August 2016

Promoting Content In Africa

Internet Society

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Executive Summary

The vision of the Internet Society is that the Internet is for everyone, everywhere, and to help achieve this aim we have conducted a number of studies of barriers to connectivity in emerging regions. This report continues in that vein, but represents a shift from examining the barriers to accessing content. As a starting point we note that, as a result of new investments in access infrastructure including notably mobile Internet networks, Internet availability now far outpaces adoption, and raises the question of why adoption is lagging behind.

Sub-Saharan Africa has seen great improvements in connectivity infrastructure and affordability in recent years. In spite of this, the growth in Internet adoption is stagnating. This report starts from the general premise that a greater emphasis on the demand for Internet connectivity is required to increase adoption rates. Specifically, the report focusses on a number of areas that need to be addressed in order to facilitate local *content availability* and *content distribution*.

Content availability. As we are increasingly seeing, the ability to access the Internet is necessary, but not sufficient, to increase Internet adoption in a country; it is a means to an end, which is the content and services that people use when they are online. Much of the international content and services is relevant in many countries worldwide - this is true of social networking services, educational access, and, of course, entertainment. However, we also note the importance of locally created content given the relevance of the content in the local context.

Content must be in familiar languages, which is often an issue in Sub-Saharan countries whose populations are not always comfortable in the official government language. While one might assume this mainly impacts international content, it is also true for local content, including e-government services, as not everyone speaks the government language. Content availability may further be limited by legal restrictions on content that impact the willingness of international providers and platforms to make content available in a country, along with local developers who may self-censor their output to keep in line with legal restrictions.

At the same time, payment mechanisms are critical for both international and locally developed content. With a lack of a payment mechanisms users may not be able to purchase content, and even if they could, the developer may not be able to receive the payments. Such restrictions extend further to an ability to receive payments for advertising and for local entrepreneurs to raise funds to develop new innovations.

Coming full circle, the problems with advertising payouts are further aggravated by the fact that most major advertising platforms do not support any African languages (except Arabic), furthermore, in some cases even the placing of ads in a supported language (such as English or French) on pages that are primarily in a different language (e.g. Swahili) is expressly forbidden.

These problems are exacerbated by a lack of local infrastructure to distribute local content and lower the cost and time to access the content.

Content distribution. For all developing countries we have studied, the majority of content - both international and locally developed, is hosted outside the country, typically overseas. For instance, in Rwanda, for all .RW websites, only a very small fraction are hosted in Rwanda, and the rest are hosted predominantly in Europe and the US. Based on work that we did recently in Rwanda, overseas hosting can have a significant impact on the cost and latency of accessing the content, which acts to depress usage. Thus, having good local and regional content distribution platforms can significantly increase the usage of available content.

Three key levels of infrastructure are discussed. First, data centres provide a location where servers be securely operated. Second, a data centre can serve local hosting of content, but also international content through Content Delivery Networks. Third, in order to make sure no connections between content demand and supply are needlessly routed abroad, an Internet Exchange Point is needed to arrange local traffic flows.

Barriers for such infrastructure include training of engineers locally to operate the equipment, legal restrictions on those who host the content of others, access to power and fibre cables within the country, and import procedures that raise the time and cost of acquiring the equipment needed.

Removing barriers to build and operate these pieces of infrastructure can increase the amount of domestically available content. As the content is closer to the users, this lowers latency. In addition, ISPs do not have to spend money on submarine cable capacity to bring the content from overseas every time it is viewed. Eventually, prices for Internet access could be reduced.

Summary. We believe that this focus on removing barriers to content availability and distribution will have significant impacts on the Internet ecosystem. It will help to make existing international content more accessible, while also providing more opportunities for local entrepreneurs to identify and meet gaps in their markets, helping also to create income and jobs. Ultimately, it will help to increase demand for the Internet, bringing new users online and increasing the usage of those already online as they find new content and services to capture their interest, for social, business, and government uses.

Introduction

The vision of the Internet Society is that the Internet is for everyone, everywhere. To help achieve this aim we have conducted a number of studies examining the barriers to connectivity in emerging regions. This report continues in that vein, but represents a shift from focusing on access infrastructure, to examining the barriers to accessing content. As a starting point, we note that as a result of new investments in access infrastructure, including most notably mobile Internet networks, Internet availability now far outpaces adoption, and raises the question of why adoption is lagging behind.

Put concretely, in some countries, 90% or more of the population live within range of a mobile Internet signal, but adoption may be 20% or less of the population. What explains this gap? While affordability is certainly an issue, in surveys of non-users, cost is not always the most cited reason for non-adoption—typically, the top reasons relate to a lack of interest or understanding of the Internet. This suggests that, contrary to the experience that many of us have with the Internet, non-users lack compelling reasons to go online.

What makes the Internet compelling is content and services - specifically, those that are in a language in which the user is comfortable, and with a relevant subject and purpose. Social media and communications fulfil a role in this because they are used to communicate with other users, who can be friends, relatives, and neighbours, and generate their own interesting content in the relevant language. However, if few people are using the Internet, there may not be enough contacts to make even social media relevant.

In order to address these questions, the report looks at barriers to the availability and delivery of content and how to eliminate or lessen them, in the Sub-Saharan Africa region. The impetus for this is to ensure that there is demand for the Internet access that is increasingly available, in large part because of mobile Internet service.

Currently, the number of Internet users in Sub-Saharan Africa is much lower than in other parts of the world, with about 28.3% of the population being online as compared to the global average of over 45%. In addition to this, there is a large divide within Africa, with much of the online population living in a small number of countries such as South Africa, Mauritius, and Kenya, whereas many other countries such as Guinea-Bissau and the Democratic Republic of the Congo still have connections rates close to zero.

This report looks at barriers to the availability and delivery of content, and how to eliminate or lessen them, in the Sub-Saharan Africa region.

Internet Access by Region
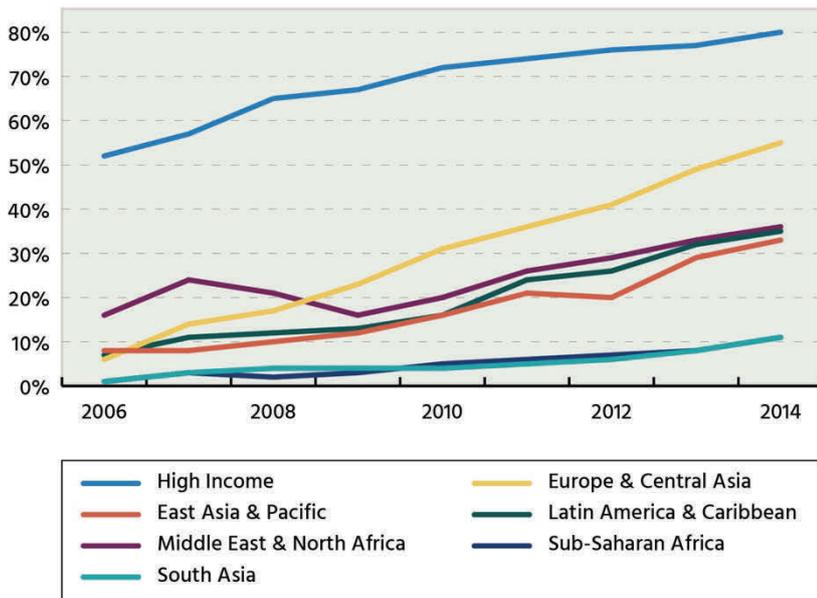
Source: World Development Report 2016.

The graph above shows how some regions, notably South Asia and Sub-Saharan Africa, lag significantly behind other regions with respect to Internet access. However, unlike when the "Connecting the Next Billion" concept first surfaced in late 2006[1] describing the infrastructural barriers to connecting the second billion Internet users, the barrier to further adoption today is less of an infrastructural problem and more of a relevance one, as we explore here.

Low adoption rates are, of course, a significant issue in the growth of the digital ecosystem in Africa. However, low growth in adoption rates may be even more worrying. The graph below shows how the growth rate of global Internet adoption is slowing significantly; while the growth rate is higher in Sub-Saharan Africa, it has fluctuated quite a bit historically and is falling now.

The graph shows how the growth rate of global Internet adoption is slowing significantly, while the growth rate is higher in Sub-Saharan Africa, although it has fluctuated quite a bit historically.

