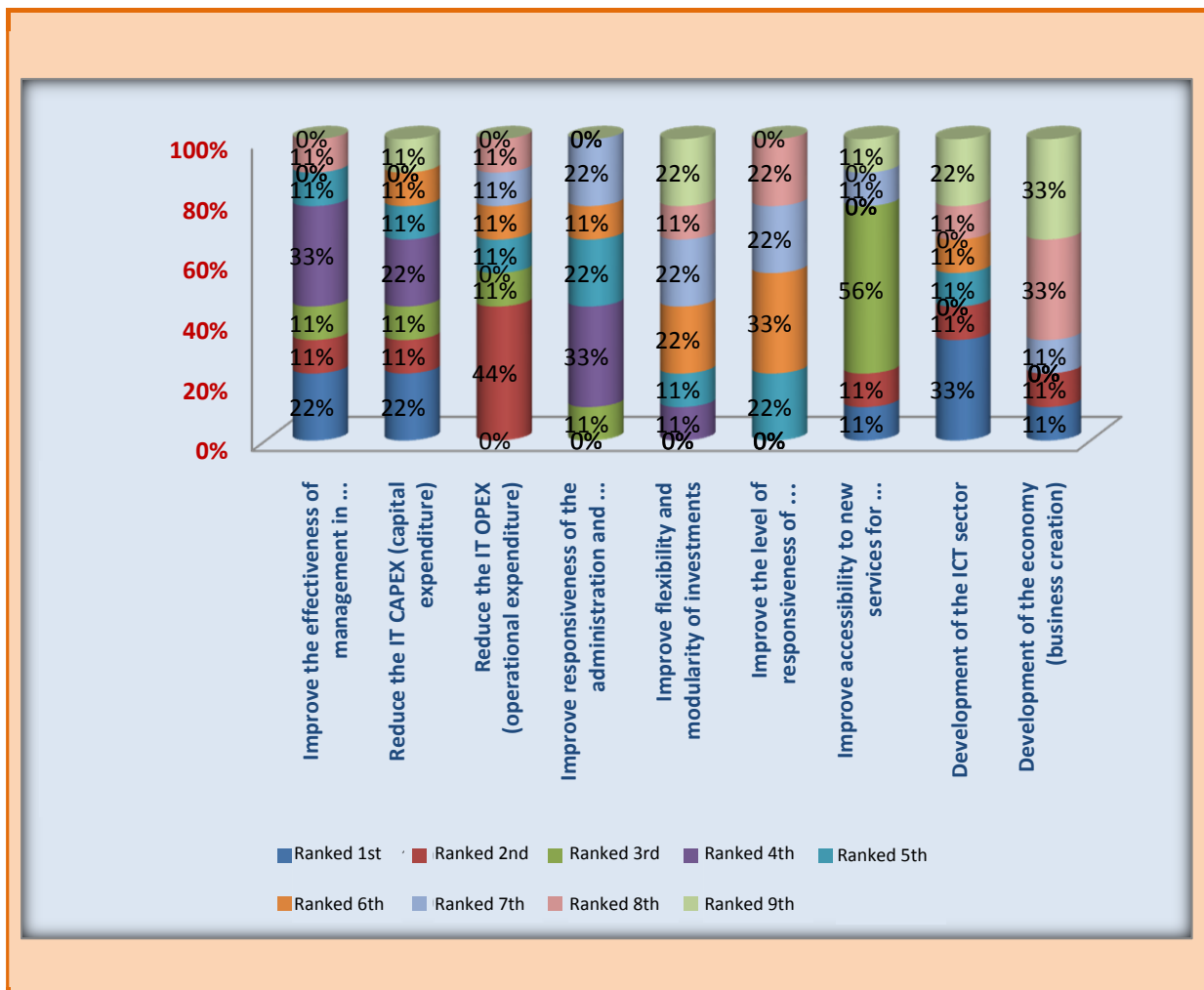
It is noteworthy that almost half the major African economic operators have, like ICT operators, adopted cloud technology.

**Q3: What are the considerations that underlie the will to introduce cloud computing services in your country?**

**Sort the following considerations from 1 to 9 by order of relevance (with 1 being the most relevant and 9 the least relevant)**

- Improve the effectiveness of management in the administration and enterprises
- Reduce the IT CAPEX (capital expenditure)
- Reduce the IT OPEX (operational expenditure)
- Improve responsiveness of the administration and enterprises in the market
- Improve flexibility and modularity of investments
- Improve the level of responsiveness of the administration and enterprises
- Improve accessibility to new services for businesses (customer relationship management (CRM), enterprise resource planning (ERP)) and the public (e-mails, online stocking, ...)
- Development of the ICT sector
- Development of the economy (business creation)

The replies to Q3 were as follows:



	Improve the effectiveness of management in administration and enterprises	Reduce the IT CAPEX (capital expenditure)	Reduce the IT OPEX (operational expenditure)	Improve the responsiveness of the administration and enterprises in the market	Improve flexibility and modularity of investments	Improve the level of responsiveness of administration and enterprises	Improve accessibility to new services for businesses (CRM, ERP) and the public (e-mails, online storage,...)	Development of ICT sector	Development of economy (business creation)
Ranked 1 <sup>st</sup>	22%	22%	0%	0%	0%	0%	11%	33%	11%
Ranked 2 <sup>nd</sup>	11%	11%	44%	0%	0%	0%	11%	11%	11%
Ranked 3 <sup>rd</sup>	11%	11%	11%	11%	0%	0%	56%	0%	0%
Ranked 4 <sup>th</sup>	33%	22%	0%	33%	11%	0%	0%	0%	0%
Ranked 5 <sup>th</sup>	11%	11%	11%	22%	11%	22%	0%	11%	0%
Ranked 6 <sup>th</sup>	0%	11%	11%	11%	22%	33%	0%	11%	0%
Ranked 7 <sup>th</sup>	0%	0%	11%	22%	22%	22%	11%	0%	11%
Ranked 8 <sup>th</sup>	11%	0%	11%	0%	11%	22%	0%	11%	33%
Ranked 9 <sup>th</sup>	0%	11%	0%	0%	22%	0%	11%	22%	33%

**Comment:**

According to respondents, developing the ICT sector, improving the effectiveness of management in the administration and reducing IT CAPEX are the main factors (77%) governing the will to introduce cloud computing technology. Reducing IT OPEX comes in second place (44%) in the classification of motivating factors in favour of the cloud.

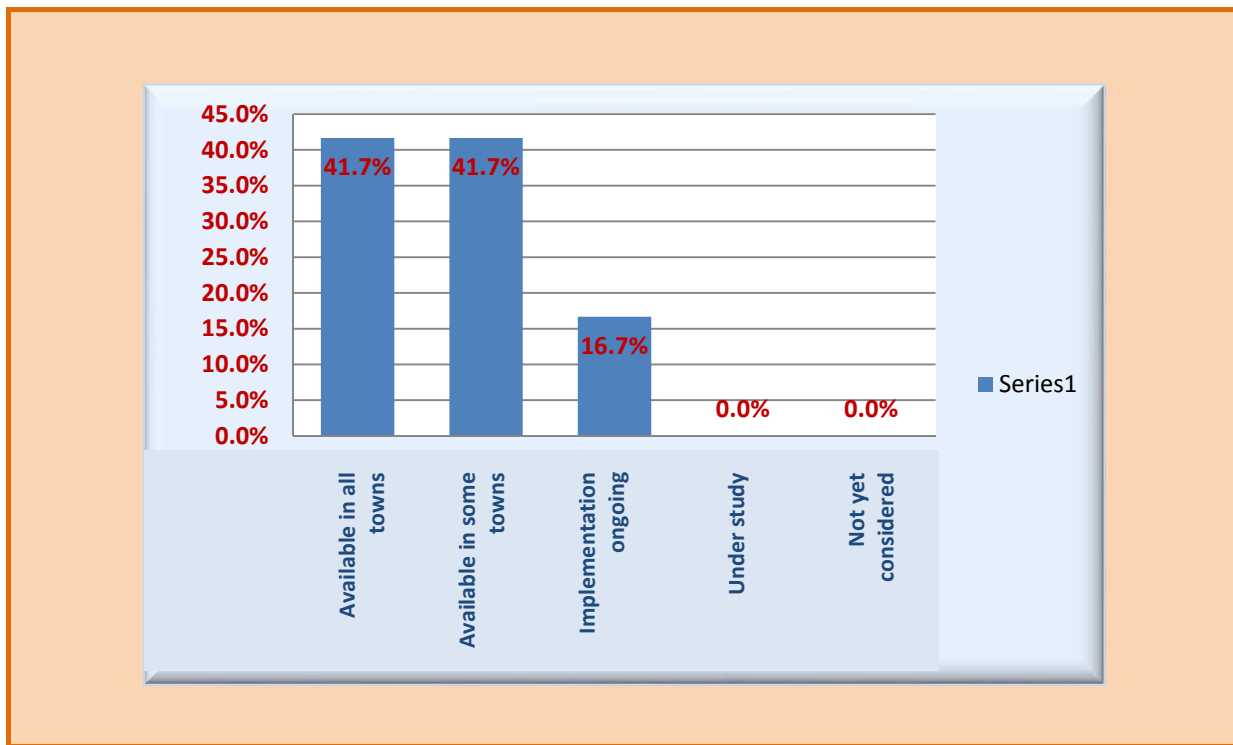
A certain reticence is, however, noted with respect to the cloud's potential for economic development and business creation, with 33% of the entities surveyed having put this consideration at the bottom of the list. This would indicate that the indirect impact and driving effect of cloud computing technology on the other sectors of activity are not yet visible to African stakeholders.