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1 http://www.economist.com/node/5134746

Internet Adoption in Sub-Saharan Africa and the World
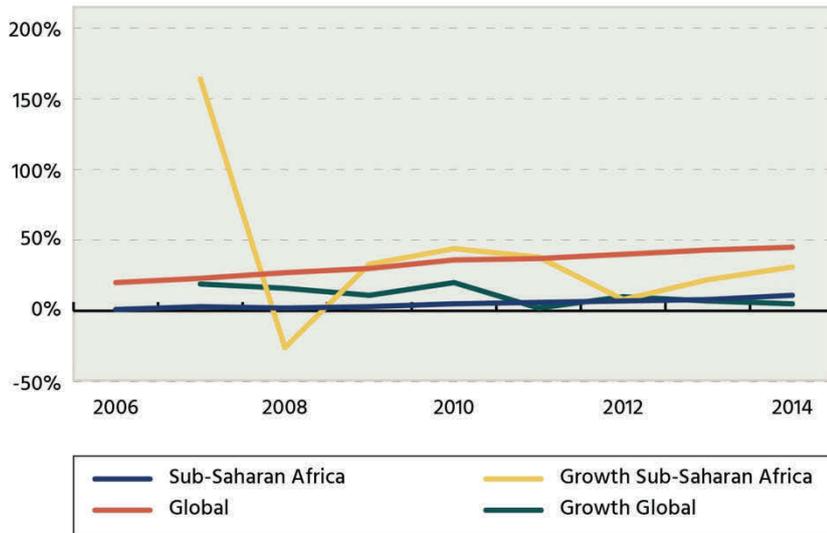
Source: ITU 2015.

The low and slowing Internet adoption is an issue, particularly given the recent improvements in infrastructure availability. Ten years ago, infrastructure was the significant concern of Internet development in Sub-Saharan Africa, when The Guardian said "The challenge now is not just to increase the level of cellular phone use across Africa, but to increase access to the Internet."[2]

At the time, there was only one submarine cable reaching Sub-Saharan Africa, leaving international Internet access to high-cost and slow satellite connections for most part of the continent. Furthermore, before mobile Internet, last-mile access relied on copper connections, which were originally laid for telephony. Unfortunately, in many Sub-Saharan African countries, very few of those were ever laid, with virtually none outside of cities.[3] Of course, the middle mile between the satellite connections and the last mile was no more developed.

Things have changed considerably since then, based on significant and sustained investment by the private sector, the public sector, and public-private partnerships. The mobile Internet, along with smart devices, has revolutionised access, while many coastal countries in Sub-Saharan Africa have multiple submarine cable connections, and landlocked countries increasingly have at least one connection to a submarine cable landing station through a neighbouring country.[4]

Consequently, the cost of providing Internet access has fallen. For instance, most African Internet markets have some degree of international access competition, since most coastal markets are now served by several submarine cables, which has led to a

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2 UN Economic Report on Africa 2005 pp. 252-253
3 http://www.theguardian.com/media/2004/may/05/citynews.newmedia and https://manypossibilities.net/2016/01/africa-telecoms-infrastructure-in-2015/
4 Of course, this is not universal, and some regions, such as the eastern part of the Democratic Republic of the Congo still have poor connectivity to the submarine cable landing stations. http://cablemap.info/ and https://manypossibilities.net/african-undersea-cables/

corresponding decrease in costs of Internet access.[5] At the same time, international Internet bandwidth in Africa grew 51% annually between 2010 and 2015. The graph below shows annual growth rates over the period compared with other regions.

International Bandwidth Growth by Region, CAGR 2010-2014
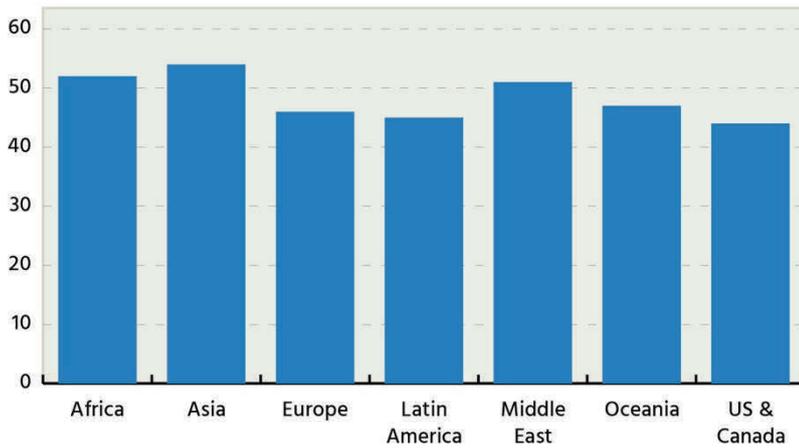
Source: ITU 2015.

Similar improvements, to varying degrees, are seen in other parts of Internet infrastructure.

The availability of mobile Internet technology in particular has increased Internet access significantly. When taking a closer look at Rwanda, for which there is a lot of data available, we see that almost 90% of the population is covered by a 3G-enabled mobile network, and 50% have access to a 4G connection. However, the number of

Availability, Adoption, Subscription in Rwanda

Source: ITU 2015.

5 http://wiocc.net/improved-international-connectivity-from-wiocc-reduces-bandwidth-prices-in-lesotho-by-67/
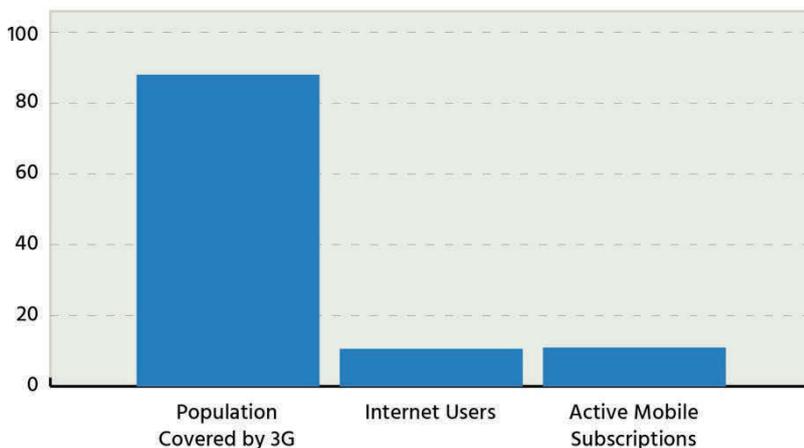
active mobile subscriptions, as well as the number of Internet users, lags far behind this, both hovering around the ten percent mark.

Based on our experience and global averages, this phenomenon is likely to be the same in varying degrees in the other countries, although we note that Rwanda benefits in this regard from high population density that lowers the cost of increased 3G population coverage. Globally, up to 84% of the population live within range of a mobile Internet signal, while less than half have access, thus this is a widespread phenomenon.[6]

The oft given explanation of the high cost of Internet may be becoming less important, as can be seen in the below graph. The price of 500MB per month of access may still be high compared to GDP per capita, but in a number of countries, it is falling below the—still quite significant— 10% of per capita GDP, towards the 5% threshold that is commonly used for affordability, except for Senegal, which is still far above that at over 50%. Of course, work must still be done on affordability, but at least the trend is encouraging.

Cost of 500MB Mobile data per month / monthly GDP per capita
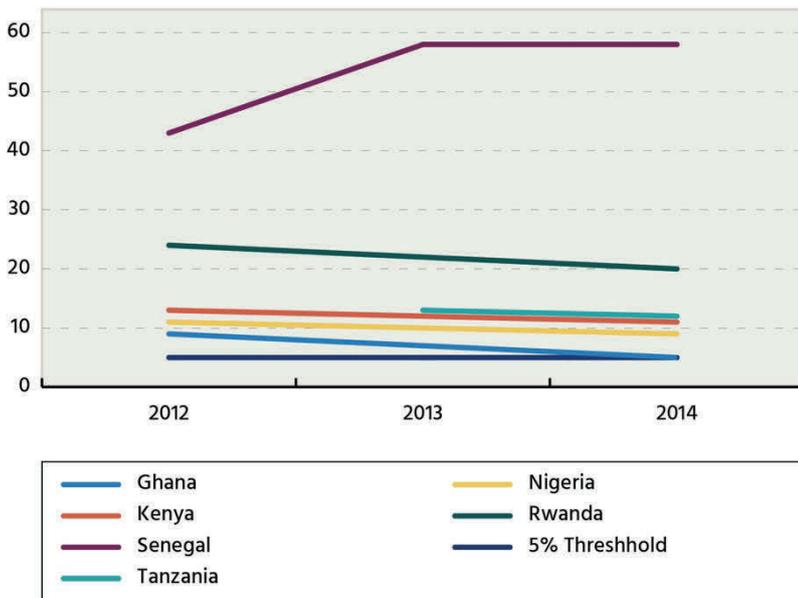
Source: ITU 2015; World Bank 2015.

Thus, there seems to be a disconnect between, on the one hand, the number of potential Internet users, as a function of the increased availability and increasing affordability, and on the other hand, the actual adoption rates, which are still lagging behind availability quite a bit. Considering the improvements discussed above, this seems to suggest that, more than before, potential new users are insufficiently interested in obtaining an Internet connection. Survey data appears to back this up.

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6 http://www.itu.int/en/ITU-D/Statistics/Pages/publications/mis2015.aspx

Reasons for no Internet
(of non-users)
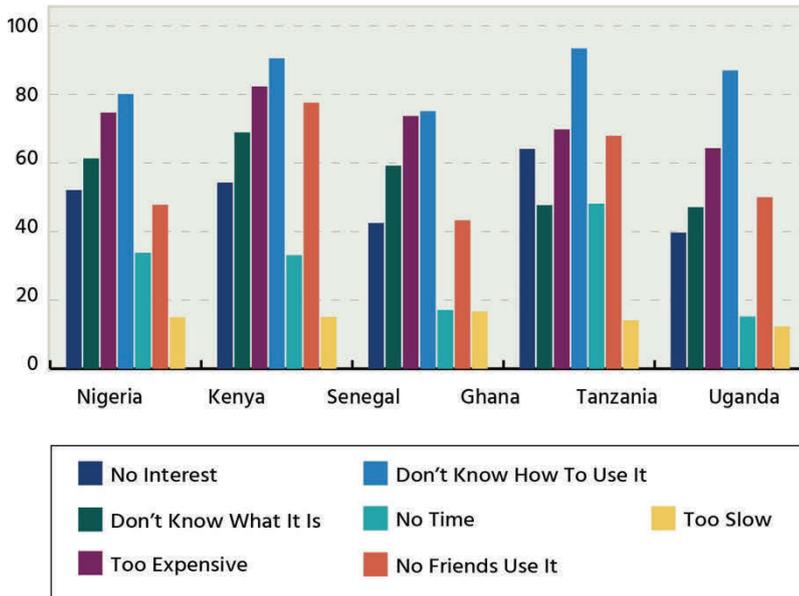
Sources: Research ICT Africa Survey 2011-2012.

A study by Research ICT Africa for a selection of countries, asked non-users about their reason for not being online. Users were allowed to choose from multiple reasons, as shown above. It is clear that 'Too Expensive' is a reason that is often given, but in no country is this the top reason. While users claiming 'No Interest" register around 50% in the countries, the predominant answer in all countries, 'Don't Know How to Use it', could be attributed in part to a lack of interest in learning how. Another popular answer, 'No friends use it' suggests a lack of relevance, as there would be few friends with whom to communicate. The other answers, including "Don't Know What it is" and "No Time" could also be attributed to a lack of compelling reasons for users to learn what the Internet is and make time to use it.

There is, of course, no question that infrastructure is not fully available everywhere, and that the Internet is not fully affordable to all. These are significant issues in every developing country, and a significant amount of work has been done to address them. For instance, the Alliance for Affordable Internet (A4AI) recently released its Affordability Index, addressing the challenges of lowering cost of access.[7]

However, in this report we focus on those who express little or no interest in the Internet, which are a significant group in most countries. While there may be overlapping reasons for non-adoption, we are particularly concerned about those for whom the Internet is available, and who can afford access. If those cannot be convinced to come online, then the challenge is multiplied for those at the edge of availability or affordability. Of course, making the Internet relevant to this group is also likely to increase usage by those already online as well.

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7 http://a4ai.org/affordability-report/report/2015/

In particular, we focus here on content and services that make the Internet relevant and attractive, with the impact of bringing new users online, and increasing the usage of those already online. There are two related issues involved - first, the availability of relevant content, and second, the distribution of that content.

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Content availability. In order to be relevant, content must be in a language understood by the local population, and it must meet local demand, whether those needs are social, entertainment, educational, government, or business related. While existing international content often may be relevant, we find that locally developed content is often more targeted at the local market. Thus, increasing the development of content is an important factor in the quest to increase Internet usage, both by those wishing to make a living creating content, and those who wish to use that content.

Content distribution. For all developing countries we have studied, the majority of content - both international and locally developed, is hosted outside the country, typically overseas. For instance, in Rwanda, for all .RW websites, only a very small fraction, are hosted in Rwanda and the rest are hosted predominantly in Europe and the US. Based on work that we did recently in Rwanda, overseas hosting can have a significant impact on the cost and latency of accessing the content, which acts to depress usage.[8] Thus, having good local and regional content distribution platforms can significantly increase the usage of available content.

The following sections address each of these questions in turn.

Relevant Content Availability

As we are increasingly seeing, the ability to access the Internet is necessary, but not sufficient, to increase Internet adoption in a country; it is a means to an end, which is the content and services that people use when they are online. Much of the international content and many of the services available are relevant in many countries worldwide - this is true of social networking services, educational access, and, of course, entertainment. However, we also note the importance of locally created content, both for the relevance of the content in the local context, as well as for the opportunities provided to the creators for earning a living and creating jobs.

There are many roadblocks to increasing the availability of locally relevant content, and many of these apply to both international content as well as locally created content. There are, however, differences. Most international content is already

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created, or will be created regardless of local conditions, and thus removing any roadblocks could make content available in large volumes; in contrast, much of the locally created content is yet to be developed, and further roadblocks may stand in the way of its creation and availability. Here we focus first on roadblocks to the availability of content in general, and then on those impacting the creation of local content specifically.

Language

Content is most relevant when it is in the local language - this applies in particular to international content and services, but also to local content that may not be available in all languages in a country. There is a significant gap in availability of content in local languages worldwide, including even in some of the most widely spoken languages, much less in some more regional or local languages.

The below chart relates the proportion of native speakers of languages globally, to the proportion of Internet-connected native speakers, and finally to the language used for web content. English is the native language for about five percent of the global population. As a proportion of the Internet-connected global population, it accounts for a much larger fraction, of about 25%. Yet over half of all Internet websites (54%) are in English. This is in stark contrast with other languages. For instance, native Hindi speakers also account for about five percent of the global population. However, as fraction of global Internet-connected population, they only account for 1.8%. The total amount of Hindi-language content online is even lower, at just 0.1%. Overall, 'other languages' in the below chart account for over half the global population, yet only for about one fifth of the Internet-connected global population, and the Internet content of all these languages put together only accounts for about ten percent of all Internet content.

Native Speakers vs. Online Content
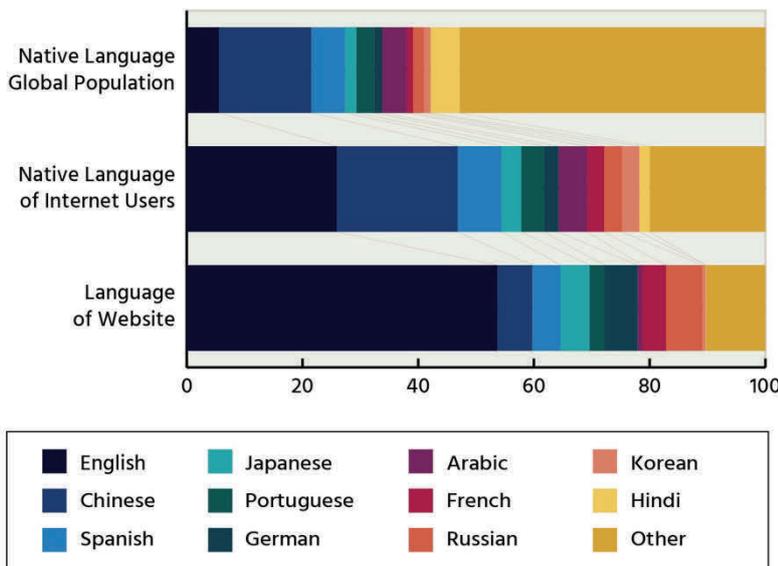
Source Telegeography.

Intuitively, we would expect that a 'trickle-down' effect would, at least partially, solve this problem. As more of the speakers of 'other languages' come online, their

proportion of the Internet-connected population increases. Subsequently, this would then lead to more content becoming available in these languages. In the above graph this would manifest itself as the connecting lines between the bars being more vertical and less diagonals, as is now the case.

Unfortunately, there is little evidence for this 'trickle down effect' to date. It seems that in some cases this first step is simply not taking place, since there appears to be little content that is of interest to the speakers of other languages. It is worth noting that the chart shows the language of websites, not the language of all Internet content. That is to say, other forms of Internet communication, particularly those that enable users to effectively create their own content, such as email and social media, are not included in these figures. These can help to provide incentive to go online, and we further discuss social media later in this section.