**Q4: What is the level of availability to broadband access services (ADSL, EDGE/3G, LS-FO (fibre-optic leased lines) in the country?**

- Available in all towns
- Available in some towns
- Implementation en going
- Under study
- Not yet considered

The replies to Q4 were as follows:

Available in all towns	Available in some towns	Implementation ongoing	Under study	Not yet considered
41,6%	41,7%	16,7%	0,0%	0,0%



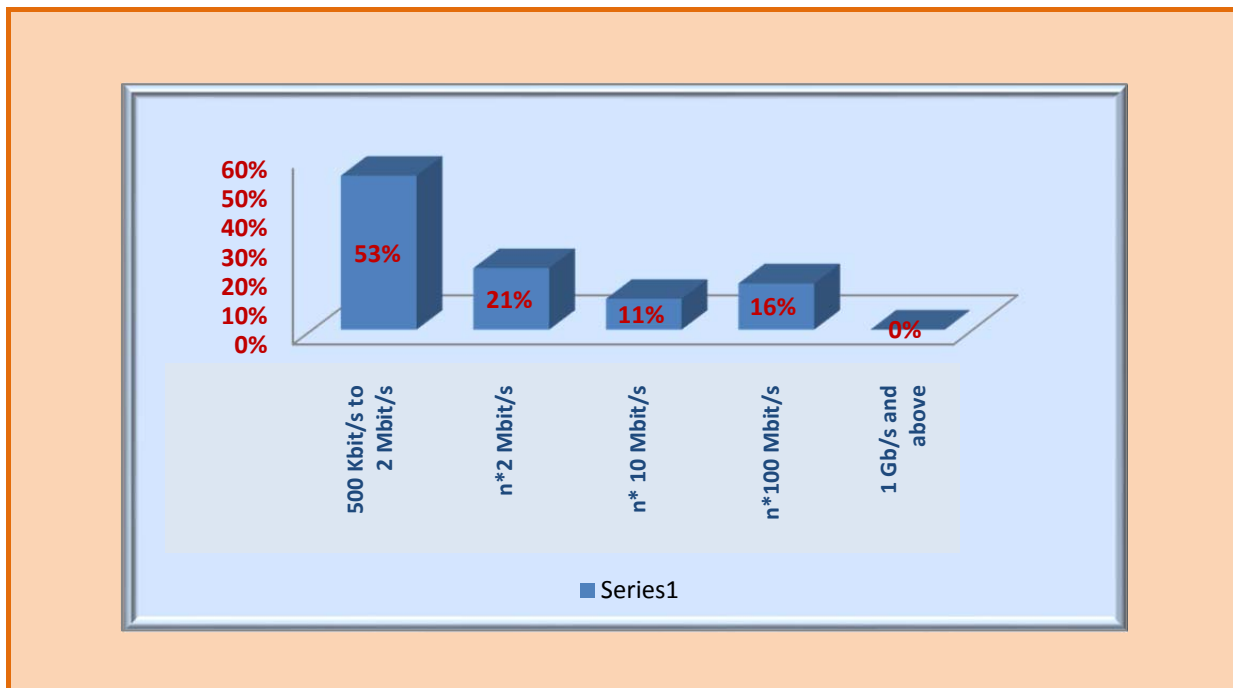
**Comment:**

It is interesting to note that the main towns in Africa are connected to a high-speed network and that this connectivity extends to all towns in 42% of the countries surveyed.

**Q5: What is the bandwidth available in the market?**

- 500 Kbit/s to 2 Mbit/s
- n\*2 Mbit/s
- n\*10 Mbit/s
- n\*100 Mbit/s
- 1 Gb/s and above

500 Kbit/s to 2 Mbit/s	n*2 Mbit/s	n*10 Mbit/s	n*100 Mbit/s	1 Gb/s and above
52%	21%	11%	16%	0%



**Comment:**

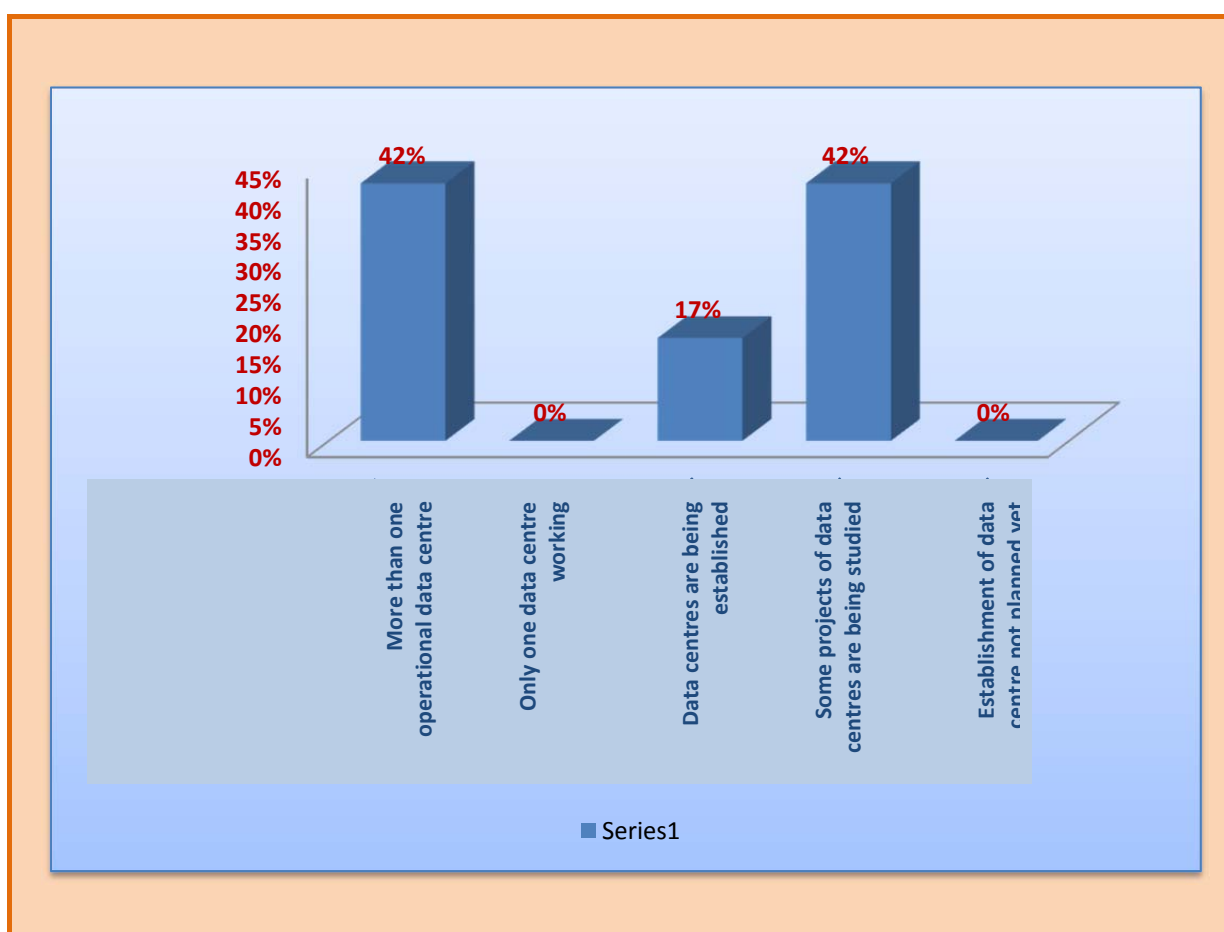
The most commonly used speeds for cloud computing services are currently n\*2 Mbit/s with xDSL technology and n\*10 Mbit/s with Ethernet. These speeds have not yet seen much development in Africa (available in only one-third of the countries surveyed). It is, however, interesting to note that the use of IP-MPLS technology is being developed in African countries, providing access at speeds of n\*100 Mbit/s. This will favour the development of data centres.