The issue of languages has a specific regional dimension. The two regions with the lowest levels of Internet access and no real indication of accelerating growth are South Asia and Sub-Saharan Africa (see first chart in Introduction section). Both of these regions are characterised by using languages introduced by colonial powers as government working languages (in South Asia it is English, in Sub-Saharan Africa it is mostly English and French), but with the majority of the population having a different native language (in the former: Urdu, Hindi, Tamil and others, in the latter: Swahili and Zulu, among others) and often lacking fluency or comfort in speaking and reading the government languages.

English Speakers (including non-native)
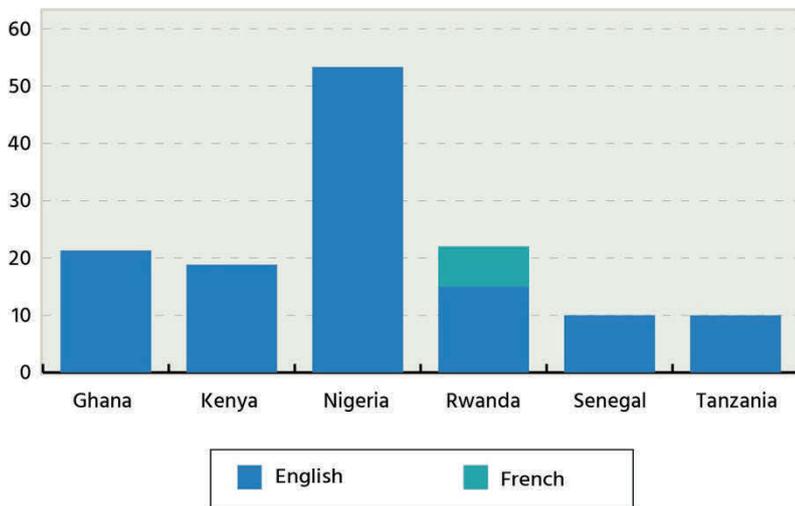
Sources: Crystal (2003), Ghana Census 2010, Euromonitor International report 2009

The table[9] above presents the percentage of English and French speakers in a selection of countries. In Nigeria over half the population speaks English, but it still leaves a sizable group who do not. However, in the other countries, English is spoken by less than a quarter of the population, with Tanzania even below ten percent. In

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9 Unfortunately, more recent surveys are not available, due the young demographic of these countries it is to be expected that current numbers are somewhat higher.

Senegal about ten percent of the population speaks the government working language of French. Yet of these countries, only Rwanda and Tanzania's government websites include (partial) translations to the other spoken languages.[10]

By way of contrast, in some other regions the government languages are generally spoken as the native language by most citizens (in Asia/Pacific, Latin America, the Middle East, and North Africa). As such, a greater amount of content is automatically made available. The language disparity in Sub-Saharan Africa would be expected to present a barrier particularly as Internet adoption attempts to spread beyond the initial high-income demographic, who can afford access and are likely to be familiar with the government language.[11]

An increasingly common way to access the Internet is now by mobile Internet, using a smartphone, and as can be seen from the graph below, the probability of being a smartphone owner is much higher for English speakers in a selection of African countries. This is surprisingly true even in Senegal, where the percentage of non-English readers owning smartphones is almost the same as that of the other Anglophone countries, even though the Francophone population could engage with French language content. This seems to suggest that the ability to read English is an important driver of smartphone adoption, and that a push in non-English content availability is needed to increase adoption.

Likelihood of Smartphone Ownership by English Reading Ability
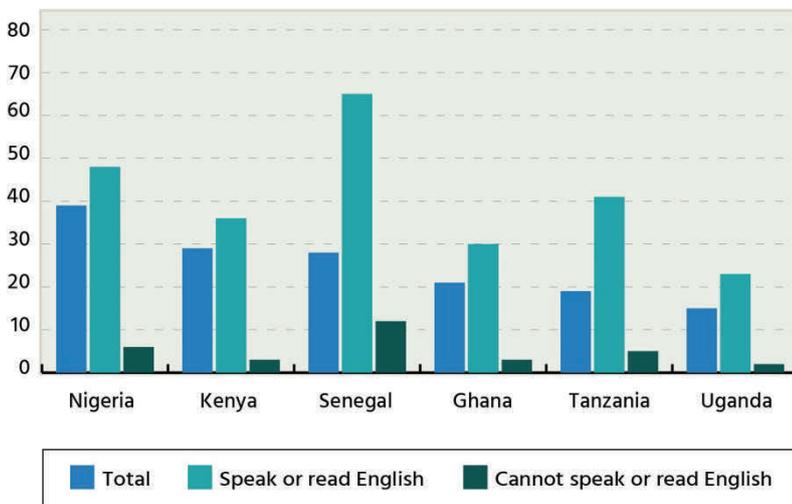
Sources: PEW Research: Spring 2014 Global Attitudes Survey.

source[12]

Social media provides one source of relevant content for non-English speakers. One reason for this could be that social media, such as Facebook and WhatsApp, rely to a large extent on their users to generate the content that is consumed by other users. Since user-generated content is necessarily localised and often in the local language

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10 In addition to this, in many cases the local language is not available as a system language on mobile phones - the primary method of Internet access - which means that even localised website cannot see the language preference and will default to English.
11 https://www.cia.gov/library/publications/the-world-factbook/fields/2098.html
12 See http://www.pewglobal.org/2015/04/15/cell-phones-in-africa-communication-lifeline/

(even when the interface language might not be), Internet users do engage with content to an extent similar to that of other Internet users. This is supported by recent evidence from a PEW study which finds that: "Internet Users in Emerging World are more frequent users of social networks compared with U.S. and Europe".[13]

For example, South Africa[14] has been the country with a highest proportion of WhatsApp users (of the adult population) worldwide for several years.[15] The median number of WhatsApp users in Sub-Saharan Africa is 76%, where in the US and Europe those figures are only 71% and 65% respectively. Since social media communication can take place in any language, it does not suffer from a lack of local content, as compared to other platforms, such as websites that must be made available in the local language(s).

These language issues come in various gradations. Firstly, there is a bias towards the English language. In historically French-speaking countries, there is generally a smaller proportion of the population that can speak English. However, even in historically English speaking countries, a large part of the population will not be able to speak English fluently. What is more, even those who are English speakers might not have adequate experience in reading and writing English, which is the primary way of communicating in a language online.

We therefore need an approach that can accommodate all of these issues as much as possible. A crucial way of doing so, is by firstly making sure that as much content as possible is made available in local languages. In addition to this, interfaces such as apps should be able to use icons that users can interpret, even when they are not literate. Furthermore, Internet usage amongst the illiterate can also be stimulated by an added focus on audio and video communication, though of course these forms of communication do come at a greater cost in terms of bandwidth.

In addition to the lack of locally relevant content, there is often limited infrastructure to make the content readily available. We show below in the following section that the limited infrastructure is another impediment to the growth of local-language content. This vicious circle of a lack of locally relevant content and a limited infrastructure needs to be broken. The existence of large amounts of existing English language content, however, can help to create scale for content infrastructure. With a more developed content infrastructure in place, this can in turn facilitate the further growth of local language content.

Distribution Platforms

Once content or services are created, they must be found by users. For this, a number of large platforms have arisen that make content easier to create and distribute for the creator and easier to find and access for the end-user. This is true for user-generated content, such as videos that can be made available through YouTube, social content available through Facebook, WhatsApp, or Twitter, and also professional content that can be made available through platforms such as Netflix for video.

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13 http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/
14 South Africa also uses English as a working language, but this is the vernacular language for only a small part of the population, the vast majority speak local languages of Afrikaans (west-Germanic)
15 http://www.globalwebindex.net/blog/top-markets-for-whatsapp-snapchat-and-wechat

Websites offering content and services directly do not necessarily need a platform as they can be discovered through web searches, direct links, and word of mouth. Increasingly, however, Internet usage is moving to mobile apps, which is particularly true in many emerging markets where users access the Internet mostly or exclusively via the mobile Internet. Mobile apps are available through app store platforms such as Google Play (for Android) and the Apple App Store (for iOS).[16],

Platform Types

The platform availability depends largely on the type of content distributed. We will examine three separate categories, noting in advance that there are some overlaps and the categories are not mutually exclusive.

User-generated content

Platforms such as YouTube, Facebook, and WhatsApp are widely available across countries, and are often very popular and locally relevant, given that the content is generated by other users, who may be neighbours, friends, colleagues, or others with similar interests in the same region. Some of the content is effectively broadcast – that is available to a large group of users or all users of the platform – while other elements of the content are messages from one user to another. These platforms have the advantage of not having to secure content rights, as platforms with professional content need to do, as described below.[17] These platforms can also help bridge the structural gap between different language groups, by adding supporting for posting messages in multiple languages. Depending on the user-defined language settings, each user can view the same item in their preferred language, such as Swahili. An example of this is Facebook[18].

On the other hand, user-generated content can generate concerns with respect to religious, political, cultural, or other sensitivities that can lead to individual pieces of content, or the entire platform, being banned from a country. Given that the platform may not be able to screen in advance any or all of the content that is made available by users, the question of who is responsible for any violations of content laws in a country is often raised, an issue that is referred to as intermediary liability, which we will go into later in this chapter. These concerns are not fully shared with platforms that present professional content, as they choose what content is and is not made available in a country, accounting for national laws and sensitivities.[19]

Although user-generated content is generally made available for free, platforms that host user-generated content must be able to at least cover their costs, as well as earning a return on their investment. A popular way to offer the content at no charge to users is to focus on advertisements as a means of monetisation. This raises additional requirements, since advertising can only be profitable if there is a substantial base of companies in the country who are online and willing to advertise. While international platforms can expand into a country on the basis of their global

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16 Depending on the country, app stores (or in the case of Apple, iTunes) offers professional content including TV shows, movies, magazines, and books.

17 We note that YouTube and other platforms with user-generated content may also provide professional content, but here focus on their role in providing a platform for users to upload content that is then made available to other users.

18 https://www.facebook.com/help/181155025579876

19 Of course, these platforms may still misinterpret a content law or be subject to subjective enforcement with respect to content that they choose to make available.

returns, and may bring in some international advertisers, monetisation is a greater challenge for local platforms for which the local market is their main source of revenue.

Another issue that user-generated content faces is the popularity in Sub-Saharan Africa of using a mobile phone as the primary means to access the Internet. This is different from many developed countries, where Internet access via a desktop computer or laptop is more popular. A key difference between these two is that while smartphones are very well designed for content consumption and simple interactions, there is a limited amount of content generation that can be done on a smartphone, as compared to a full computer. For instance, users might film video or write a brief Facebook post on a smartphone keyboard, but the limitations of this keyboard means that they are much less able to write lengthier text such as a news article or an in-depth discussion in a Medium blog post, much less coding a new website or platform.

Luckily, this shortcoming has not escaped the attention of some software vendors. The South African vendor Canonical produces a version of the Linux operating system called Ubuntu, which is already popular on desktops in many countries in Sub-Saharan Africa. In order to capture the mobile-first users, they have added a feature called Convergence that can instantly switch the smartphone to a desktop interface, when connected to an external display and keyboard. Microsoft is trying to achieve something similar with a feature called Continuum on its Lumia phones, using a screen and keyboard adapter called the display dock.[20] Hopefully, this will help increase the amount of user-generated content.

Professional content

Platforms with professional content, such as Netflix, Spotify, and blogger, bring with them their own issues. Professional content platforms share certain constraints with user-generated content platforms, most notably with respect to the distribution of sensitive content. Although we note that professional platforms typically have control over third-party content, since they license it and make it available themselves, unlike the user-generated content which may not all be screened before being made available.

The primary difference with user-generated content is that professional content must be licensed for distribution in each country before it is made available. Depending on the type of content being offered, this can sometimes be accomplished in global licensing agreements, such as for most music content. Otherwise, with video such as with films and TV shows, this is generally done on a country-by-country or regional basis, which makes global expansions —such as the Netflix one described in the box— problematic.

In addition to this, there needs to be a way to monetise the distribution of the content. Unlike with user-generated content, the professional platforms typically have higher costs associated with them, in no small part as a result of licensing costs. As a result, monetisation through advertising may not generate sufficient revenue,

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20 https://www.microsoft.com/en/mobile/accessory/hd-500/

which means that payments for content would be needed, requiring a payment mechanism, as discussed in detail below.

If these platforms provide access to media such as video that requires significant bandwidth, the platform will also rely heavily on a distribution platform such as a content delivery network (CDN), described below.

Netflix 2016 Global Expansion

In 2016, Netflix expanded from initially targeting most developed countries, to being available in almost all countries. Because of its global nature, Netflix generally tries to engage in worldwide licensing agreements. As a rule, however, certain content producers prefer to grant exclusive licenses to each country's market leader (e.g. Sky in the UK, Canal+ in France, etc.), resulting in higher revenues than non-exclusive global licensing deals would provide. As a result, the availability of content on Netflix can be limited in certain countries.

As an alternative to this, Netflix develops original content, for which no licencing is needed. This includes many popular TV shows such as "House of Cards" and "Orange is the New Black". In 2016 Netflix has budgeted 6 billion USD for original content.

A professional content approach that has seen its emergence primarily in developing countries is the use of chatbots on messaging platforms.[21] These allow users to interactively communicate with a platform and sometimes with other users via the platform, receiving information such as the weather or local news, or updates from other users. The infrastructure requirements for setting up such a platform are extremely minimal, and platforms such Facebook (through both Messenger and WhatsApp) and Telegram are creating special APIs and facilities for developers to easily set up these bots. The bots can provide professional content such those mentioned above, but can also act as intermediaries between two unfamiliar parties, for instance in an online second-hand goods marketplace.

App Stores

Given the popularity of the mobile Internet, and the predominance of use, app store availability is increasingly important for Internet content. App stores can carry both professional content, including apps (but also movies, TV, and books), and also user-generated apps. However, the story in many emerging countries is discouraging, as app stores may not be fully, or even partially, available in every country.

For instance, Google Play is not available in every country in Sub-Saharan Africa, and even where it is available, not all options are available. For instance, in some countries users can only download free apps, and in some other countries developers can only upload free apps. Only in Nigeria can users buy and sell apps the way they can in most developed countries. In particular, only in Nigeria can developers create and sell apps to the global market, allowing them to earn from their creations. This appears to be an issue with international payments, which has a wide impact on the ability to monetise services in emerging countries.[22]

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21 http://qz.com/390475/in-the-siberian-province-of-yakutia-whatsapp-is-basically-the-Internet/ and http://secretmag.ru/articles/2015/04/21/whatsapp_yakutsk/
22 "The Mobile App Divide", http://www.Internetsociety.org/doc/discussion-paper-mobile-app-divide

Legal Considerations

As noted in the previous sub-section, content creates legal, cultural, political, or security challenges in some countries that may limit or block the availability of individual pieces of content or entire platforms at times.

Content blocking and filtering

A number of countries impose restrictions on content based on religious, political, and cultural sensitivities as well as national security issues. Such restrictions predate the Internet, of course, but these have also been applied online since then, especially after Internet usage became more widespread. Online legal restrictions are legal bans on displaying certain content, which typically include penalties for violators. Legal restrictions may be implemented with technical restrictions, as described below. Both the legal and technical aspects of a ban are likely lead to the blocking of content that was not primarily targeted.[23]

With respect to the legal aspect of a ban on content, it may be difficult to interpret what does and what does not qualify as a violation of any ban, especially when definitions are vague. The resulting internalised self-censorship is likely to lead people to err on the side of caution, particularly for those living in a country and subject to its laws and any repercussions. It is important for governments and lawmakers to understand the adverse effects of any such uncertainty.

It is also worth noting that attempts to limit access to content, especially when it concerns a specific item, often backfire through what is known as the Streisand Effect, discussed in the box below.

The Streisand Effect
The Streisand Effect - named after entertainer Barbra Streisand - occurs when the attempt to censor a piece of information draws further attention to that piece of information, thereby doing more damage to the would-be censor than the information would have done had it been left unmentioned.

In the event that gave name to the effect, Barbra Streisand sued the California Coastal Records Project, attempting to have them remove photos of her Malibu cliffside mansion, in order to prevent Internet users from seeing these. The lawsuit attracted much more attention to the photos than otherwise would have been the case.

A similar incident occurred when the French domestic intelligence agency *Direction Centrale du Renseignement Intérieur* forced a French Wikipedia administrator to delete an article about the French military radio station Pierre-sur-Haute. The attention drawn to this led to the restoration of the article (from Switzerland)[24] as well as the translation of an otherwise insignificant article to— at the time of writing—34 other languages, including Chinese and Arabic, to which it otherwise presumably would not have been translated.[25]

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23 Internet Society Perspectives on Domain Name System (DNS) Filtering.
https://www.internetsociety.org/sites/default/files/Perspectives%20on%20Domain%20Name%20System%20Filtering-en.pdf
24 https://fr.wikipedia.org/wiki/Station_hertzienne_militaire_de_Pierre-sur-Haute
25 http://www.economist.com/blogs/economist-explains/2013/04/economist-explains-what-streisand-effect

Further, in some countries, the use of lèse-majesté laws makes it a criminal offense to offend a head of state. As a result of this, content is sometimes censored. Yet the news of this censoring, even if successfully suppressed domestically, inevitably draws more attention to it internationally where the content is still available.