**Q6: What is the availability of data centres in your country?**

- More than one operational data centre
- Only one data centre working
- The data centres are being established
- Some projects of data centres are being studied
- Establishment of data centre not planned yet.

The replies to Q6 were as follows:

<i>More than one operational data centre</i>	<i>Only one data centre working</i>	<i>The data centres are being established</i>	<i>Some projects of data centres are being studied</i>	<i>Establishment of data centre not planned yet</i>
42%	0%	17%	42%	0%



**Comment:**

It is interesting to note that in each of the following nine countries there is more than one operational data centre: Tanzania, Gabon, Burkina Faso, Rwanda, Zimbabwe, Kenya, Senegal, Cape Verde and Cameroon.

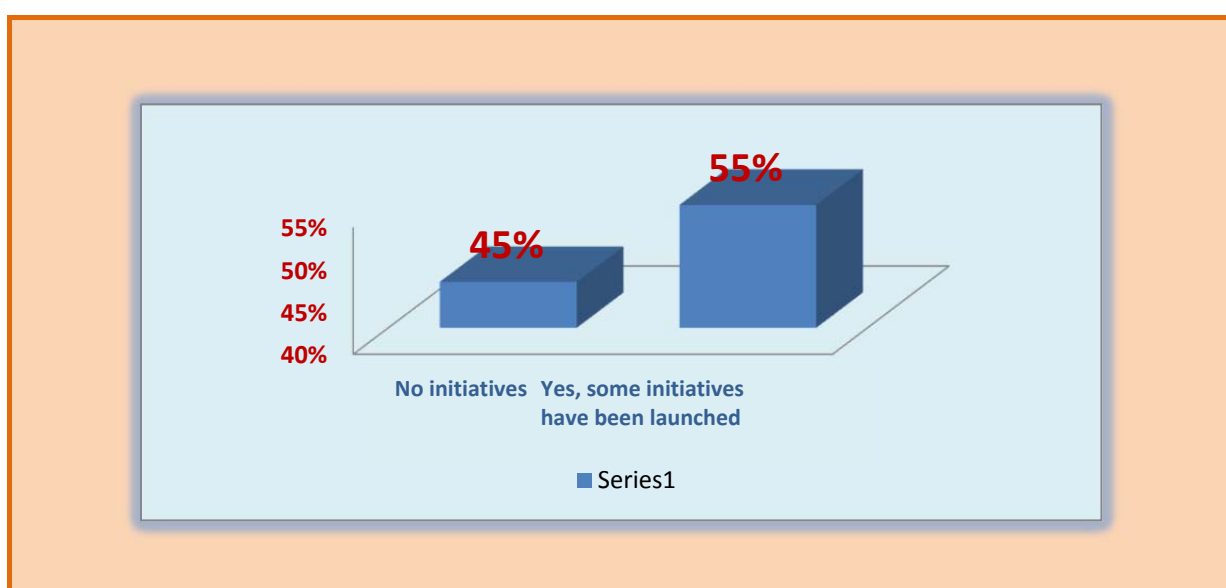
This is a good illustration of the successful startup of cloud computing technology in Africa, confirming in part that the characteristics of cloud computing would be very well suited to conditions in Africa, despite the shortcomings in terms of infrastructure and speed.

**Q7: Are there government initiatives to promote cloud computing services?**

- No initiatives
- Yes, some initiatives have been launched

The replies to Q7 were as follows:

No initiatives	Yes, some initiatives have been launched
45%	55%



**Comment:**

In Tanzania and Rwanda, concrete data centre projects are already operational or in the process of being implemented. In Benin and Burundi, strategies are emerging for the introduction of cloud computing. In the remainder of the countries surveyed, the initiatives mentioned, although interesting, are in fact broader actions or programmes not specific to the cloud (regulatory frameworks for electronic transactions, outsourcing of business processes, technology parks).

The following is a full list of these initiatives.

**List of government initiatives taken to favour the emergence of cloud computing in the African countries surveyed**

**Benin**

Implementation of multimedia community centres.

Feasibility study and implementation of a data centre to bring together the major State applications.

Tax exemption for IT equipment.

### **Burkina Faso**

The Government has taken the major initiative of implementing a regulatory framework that is favourable to electronic transactions (Act 045-2009/AN of 10 November 2009).

### **Burundi**

The Government participates in regional and international conferences and workshops on cloud computing.

The Government plans to recruit a cloud computing expert to assist it in the feasibility study for and implementation of whatever would be necessary to introduce cloud computing in Burundi.

### **Cape Verde**

The Government's programme comprises a cluster of ICT development strategies. This will be based on the outsourcing of business processes in the back office, a data centre and technology parks.

### **Gabon**

The country has access to SAT3 through Gabon Telecom.

The Government has launched a vast programme to make Gabon a hub for ICT services.

The site for the construction of a fibre-optic high-speed national backbone has been initiated with the launch of a call for bids for execution of the associated studies.

Participation in the Central Africa Backbone (CAB) led by CEMAC and financed by the World Bank. The aim of this project is to interconnect the countries of the CEMAC area using fibre-optic high-speed links.

Signature of the agreement of intent relating to the country's participation in the ACE fibre-optic submarine cable project that will link Africa's west coast with Europe. Its participation is intended to ensure the availability of international broadband access by diversifying the routing options.

### **Mali**

A technopole is currently being established to accommodate certain cloud computing services.

### **Rwanda**

The Government of Rwanda, through RDB ([www.rdb.rw](http://www.rdb.rw)), is implementing the cloud computing solution, to be managed and operated by BSC Ltd. ([www.bsc.rw](http://www.bsc.rw)).

### **Tanzania**

High Performance Computing Center [www.dit.ac.tz/supercomputing.htm](http://www.dit.ac.tz/supercomputing.htm)

Rhapta ICT City (proposed to be in Dar es Salaam). [www.costech.or.tz](http://www.costech.or.tz)

### **Togo**

Within the framework of the e-government project currently being implemented in Togo, discussions are under way with a view to possibly making cloud computing services available to the general public.

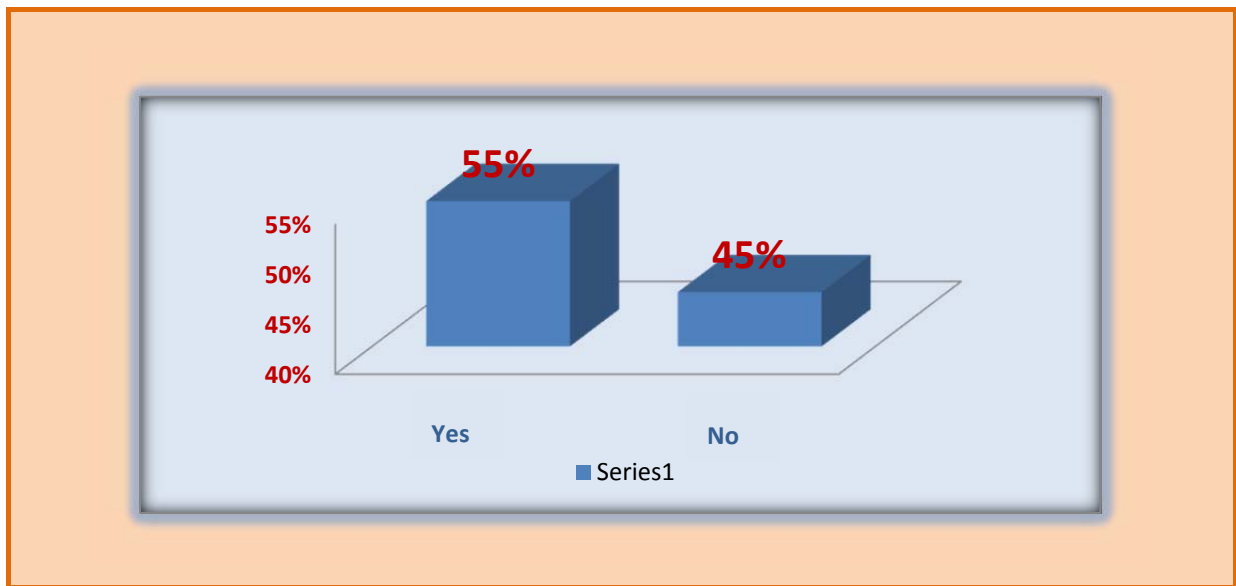


**Q8: Does your country have legislation on data protection?**

- Yes
- No

The replies to Q8 were as follows:

Yes	No
55%	45%



**Comment:**

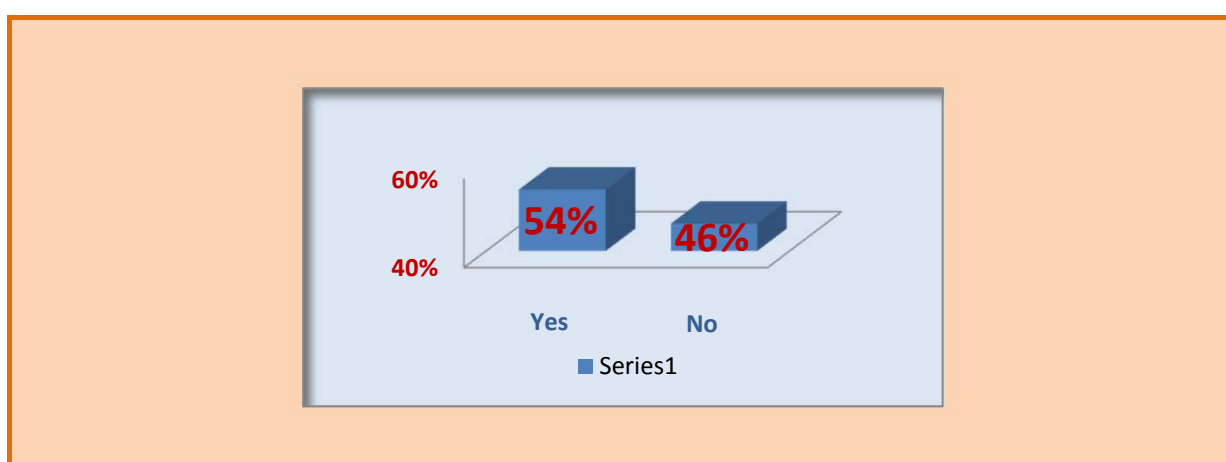
It is interesting to note that almost half the countries surveyed have no legislation on data protection.

**Q9: If yes, is it necessary to revise this legislation related to data protection to promote cloud computing?**

- Yes
- No

The replies to Q9 were as follows:

Yes	No
54%	46%



**If yes, please describe the most relevant revisions needed:**

The desired regulatory reviews, as proposed by the African stakeholders consulted, mainly concern:

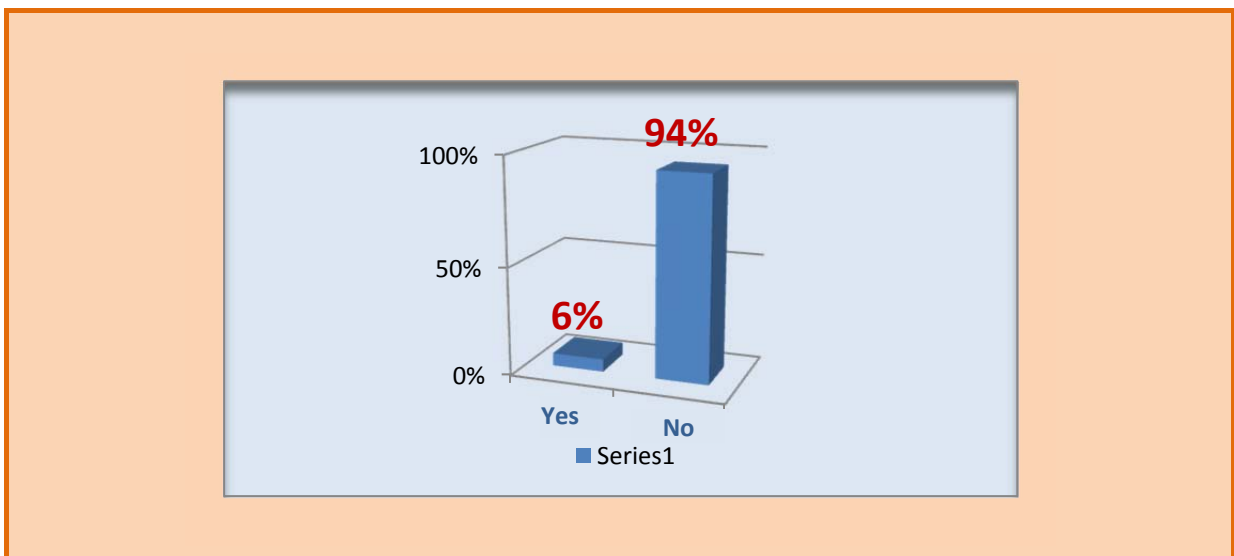
- Transposition to the national level of regional and international texts on data protection.
- Revision of the prevailing legislation, particularly to take account of the situation of data hosted in the cloud.
- Strengthening of legislation, codes of conduct and standards in the ICT sector.
- Clarification of relations between data centre managers, cloud computing and data protection.

**Q10: Do you have agreements on data protection with countries providing cloud computing services (USA, Europe...)**

- Yes
- No

The replies to Q10 were as follows:

Yes	No
6%	94%



**Comment:**

The only respondent having mentioned the existence of agreements between its country and countries providing cloud computing services (United States, Europe...) is the regulator in Benin (the Autorité Transitoire de Régulation des Postes et Télécommunications), which did not, however, specify the object of those agreements.

**Q11: What aspects of cloud computing need legislation coordination between countries and subregions?**

- None
- Data protection
- Technical aspects

The replies to Q11 were as follows:

None	Data protection	Technical aspects
6%	100%	65%



**Comment:**

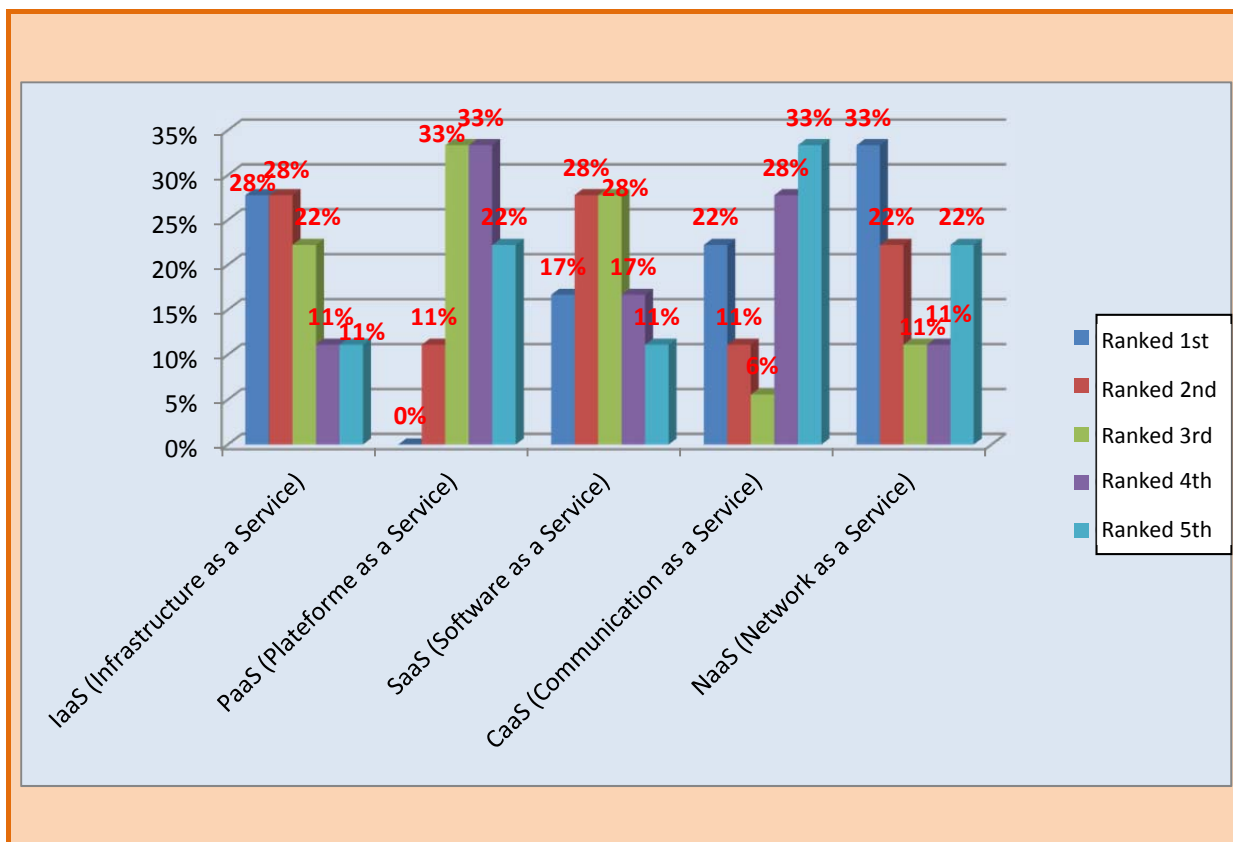
The respondents are almost unanimous in expressing the need for coordination between countries, particularly where data protection is concerned.

**Q12: Sort (from 1 to 5) the following services by order of importance for the development of cloud computing services in your country (a brief description of the services can be found in Annex 1) (1 the most important, 6 the less important).**

- IaaS (Infrastructure as a service)
- PaaS (Platform as a service)
- SaaS (Software as a service)
- CaaS (Communication as a service)
- NaaS (Network as a service)

The replies to Q12 were as follows:

	IaaS (Infrastructure as a service)	PaaS (Platform as a service)	SaaS (Software as a service)	CaaS (Communication as a service)	NaaS (Network as a service)
Ranked 1st	28%	0%	17%	22%	33%
Ranked 2nd	28%	11%	28%	11%	22%
Ranked 3rd	22%	33%	28%	6%	11%
Ranked 4th	11%	33%	17%	28%	11%
Ranked 5th	11%	22%	11%	33%	22%



**Comment:**

It is interesting to note that the majority (83%) of African stakeholders consider NaaS, IaaS and CaaS to be the three cloud computing services most important for development of the ICT sector. SaaS is considered important by only 17% of those consulted, while PaaS, for the time being at least, is of no interest to the African countries surveyed.

These results certainly differ from what one finds in countries where high-speed Internet is well-developed, and where SaaS and PaaS are much more in demand than NaaS and CaaS.

**Q13: What are the cloud computing services offered by multinational companies (Google, Microsoft, IBM...) in your country?**

Type	Description	Service provider
IaaS	Security services	IBM
	Infrastructure leasing, virtualized server and storage services for cloud computing customers	Google, Microsoft, IBM, HP, Orange, SFR, Colt and Verizon
	E-mail services	Safaricom, Google, EMC, Tata
	Google Cloud Print, LinkedIn (IaaS), Amazon EC2 – Virtual Machine, Amazon S3 - Storage	Google, LinkedIn, Amazon
PaaS	Data storage service	IBM, Microsoft
	Physical infrastructure leasing service for business customers (SMEs)	Google, Microsoft, IBM, HP, Orange, SFR, Colt and Verizon
	Customer relationship manager	Safaricom, Google, Tata
	Microsoft Windows Azure platform	Microsoft
SaaS	Business application hosting service for companies	Google, Microsoft, IBM, HP, Orange, SFR, Colt and Verizon
	E-mail services	Google
	Google Apps Engine, Salesforce Force.com platform, Cisco WebEx Connect platform.	Google, CISCO and Salesforce.com
CaaS	Basic communication service suitable for all types of customer	Google, Microsoft, IBM, HP, Orange, SFR, Colt and Verizon
	Website hosting service	Google
	Internet e-mail, instant messaging, online music, online video games	Yahoo, Hotmail, Microsoft, Gmail, YouTube, Napster, 3LLYRICS
	E-mail as a service, instant messaging as a service	Google
	Microsoft Connected Service Framework	Microsoft
	Communication services, videos, e-mail, instant messaging	Google
NaaS	Network access service offering considerable availability to cloud computing customers	Google, Microsoft, IBM, HP, Orange, SFR, Colt et Verizon
	Managed Internet, flexible and on-demand bandwidth	Orange, MTN
	Managed Internet services	MTN Business, Tata
	OpenStack	CISCO

**Comment:**

- 1 All the types of service are available and in use
- 2 CaaS (communication) services are the most sought after by multinationals
- 3 All of the major global cloud computing providers are present on the African market

The demand for cloud computing services is thus well and truly present in Africa, and the fact that, for the time being at any rate, it is more focused on CaaS and NaaS shows that the need for communication tools is greater than it is for SaaS services.

## Q14: What are the CC services developed and proposed by companies from your country?

The following table shows the services being offered by **national entities**:

Type	Description of Services	Service provider
IaaS	Security services Data centre service	ACCESS LINK COMTEL technologies Huawei
	Virtualized and on-demand server, flexible and on-demand storage space	RINGO
	E-mail services	Access Kenya MTN Business Safaricom
	Reseller of Computing Solution	Agumba Computers
	Shared data centres	
PaaS	Provision of storage services	SOFTNET
	Customer management, billing services	Bandwidth & Cloud Services Group Safaricom
SaaS	Business applications for customer relations and support (CRM), HR, finance (ERP)	HRM and IT engineering company
	Business applications	MyISP Safaricom
	Software provision	SOFTNET
	Software as a service in partnership with international companies (CRM)	
	Provision of accounting packages in cloud computing	CATS Tanzania
	E-mail / web hosting	
CaaS	Audio communication services, collaborative services, unified communications, e-mail, instant messaging, data sharing (web conference)	H2COM
	E-mail	CAMTEL-CAMNET
	Unified communications, e-mail	MTN Business Safaricom
	Unified communication, collaborative services, e-mail and instant messaging	Information Technologies and Communication Agency; telecommunication operators; a number of companies for their internal requirements.
	E-services and virtual resources for small enterprises	Net Innovations Ltd.
NaaS	Propagation of Internet flows	Huawei
	Managed Internet, flexible and on-demand bandwidth	CAMTEL, ORANGE Cameroun, MTN Cameroun, RINGO, YooMee
	Managed Internet	Bandwidth & Cloud Services Group Kenya Data Networks (KDN) MTN Business Safaricom



**Comment:**

The above cloud services are being developed and provided by African national entities operating in Benin, Burkina Faso, Cameroon, Kenya, Mali, Rwanda, Tanzania, Zambia and Zimbabwe.

It is to be noted that several applications and services pertaining to all the various types of cloud service are being developed and provided by African entities based in the aforementioned countries.

The following main services are on offer: storage space, security services, virtualized servers, business applications (CRM, ERP, ...), e-mail, collaborative services (unified messaging) and managed Internet (bandwidth).

**Q15: What cloud computing services proposed by regional companies located in Africa are available in your country?**

**Specify the service, the company and the country.**

**Benin**

CaaS: collaborative services, e-mail, Microsoft instant messaging

**Kenya**

CaaS: Unified communication/MTN Business/South Africa

SaaS: Business applications/Google/Google Africa office

NaaS: Managed Internet/MTN Business, Kenya Data Networks/South Africa

**Mali**

IaaS: Subregional Central Bank; Subregional Bank; NGO; (a CRT survey is under way)

**Tanzania**

IaaS and PaaS: IBM is supporting the Government of Tanzania with the implementation of cloud computing solutions.

SaaS: Rubikon has provided support to Efatha Bank Tanzania for the setting up of cloud computing infrastructures.

**Comment:**

CaaS and NaaS for e-mail and Internet connectivity management have been assimilated by African companies and are already provided in the majority of countries.

The more "weighty" IaaS and PaaS services are currently being taken up mainly by banks, with the support of key partners.

**Q16: What is the experience of your country (good practices, success stories, lesson learned) regarding the implementation and use of cloud computing services?**

**Comment:**

Feedback concerning the use of cloud computing refers to applications that are accessible via the cloud in areas such as:

- 1 Banking: data security, e-banking, payment of invoices and registration fees.
- 2 Education: e-learning.

Respondents state, however, that efforts remain to be made and that the introduction of an adequate regulatory framework and improvement of the quality and availability of the network are prerequisites for the development of cloud computing in Africa.