To help enforce legal restrictions and possibly avoid the Streisand effect, technical restrictions may be imposed, which seek to prevent the censored content from being viewed. Technical restrictions are often by nature blunt tools, however, which makes it hard to consistently block targeted content without also filtering out untargeted content. For instance, DNS blocking works by stopping the domain name system (DNS) from returning the valid IP address corresponding to a restricted website domain name. As a result, the censored content is not displayed. However, the rest of the website is not displayed as well, raising the issue that certain large websites such as YouTube may only have a very small amount of content in violation, but are blocked as a whole.

In addition to this, it is relatively easy to find a way to circumvent this approach. If an Internet user knows the IP address of the server, it is still possible to visit the website by typing the IP address instead of the URL into the browser, which circumvents the DNS and thus any blocking of the website name. As a result, any and all articles describing this circumvention and/or providing the underlying IP addresses might also be blocked, quickly escalating the amount of banned content.

Intermediary Liability

While content restrictions are largely aimed at the creators or direct distributors of content, they are also relevant to platforms such as ISPs, social media platforms, and search engines that carry user-generated content. These platforms may be subject to what is known as intermediary liability. Since platform intermediaries do not directly develop the content, the question of liability is different, and some countries exempt platforms from liability for content uploaded by users.[26]

Where intermediaries are liable, the repercussions of a possible violation can include arresting and charging company executives, as Italy did with YouTube executives[27] and more recently Brazil did with a WhatsApp executive, which also led to a blocking of service that impacted many users as a result of WhatsApp not cooperating with a government request for information pertaining to a user.[28] Such actions can significantly reduce investment in a country's Internet ecosystem by companies unwilling to risk their executives' freedom.

In order for innovation and content creation to fully thrive, an exclusion from intermediary liability is crucial. This avoids the need for platforms to mediate types of content and allows them to build robust platforms, in exchange for removing offending content when presented with a request from an agreed authority.

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26 http://unesdoc.unesco.org/images/0023/002311/231162e.pdf
27 https://www.theguardian.com/technology/2010/feb/24/google-video-italy-privacy-convictions
28 http://fortune.com/2016/03/01/brazil-facebook-arrest/

Monetisation Platforms and Methods

In addition to the legal considerations discussed above, content availability is largely dependent on the means for the platform to be paid for their content. Broadly speaking, platforms tend to either sell services directly to end users (through a subscription or per-unit pricing) or are able to provide the services without an end-user charge through advertising.[29] Both means of monetization require a means for buyers to pay for the service, and a means to distribute the revenues to the developers.

Payments

A key problem with content monetisation in Sub-Saharan Africa is affordability, with many potential users not having the disposable income to pay a fee for content or an app. However, even when users are able and willing to pay for content or for an app, the lack of a payment mechanism, such as credit cards, means that it is hard for large platforms to add an effective payment method.

App stores typically offer a very convenient way to pay, and be paid, for apps and other content, however that is not always possible. First, in many Sub-Saharan countries the app stores do not allow access to paid apps, restricting the value of this marketplace for users. This issue is aggravated by the fact that it is even more difficult for developers to sell their apps. For example, as already discussed, on the Google Play Store, developers in only one Sub-Saharan country— Nigeria—can actually sell apps. This significantly restricts the ability of developers to monetise their apps.[30]

One potential solution is a partnership between the app store operator (e.g. Apple / Google) and the mobile phone provider, where the latter acts as a payment collector for the former. Unfortunately, this often is most commonly available with post-paid subscriptions, which are relatively rare in Africa.[31]

One underutilised mechanism that could help solve the issue on the supply side is gift cards. Gift cards allows people to add credit to their Google or Apple accounts, without needing a credit card or other form of electronic money. This would allow users to purchase content on two very large platforms (or ecosystems) that are especially relevant to Sub-Saharan Africa as they are built into almost all smartphones. Surprisingly, these systems that work with cash payments are generally only available in developed countries,[32] although Google has made a first foray into this by introducing its Gift Cards as prepaid cards in India.[33]

Additionally, a straightforward method of creating a marketplace would be to introduce a method for users of app stores to transfer credit between themselves. This would allow an app developer to transfer his credit to a user looking to buy an app, in return for a cash payment. This is similar to existing systems in Sub-Saharan Africa for transferring mobile phone credits, which are used in many countries as a payment mechanism.

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29 There are, of course, hybrids that subsist with both.
30 https://support.google.com/googleplay/android-developer/table/3539140
31 http://www.statista.com/statistics/220714/prepaid-and-postpaid-connection-share-in-africa-by-country/
32 https://support.google.com/googleplay/answer/3422734
33 http://googleindia.blogspot.com/2015/06/google-play-prepaid-vouchers-now.html

Online payment mechanisms such as PayPal are expanding into Sub-Saharan Africa, including the recent addition of Nigeria[34] that provides pay-out possibilities from the US to large numbers of potential new users in Sub-Saharan Africa. Unfortunately, the final link of this payment system can again be problematic, with credit being added to a user's PayPal account, but with only limited options for converting this into liquid assets, such as a bank account, or conversion to a credit card. Purchases are also difficult, however, even with liquid assets available. Prepaid credit cards could be used directly for purchases. While they add an extra step when compared to prepaid app store cards, they do allow flexibility, as users can spend their credit through a variety of platforms.

In any case, it appears that there are two issues that need to be addressed to create online marketplaces that enable developers to monetise their content if they so choose. First, a local payment system must be developed in order for users to purchase and for the developers to receive the payments.[35] Second, it appears that international financial integration must occur to enable developers to sell things outside the country and receive the payments online. As noted below, payment issues extend to other facets of developing local content, including fundraising.

Advertising

Advertising platforms on either apps or websites generally allow anyone to create an account and charge advertisers to include ads with their content. However, there are several problems. Advertising may raise its own set of language issues, and requires a large base of advertisers. Second, even if the advertising can be generated, as with other forms of monetisation, the payout to the content owner or platform can be problematic.

Surprisingly, the language that can be used in advertisements on most major platforms are restricted. For instance, Google has three major advertising platforms that developers can use to monetise their content: AdSense, which places textual ads; DoubleClick which is primarily for banners; and Admob, which places ads in Android apps. For all these three platforms the supported languages are mostly European, as well as Arabic, Hebrew and a few Asian languages. Not a single Sub-Saharan African language is supported.[36]

As a result, websites that target speakers of a Sub-Saharan African language, such as Swahili, cannot choose to include advertisements in Swahili. This situation is aggravated by the fact that the terms and conditions explicitly do not allow including advertisements that are not in the same language as most of the content on the page. This means that a Swahili-language website cannot even include English language advertisements, which – although of perhaps limited relevance – might have brought in some revenue.

Where major advertising platforms such as Google's AdSense are available, local businesses are an obvious source of relevant ads (and resulting revenue), however

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34 http://www.forbes.com/sites/mfonobongnsehe/2014/06/17/paypal-extends-payment-services-to-nigeria-9-other-countries/#e83fe333d0bf

35 In many countries, there is potential for a link between the existing mobile banking systems and such a payment platform.

36 AdSense: https://support.google.com/adsense/answer/9727?hl=en; DoubeClick: https://support.google.com/adxseller/answer/2561535?hl=en; Admob: https://support.google.com/admob/answer/2784738?hl=en

local businesses tend to have a low online presence. As a result, the ads may not be very relevant, causing them to generate fewer clicks,[37] and thus ads are not generating optimal revenue. This is a vicious cycle—with few users, few businesses might be convinced of the need for an online presence, making the market for locally relevant advertising smaller, which in turn inhibits further development of local content for users.

Even if there were relevant ads, it is still difficult to receive payments from advertising. For instance, the above-mentioned lack of a payout mechanism on app stores extends to other monetisation methods such as in-app advertising. In countries where it is not possible to charge users for an app, developers would still be able to monetise content through advertising, which can generate revenue, but they cannot receive this revenue, due to lack of a payout system.

In addition to issues of general relevance of advertisements, large heterogeneous countries such as Nigeria also have further difficulties with respect to targeting the right audience even with local advertisements. The addressing of this issue is generally referred to as "Multicultural Marketing". This field that was originally developed for international marketing, but with some of its methods are also relevant within large domestic markets such as Nigeria[38], addressing differences in cultural referents such as language, traditions, and religion.

While the challenges of monetisation are daunting for all content developers and platforms, they may be particularly so for local content developers, who do not have economies of scale and international markets that can help cover their costs. We now turn to the additional challenges facing such local developers.