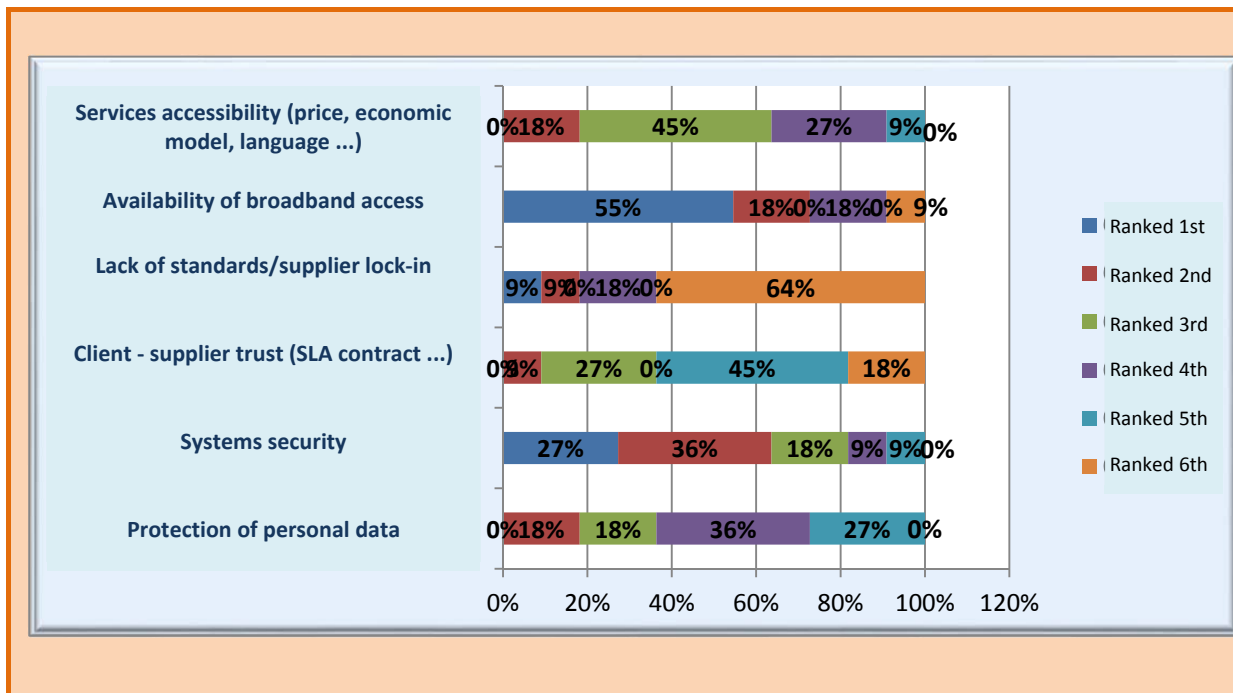
The limited level of expertise and experience in the cloud sphere are also mentioned by respondents as being an obstacle to cloud development.

**Q17: Sort the possible barriers to the adoption of cloud computing (from 1 to 6, 1 the most important, 6 the less important)**

- Protection of personal data
- Systems security
- Client – supplier trust (SLA contract ...)
- Lack of standards / supplier lock-in
- Availability of broadband access
- Services accessibility (price, economic model, language ...)

Les réponses à Q17 se présentent comme suit:

	<i>Protection of personal data</i>	<i>Systems security</i>	<i>Client – supplier trust (SLA contract ...)</i>	<i>Lack of standards/ supplier lock-in</i>	<i>Availability of broadband access</i>	<i>Services accessibility (price, economic model, language ...)</i>
<b>Ranked 1st</b>	0%	27%	0%	9%	55%	0%
<b>Ranked 2nd</b>	18%	36%	9%	9%	18%	18%
<b>Ranked 3rd</b>	18%	18%	27%	0%	0%	45%
<b>Ranked 4th</b>	36%	9%	0%	18%	18%	27%
<b>Ranked 5th</b>	27%	9%	45%	0%	0%	9%
<b>Ranked 6th</b>	0%	0%	18%	64%	9%	0%



**Comment:**

Where the development of cloud computing in Africa is concerned, the main concern for African stakeholders is the availability of high-speed access (55%), followed by the issue of systems security (27%).

It is also noteworthy that issues pertaining to customer relations and data protection ranked 27% and 18%, respectively.

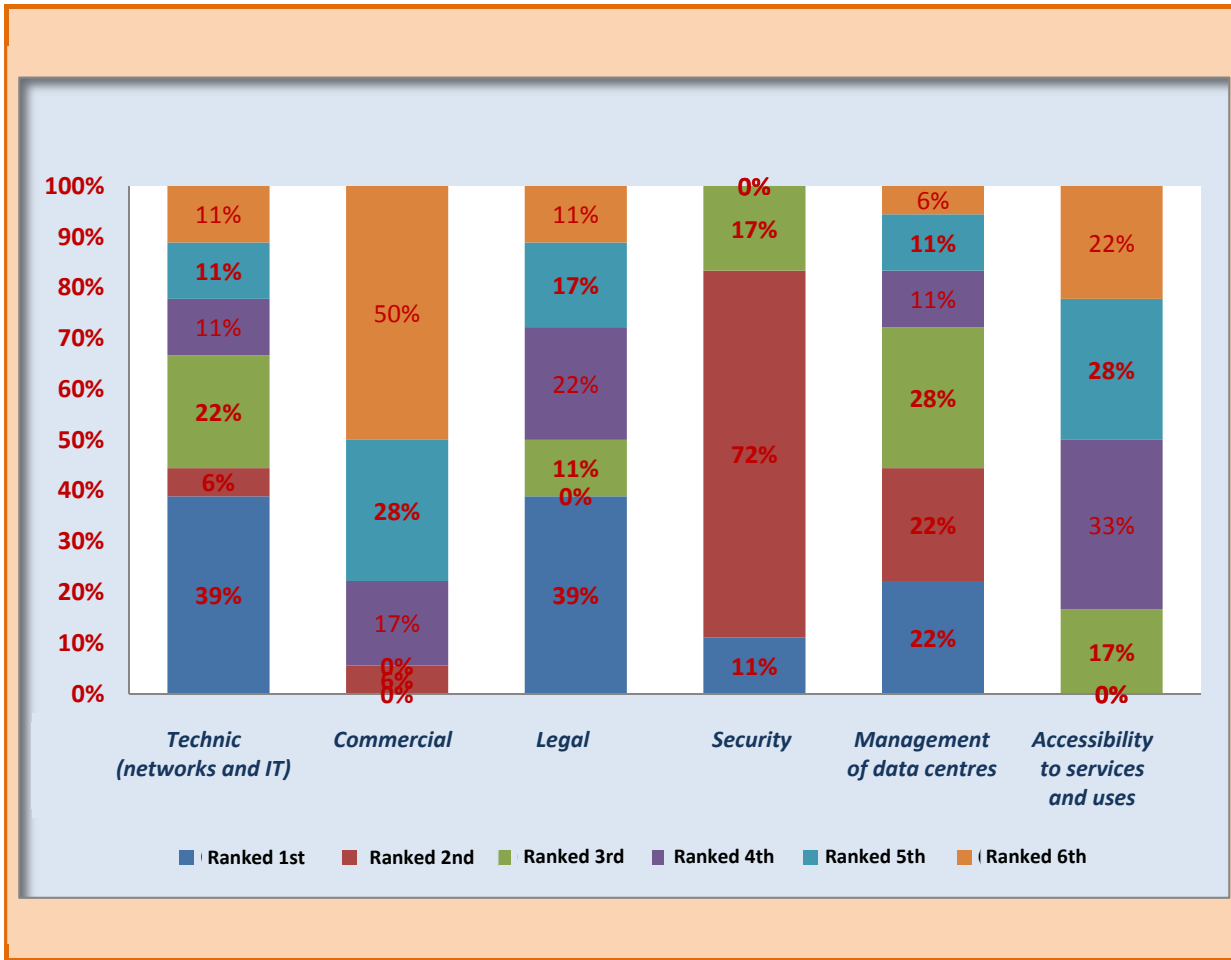
All of which once again confirms that the prerequisites for the success of cloud computing (infrastructures, high-speed networks and data centres) are not yet universally available in Africa.

**Q18: Sort (from 1 to 6) your cloud computing capacity building needs (seminars, workshops ...) based on following domains (1 the most important, 6 the less important):**

- Technic (networks and IT)
- Commercial
- Legal
- Security
- Management of data centres
- Accessibility to services and uses

The replies to Q18 were as follows:

	<i>Technic (networks and IT)</i>	<i>Commercial</i>	<i>Legal</i>	<i>Security</i>	<i>Management of data centres</i>	<i>Accessibility to services and uses</i>
<b>Ranked 1st</b>	39%	0%	39%	11%	22%	0%
<b>Ranked 2nd</b>	6%	6%	0%	72%	22%	0%
<b>Ranked 3rd</b>	22%	0%	11%	17%	28%	17%
<b>Ranked 4th</b>	11%	17%	22%	0%	11%	33%
<b>Ranked 5th</b>	11%	28%	17%	0%	11%	28%
<b>Ranked 6th</b>	11%	50%	11%	0%	6%	22%



**Comment:**

For African countries, the two absolute priorities in terms of training requirements are the legal environment and technical environment.

In third position comes the management of data centres, followed by data security.

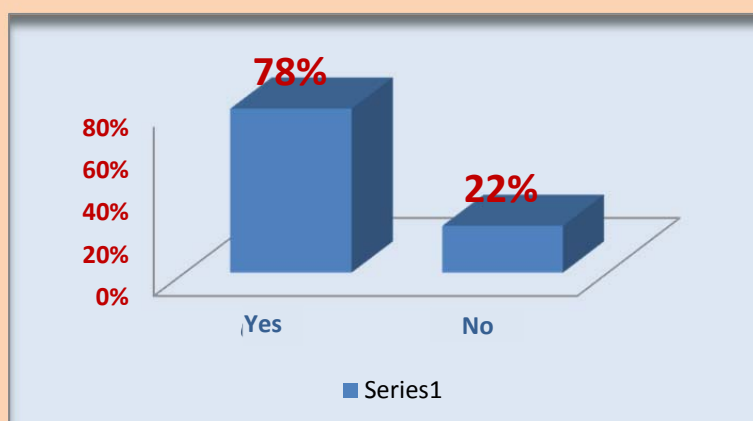
**Q19: Is the level of equipment's penetration of enterprises on PC / smartphones sufficient to ensure a wide usage of cloud computing services by professionals?**

- Yes
- No

If no, what are, if any, the initiatives taken to encourage the equipment's penetration of enterprises in PC/smartphones:

The replies to Q19 were as follows:

Yes	No
78%	22%



**Comment:**

The degree of penetration of terminals (PC/smartphones) within companies in the African countries surveyed must not constitute an obstacle to the use by those companies of cloud computing technology.

Initiatives taken to encourage the acquisition of terminals may be summarized as follows:

- **Cote d'Ivoire:** Flexibility of terminal equipment type approval procedures; liberalized ICT sector.
- **Gabon:** Low level of customs duties on the importation of PCs and smartphones, making their importation for commercial purposes a widespread activity.
- **Cape Verde:** By way of compensation for 3G licences, operators should contribute to public access to ICT equipment. The Government has a plan to distribute 150 000 computers (Mundu Novu Programme).
- **Burkina Faso:** IT equipment exempt from duties; promotion of ICT use; generalized use of the Internet by students; introduction of the LMD system in education.

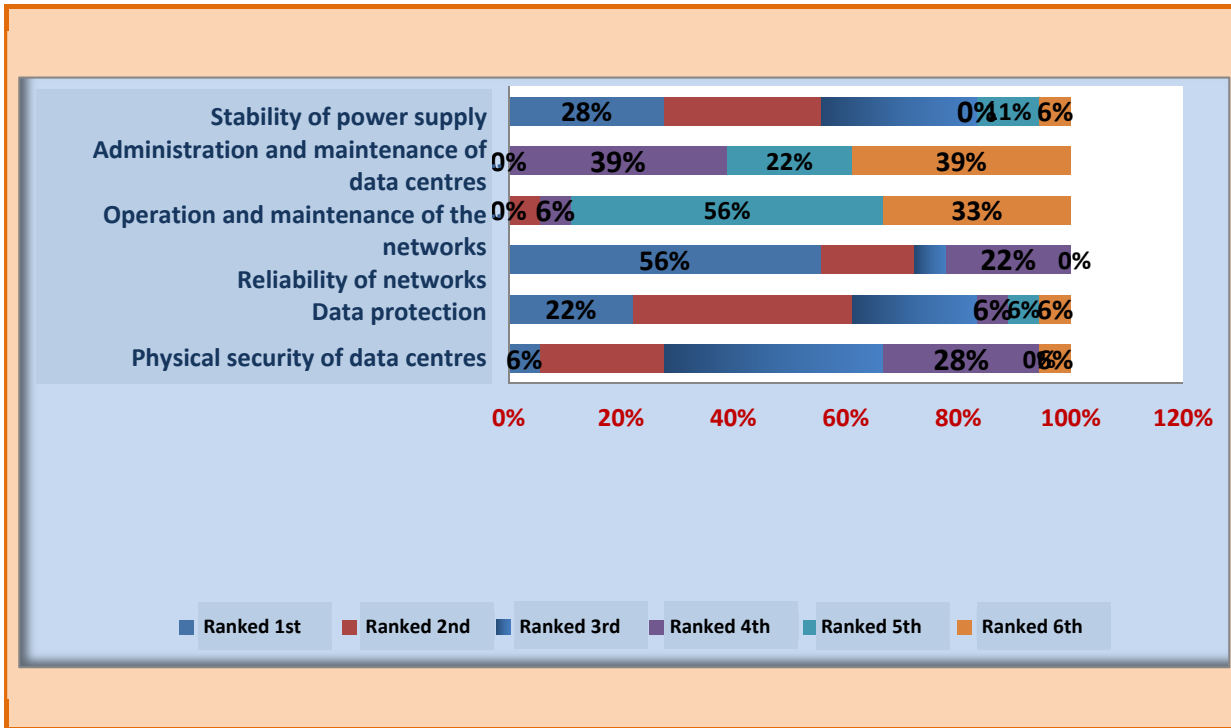


**Q20: Concerning data centre security, which of the following issues need to be improved to ensure always-on access to good quality cloud computing services? By order of priority from 1 to 6 (1 the most important, 6 the less important):**

- Physical security of data centres
- Data protection
- Reliability of networks
- Operation and maintenance of the networks
- Administration and maintenance of data centres
- Stability of power supply.

The replies to Q20 were as follows:

	<i>Physical security of data centres</i>	<i>Data protection</i>	<i>Reliability of networks</i>	<i>Operation and maintenance of the networks</i>	<i>Administration and maintenance of data centres</i>	<i>Stability of power supply</i>
Ranked 1st	6%	22%	56%	0%	0%	28%
Ranked 2nd	22%	39%	17%	6%	0%	28%
Ranked 3rd	39%	22%	6%	0%	0%	28%
Ranked 4th	28%	6%	22%	6%	39%	0%
Ranked 5th	0%	6%	0%	56%	22%	11%
Ranked 6th	6%	6%	0%	33%	39%	6%



**Comment:**

84% of the African stakeholders surveyed considered it essential to devote more effort to the upgrading of telecommunication networks and provision of a stable power supply.

Those same stakeholders confirmed once again that the areas of data protection and physical security of data centres likewise call for significant improvements so as to ensure always-on access to high-quality cloud computing services.

## Bibliography

- ITU focus group documentation, FG Cloud website  
[www.itu.int/ITU-T/focusgroups/cloud/](http://www.itu.int/ITU-T/focusgroups/cloud/)  
[www.itu.int/ITU-T/edh/faqs-guest.html](http://www.itu.int/ITU-T/edh/faqs-guest.html)
- Accellion white paper: Eight critical requirements for secure, mobile file sharing and collaboration, Accellion, Inc. [www.accellion.com](http://www.accellion.com)
- Example of recommendations and best practices for the administration of cloud systems: the VMware resource centre at [www.vmware.com/fr/technical-resources/](http://www.vmware.com/fr/technical-resources/) offers documentation containing a wealth of recommendations and best practices for the administration of cloud systems
- Cloud computing: Attentes & potentiels pour les infrastructures (IaaS) et les plates-formes (PaaS) (in French)  
[*Expectations and potential for infrastructures (IaaS) and platforms (PaaS)*], MARKESS International  
[www.markess.fr](http://www.markess.fr)
- Etat de l'Art Cloud Computing (in French)  
[*State of the art – cloud computing*]  
White paper by SOGETI Enterprise Services Consulting, March 2009  
[www.sogeti.com](http://www.sogeti.com)
- Le Cloud Computing: Réelle révolution ou simple évolution? (in French)  
[*Cloud computing: a real revolution or simple evolution?*]  
Wygwam Consulting
- An SME perspective on Cloud Computing  
ENISA (the European Network and Information Security Agency)  
[www.enisa.europa.eu](http://www.enisa.europa.eu)
- Cloud Computing: Strategies for Cloud Computing Adoption  
Faith Shimba, Dublin Institute of Technology (faith.shimba@gmail.com)  
[arrow.dit.ie/scschcomdis/29](http://arrow.dit.ie/scschcomdis/29)
- Evaluating Cloud Risk for the Enterprise: A Shared Assessments Guide  
Shared Assessments Program, October 2010  
[www.sharedassessments.org](http://www.sharedassessments.org)
- Outsourcing Technology Services Booklet  
Federal Financial Institutions Examination Council (FFIEC), United States
- Open Data Center Alliance Usage: Regulatory Framework  
[www.opendatacenteralliance.org](http://www.opendatacenteralliance.org)
- Datacenters et Développement Durable: État de l'art et perspectives (in French)  
[*Data centres and sustainable development: status and prospects*]  
Syntec Numérique  
[www.syntec-numerique.fr](http://www.syntec-numerique.fr)  
[www.passinformatique.com](http://www.passinformatique.com)
- Cloud computing: 30 entreprises détaillent leurs retours d'expériences (in French)  
[*Cloud computing: detailed feedback from 30 companies*]  
Ipanema Technologies Orange Business Services Electronic Business Group / Elenbi  
[www.orange-business.com](http://www.orange-business.com)  
[www.ipanematech.com](http://www.ipanematech.com)  
[www.ebg.net](http://www.ebg.net)