Local Content Development

The lack of local content means that there are great opportunities for local entrepreneurs and other content creators to step in and address this need. Especially for local developers of content, this also may create new sources of income. At the same time as providing developers with income, local content can help to address local needs for information, coordination, entertainment, and other Internet services, through apps and websites.

Local developers have several advantages with respect to local content. First, they know the local market and information needs. Second, they know about existing channels and methods of communication, as well as cultural referents, allowing them to best target the local market. The iCow app described in the box is a good example of the utilisation of these advantages.

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37 http://www.oafrica.com/business/africa-should-want-its-own-ad-networks/

38 "Multicultural marketing is the marketing discipline of communicating towards people with a different cultural history than the country they're living in." from http://joinville.se/wp-content/uploads/2014/12/article-5-things-multicultural-marketing.pdf

iCow

iCow is an SMS-based phone application for small-scale dairy farmers in Kenya, developed by local farmer Su Kahumb, who wished to address the problems of her neighbours herding cattle, despite the fact that she had no previous experience developing apps.

The app helps farmers by giving them tips on issues such as breeding, nutrition and milk production, which can help increase revenues. The messages with these tips cost about 10 Kenyan shillings each, which is roughly USD 0.10.[39] While starting using SMS, the service is migrating to mobile apps.

Apps such as these create immediate relevance for users in places where the relevance of Internet services was previously perhaps not always apparent. They also migrate users to smartphones, opening up other potential channels for relevant content.

However, unlike international content, which is developed at a large scale and targets many markets at the same time, the local content developer may just target the home market, at least at the start. As a result of this, it is crucial for the local content developer to be able to monetise the resulting product. Local content development can benefit from the scale of large existing platforms such as the app stores. However, even with the availability of these platforms, local content would benefit from the legal clarity and monetisation mechanisms that were outlined above.

In addition to the challenges listed above, there are additional challenges facing creators of local content. The rise of smartphones in Sub-Saharan Africa, for instance, has also led to the closing down of local businesses, as a result of being overrun by global alternatives. A prominent example of this is the South African social network Mxit. Mxit was set-up to target the local market, and built instant messaging apps for many feature phones that were very popular. However, with the greater affordability of smartphones, many users switched to the more global instant messaging platforms such as WhatsApp.[40]

Other challenges for local developers relate to fundraising for innovation, and how to promote collaboration. Both issues are of interest, and we look at them in turn.

Fundraising

Startups everywhere need funds to create companies to implement their innovations. While there is a large base of venture capital and other investors in traditional technology clusters such as notably Silicon Valley, there is less tradition for this in developing regions. Lately, however, there is evidence of an increasing and encouraging amount of activity taking place in Africa.

One organisation aiming to create a network of entrepreneurs and investors is Venture Capital for Africa (VC4Africa), which recently put out a survey of their community.[41] The survey showed increased venture capital, with a focus on computer

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39 http://www.forbes.com/sites/mfonobongnsehe/2011/08/02/the-best-african-mobile-apps-icow/#1bf6a7001934
40 http://qz.com/531667/south-africas-social-network-loses-out-to-whatsapp-and-shuts-down/
41 See "2015 Venture Finance in Africa, the progress of early-stage high-potential growth companies:, by Venture Capital for Africa.

software, Internet and e-Commerce investments in Africa. Average investments in Africa were over USD 200K per investment, and while they came from international sources, they are more likely if a local investor was involved.

While the increase in venture capital is encouraging, it still lags behind more developed areas significantly. Nonetheless, the Internet is not just an interesting market for innovations, it is also becoming a solution for fundraising through crowdfunding, which uses the Internet to find and aggregate investors. This is making fundraising even more accessible, by drawing off a large international pool of small investors and matching them with promising entrepreneurs.

There are three typical models for crowdfunding sites: first, the investment is repaid in exchange for early and discounted access to the final product; second, the investor receives equity in the company; and third a debt model in which case the investor is repaid for their loan.

Kickstarter and Indiegogo are examples of crowdfunding models in which the investors are repaid with early and/or discounted access to the products. In effect, they are a means of bundling demand so that the entrepreneur has enough capital to begin production. For instance, one of the largest Kickstarter campaigns was for the Pebble, which arguably launched the smartwatch category. Pebble raised over USD 10 million, significantly more than its goal, before stopping the campaign. At that point, the company turned to using the revenue to move from prototypes to investing capital in production, a move enabled by the upfront payments of crowdfunding.[42]

In addition, equity crowdfunding campaigns or Angel Networks, on platforms such as AngelList, are becoming increasingly popular. In campaigns such as these, small investors are awarded a share of the future value of the company upon an exit or valuation after a number of years. Equity funding has a lot of potential, as it encourages investors who are not particularly interested in owning the result of the crowdfunding, but nevertheless feel that it might be a successful business idea. This would also help entrepreneurs that want to set up a service that is free anyway, such as a website, which they eventually intend to sell.

Other than equity funding, there are also several debt crowdfunding platforms, creating what are sometimes called P2P loans (Person To Person). These loans allow the investor to choose to contribute a loan at a certain interest rate. A popular platform that specifically targets developing countries is Kiva[43], although the loans tend to be fairly small.

However, these crowdfunding platforms all share the problems listed above under monetisation; namely that they do not operate in a particular country because of the challenges of receiving the income. In that regard, Kickstarter will take money from backers anywhere, but can only be used to raise money in a handful of countries in North America and Europe.[44] Indiegogo, on the other hand, appears to allow entrepreneurs to raise money in virtually any country; as the capital payouts are

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42 https://www.kickstarter.com/projects/597507018/pebble-e-paper-watch-for-iphone-and-android/description
43 https://www.kiva.org/about
44 https://www.kickstarter.com/help/faq/creator+questions

infrequent and relatively large amounts, it appears feasible to find a customised solution to the payment conundrum.[45]

Innovation Hubs

We finally turn to another ingredient that is often key for successful entrepreneurs, and that is collaboration. The Internet opens new opportunities for entrepreneurs anywhere in the world, who do not necessarily need to be in a traditional hi-tech cluster such as Silicon Valley, but rather can innovate, raise money, and sell their content or services from any location with an Internet connection. However, there is still evidence that in-person interactions can make a difference.

In recent years many Sub-Saharan countries have seen the emergence of at least one innovation hub. The combination of the virtually endless possibilities for online businesses with the possibility of starting a business with relatively small upfront investments[46] means that many of the projects taking place at these innovation hubs are Internet oriented. For instance, the Kenyan innovation hub, called iHub[47], describes itself as a technology innovation community. However, even other hubs such as Rwanda's Impact Hub, when not explicitly targeting ICT innovation, still tend to focus on this sector.[48]

Innovation hubs fulfil several different roles at the same time. Primarily, they provide workspaces for entrepreneurs to develop their products or services. These workspaces come fully equipped with furniture and services such as Internet access, security, cleaning, etc. which leaves the entrepreneur more time to focus on their product. In its 2016 World Development Report entitled *Digital Dividends*, the World Bank finds that there are currently 117 innovation hubs in Africa, a number which is expected to rise even further.

The other focus of an innovation hub is collaboration. Typically, the workspaces are arranged in an open floor plan. The idea behind this is that entrepreneurs see each other's products and services, discover new tools, and come up with new ideas. They can also meet other employees or employers, investors, and potential customers, all personal interactions that cannot always be easily duplicated online.

Innovation hubs play a particularly important role in the fundraising process. As this process is much less formalised in Sub-Saharan countries than it is, for example, in the United States, having a single physical focal point helps navigate some of the problems surrounding the nascent nature of fundraising in Sub-Saharan African countries, and enables often crucial face-to-face meetings between investors and entrepreneurs.[49]

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45 https://www.indiegogo.com/about/terms. The exception is countries under US trade embargo.
46 http://www.wsj.com/articles/SB10001424052748703720504575376664285510930 and http://money.howstuffworks.com/online-businesses-lower-startup-costs.htm
47 https://www.ihub.co.ke/about
48 http://africa.impacthub.net/2015/07/31/impact-hub-kigali-launches/i
49 World Development Report 2016: Box 4.3 p. 229 and http://research.ihub.co.ke/uploads/2013/may/1367840837__923.pdf chapter 3

Summary

The lack of local content limits the interest of potential users. This problem primarily manifests itself in two forms: on the one hand international content is not sufficiently available or relevant, on the other hand, there is insufficient creation of local relevant content. Two major issues are content restrictions and payment mechanisms.