- Cloud computing: benefits, risks and recommendations for information security  
ENISA (the European Network and Information Security Agency)  
[www.enisa.europa.eu](http://www.enisa.europa.eu)
- Construire le datacenter du futur: par où commencer? (in French)  
[*Building the data centre of the future: where to begin?*]  
"On" is a magazine published by EMC Computer Systems France  
[www.emc2.fr](http://www.emc2.fr)

## Office of the Director

### Telecommunication Development Bureau (BDT)

Place des Nations

CH-1211 Geneva 20

Email: [bdtdirector@itu.int](mailto:bdtdirector@itu.int)

Tel.: +41 22 730 5035/5435

Fax.: +41 22 730 5484

### Infrastructure Enabling Environment and E-Applications Department (IEE)

Email: [bdtiee@itu.int](mailto:bdtiee@itu.int)

Tel.: +41 22 730 5421

Fax: +41 22 730 5484

### Deputy to the Director and Administration and Operations Coordination Department (DDR)

Email: [bdtdrr@itu.int](mailto:bdtdrr@itu.int)

Tel.: +41 22 730 5784

Fax: +41 22 730 5484

### Project Support and Knowledge Management Department (PKM)

Email: [bdtpkm@itu.int](mailto:bdtpkm@itu.int)

Tel.: +41 22 730 5447

Fax: +41 22 730 5484

### Innovation and Partnership Department (IP)

Email: [bdtip@itu.int](mailto:bdtip@itu.int)

Tel.: +41 22 730 5900

Fax: +41 22 730 5484

## Africa

### Ethiopia

#### International Telecommunication Union (ITU)

##### Regional Office

P.O. Box 60 005

Gambia Rd. Leghar ETC Bldg 3rd Floor

Addis Ababa – Ethiopia

E-mail: [itu-addis@itu.int](mailto:itu-addis@itu.int)

Tel.: +251 11 551 49 77

Tel.: +251 11 551 48 55

Tel.: +251 11 551 83 28

Fax.: +251 11 551 72 99

### Cameroon

#### Union internationale des télécommunications (UIT)

##### Bureau de zone

Immeuble CAMPOST, 3ème étage

Boulevard du 20 mai

Boîte postale 11017

Yaoundé – Cameroun

E-mail: [itu-yaounde@itu.int](mailto:itu-yaounde@itu.int)

Tel.: +237 22 22 92 92

Tel.: +237 22 22 92 91

Fax.: +237 22 22 92 97

### Senegal

#### Union internationale des télécommunications (UIT)

##### Bureau de zone

Immeuble Fayçal, 4ème Etage

19, Rue Parchappe x Amadou Assane

Ndoye

Boîte postale 50202 Dakar RP

Dakar – Sénégal

E-mail: [itu-dakar@itu.int](mailto:itu-dakar@itu.int)

Tel.: +221 33 849 77 20

Fax.: +221 33 822 80 13

### Zimbabwe

#### International Telecommunication Union (ITU)

##### Area Office

TelOne Centre for Learning

Corner Samora Machel

and Hampton Road

P.O. Box BE 792

Belvedere Harare, Zimbabwe

E-mail: [itu-harare@itu.int](mailto:itu-harare@itu.int)

Tel.: +263 4 77 59 41

Tel.: +263 4 77 59 39

Fax: +263 4 77 12 57

## Americas

### Brazil

#### International Telecommunication Union (ITU)

##### Regional Office

SAUS Quadra 06 Bloco “E”

11 andar – Ala Sul

Ed. Luis Eduardo Magalhães (AnaTel.) –

CEP 70070-940 – Brasília – DF – Brasil

E-mail: [itubrasilia@itu.int](mailto:itubrasilia@itu.int)

Tel.: +55 61 2312 2730

Tel.: +55 61 2312 2733

Tel.: +55 61 2312 2735

Tel.: +55 61 2312 2736

Fax.: +55 61 2312 2738

### Barbados

#### International Telecommunication Union (ITU)

##### Area Office

United Nations House

Marine Gardens

Hastings – Christ Church

P.O. Box 1047

Bridgetown – Barbados

E-mail: [itubridgetown@itu.int](mailto:itubridgetown@itu.int)

Tel.: +1 246 431 0343/4

Fax.: +1 246 437 7403

### Chile

#### Unión Internacional de Telecomunicaciones (UIT)

##### Oficina de Representación de Área

Merced 753, Piso 4

Casilla 50484 – Plaza de Armas

Santiago de Chile – Chile

E-mail: [itusantiago@itu.int](mailto:itusantiago@itu.int)

Tel.: +56 2 632 6134/6147

Fax.: +56 2 632 6154

### Honduras

#### Unión Internacional de Telecomunicaciones (UIT)

##### Oficina de Representación de Área

Colonia Palmira, Avenida Brasil

Edificio COMTELCA/UIT 4 Piso

P.O. Box 976

Tegucigalpa – Honduras

E-mail: [itutegucigalpa@itu.int](mailto:itutegucigalpa@itu.int)

Tel.: +504 2 201 074

Fax: +504 2 201 075

## Arab States

### Egypt

#### International Telecommunication Union (ITU)

##### Regional Office

c/o National Telecommunications

Institute Bldg (B 147)

Smart Village – Km 28

Cairo – Alexandria Desert Road

6th October Governorate – Egypt

E-mail: [itucairo@itu.int](mailto:itucairo@itu.int)

Tel.: +20 2 35 37 17 77

Fax.: +20 2 35 37 18 88

## Asia and the Pacific

### Thailand

#### International Telecommunication Union (ITU)

##### Regional Office

3rd Floor Building 6,

TOT Public Co., Ltd

89/2 Chaengwattana Road, Laksi

Bangkok 10210 – Thailand

Mailing address:

P.O. Box 178, Laksi Post Office

Bangkok 10210, Thailand

E-mail: [itubangkok@itu.int](mailto:itubangkok@itu.int)

Tel.: +66 2 574 8565/9

Tel.: +66 2 574 9326/7

Fax.: +66 2 574 9328

### Indonesia

#### International Telecommunication Union (ITU)

##### Area Office

Sapta Pesona Building, 13th floor

Jl. Merdeka Barat No. 17

Jakarta 10110 – Indonesia

Mailing address:

c/o UNDP – P.O. Box 2338

Jakarta – Indonesia

E-mail: [itujakarta@itu.int](mailto:itujakarta@itu.int)

Tel.: +62 21 381 35 72

Tel.: +62 21 380 23 22

Tel.: +62 21 380 23 24

Fax.: +62 21 389 05 521

## CIS countries

### Russian Federation

#### International Telecommunication Union (ITU)

##### Area Office

4, building 1

Sergiy Radonezhsky Str.

Moscow 105120

Russian Federation

Mailing address:

P.O. Box 25 – Moscow 105120

Russian Federation

E-mail: [itumoskow@itu.int](mailto:itumoskow@itu.int)

Tel.: +7 495 926 60 70

Fax: +7 495 926 60 73

## Europe

### Switzerland

#### International Telecommunication Union (ITU)

##### Europe Unit EUR

#### Telecommunication Development Bureau BDT

Place des Nations

CH-1211 Geneva 20 – Switzerland

E-mail: [euregion@itu.int](mailto:euregion@itu.int)

Tel.: +41 22 730 5111



---

International Telecommunication Union  
Telecommunication Development Sector  
Place des Nations  
CH-1211 Geneva 20  
Switzerland  
[www.itu.int](http://www.itu.int)