Content must be in familiar languages, which is often an issue in Sub-Saharan countries whose populations are not always comfortable in the official government language. While one might assume that this mainly impacts international content, it is also true for local content, including e-government services, as not everyone speaks the government language. Content availability may further be limited by restrictions on content that impact the willingness of international providers to make content available in a country, along with local developers who may self-censor their output to keep in line with legal restrictions.

At the same time, payment mechanisms are critical for both international and locally developed content. With a lack of a payment mechanism, users may not be able to purchase content, and even if they could, the developer may not be able to receive the payments. Such restrictions extend further to an ability to receive payments for advertising and raise funds to develop new innovations.

Coming full circle, the problems with advertising payouts are further aggravated by the fact that most major advertising platforms do not support any African languages (except Arabic), furthermore, in some cases even the placing of ads in a supported language (such as English or French) on pages that are primarily in a different languages (e.g. Swahili) is expressly forbidden.

These problems are exacerbated by a lack of local infrastructure to make whatever content is developed easy to access, as described in the next section.

Content Infrastructure

In addition to having locally relevant content developed, it is also important to make the content locally accessible. In the current situation, many African websites are hosted abroad, often in the US or in Europe, where hosting is relatively cheap due to large scale and low cost inputs (such as electricity). By moving websites locally into the country of the target audience, webmasters may incur higher hosting costs. Yet these extra hosting costs are relatively small compared to the costs to the ISPs of continuously downloading website data over submarine cables from a host in the US or Europe to the local target audience. As a result, local hosting can remove two types of costs, with significant benefits for the local ecosystem.

First, having the website hosted overseas means that for each and every time that it is downloaded, it has to be transmitted over submarine cables. This typically results in a loading time of around 300-400 MS (just under half a second). The result for the owner of the website is that while the cost of hosting the website is lower abroad, the loading time for the visitors is much longer. This typically translates into a combination of several negative effects, such as lower retention rates, less time spent on the website, fewer pages visited, and fewer return visits. Hosting the content locally can reduce the loading time to around 10-20 MS, making it much easier for users to navigate content.

Second, an indirect effect of having to always transfer websites over submarine cables is that the costs for ISPs that provide access to end users goes up, since a greater share of their traffic will come over these cables, they will need to purchase greater capacity. The costs of this greater capacity are typically transferred on to the end user in the form of higher rates. These higher rates in turn, deter more people from getting Internet access, eventually lowering the number of potential visitors for website owners. Hosting the content locally can significantly lower the cost to ISPs.

While ISPs clearly benefit when content is hosted locally, as they no longer pay for transit, local websites also benefit, even if local hosting may cost more. As a result of hosting locally, latency is lower, with decreased bounce rates and resulting in increased user retention.[50] This can result in more page views, and greater ability to monetise content through advertising or payments (after the issues raised in the previous section are addressed).

A recent study that we did in Rwanda confirms that hosting content locally lowers the cost and latency of access, significantly increasing the usage. For instance, as shown in the study[51], when Akamai put a server in Rwanda, the throughput of their content went up significantly, and as a result usage doubled within a few months. Simply put, users like lower latency, and will use a website more if it loads fast.

Local content hosting requires its own infrastructure, however. Some of this infrastructure overlaps with the infrastructure needed to deliver Internet access, such as national and metro backhaul. In addition, data centres are required to host the content. Within the data centres, content delivery networks (CDNs) often distribute international content, while hosting providers will often take care of domestic

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50 https://blog.kissmetrics.com/loading-time/
51 https://www.internetsociety.org/news/local-internet-hosting-opportunities-key-furthering-internet-development-emerging-economies

content. Finally, a local Internet exchange point (IXP) is necessary to connect the ISPs to the content through local connections. It is possible that a data centre hosts ISP points of presence (PoPs), the content providers, and the IXP, making traffic exchange efficient and inexpensive.

There are challenges and roadblocks to varying degree at each stage of the value chain; the below sections discuss each part.

Carrier-Neutral Data Centres

Data centres are large rooms or buildings that provide a place for content providers, ISPs, and IXPs to put their equipment, and connect with each other and, through fibre connections, the entire Internet. The data centres must provide racks to hold the equipment, electricity to power the equipment, and air conditioning to keep from overheating. In addition, the data centre has staff available to keep the data centre running and help customers with any issues that arise, preferably at any hour of any day.

Access to fibre to connect to the Internet is critical for a data centre, so much so that the trend now is toward Carrier-Neutral Data Centres (CNDCs) (also known as Network Neutral Data Centres), which are data centres that enable Internet access through several competing fibre providers. This stands in contrast to a data centre owned by a carrier, for which there is no competition in providing access to the data centre. The greater competition in terms of prices and options means that CNDCs are a very popular choice. The competing connections may also be redundant, resulting in less down-time when there are individual cable outages.

As a result of this popularity, many telecom operators in highly competitive markets, such as Verizon in the US, are also converting their single-ISP Data Centres to Carrier Neutral Data Centres by allowing users access to third party network providers (while retaining ownership). As of yet, we are not aware of any such transformations with African data centres.[52] However, the CNDC market in Sub-Saharan Africa is starting to undergo growth, for instance, Kooba and Icolo.io have recently announced new CNDCs, both based in the Kenyan port city of Mombasa where the submarine cables land.

Since competition in Internet-connectivity is essential to CNDCs, these can only be built in locations that can provide access to several fibre-optic cables. Unfortunately, information on the locations of these cables is often unavailable, incomplete or outdated. As a result, the effective ability to build CNDCs is often— entirely unnecessarily— complicated, due to a lack of information. It would therefore be useful for local industry to improve the availability of information (such as with an Atlas of Passive Infrastructure[53]), allowing for easier growth in the CNDC market and providing more clientele to ISPs.

Access to fibre is not the only critical factor for a data centre—a second major issue is maintaining an uninterrupted power supply. While backup power can help overcome

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52 http://www.datacenterdynamics.com/servers-storage/verizon-converts-five-us-colos-to-carrier-neutral/87414.fullarticle
53 Schumann and Kende:
http://www.internetsociety.org/sites/default/files/Barriers%20to%20Internet%20in%20Africa%20Internet%20Society_0.pdf

unstable power supplies, this does of course come at a cost, in addition to the already high cost of power in many countries. Nonetheless, data centres in all countries need to engineer backup electricity supplies – some will just need to use it more than others, which increases the need for reliable power.

Training of professionals is important to help set up any data centre, as well as for future maintenance and troubleshooting. Fortunately, there are options, for instance through programmes such as Google's Digify Africa[54] that provides free training in IT skills to interested people in Nigeria and in Kenya, as well as fully online courses such as those offered by Cisco.[55]

A further problem for setting up data centres is uncertain or vague regulatory environments. Through interviews we learned that in several Sub-Saharan African countries, the regulations are lacking, or are in a bad state, such that they create a disproportionate amount of liability for the data centre, thereby inhibiting or blocking the starting of data centres in these countries.

In addition to helping remove these roadblocks, governments can promote data centres by using data centres for hosting for their own data (see the box "Government as an Anchor Tenant"). This helps to create a guaranteed demand, which may be sufficient to warrant investment in the data centre that will then be filled up with others clients.

> **Government as an Anchor Tenant**
>
> Data centres depend on scale, and low demand may be holding back construction. One solution is for the government to act as an anchor tenant, similar to a large department store anchoring the development of a shopping mall. Governments can provide the necessary stable income, which reduces the uncertainty for potential data centres, thereby helping to stimulate development.
>
> In some cases, the government prefers to build its own data centre, for which there can be good reasons. However, it is important to understand the opportunity costs of such a decision, since government-only data centres cannot help create a market the way the government can as an anchor tenant.

Local Content Delivery

Data centres such as the above-discussed CNDCs rely on a number of different types of clients including Content Delivery Networks (CDNs) and hosting providers. CDNs manage local copies of websites whose main point of hosting is elsewhere, while hosting providers host local websites, along with providing ancillary services. International content providers use a CDN to localise copies of the content in multiple countries, improving local loading times and thereby retention. Local websites that rely largely on their home market would not need a CDN to achieve this, they can simply move their hosting home to their target market.[56]

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54 http://digifyafrica.com/home/digifyafrica/
55 https://learningnetwork.cisco.com/community/connections/ccnp-training-route-switch-tshoot
56 In fact, often a local hosting provider bundles all their website clients together and hosts them abroad, and likewise can decide to instead host them locally.

Content Delivery Networks

Content Delivery Networks provide localised access to the popular content of client websites, which are primarily hosted elsewhere, but want to provide their visitors with faster loading times than those which are possible from the primary hosting location. Having CDNs in a local data centre improves loading times for clients of ISPs connected to the data centre (sometimes through an IXP).
CDNs face some similar legal issues to the other platforms and data centres described above—namely that they are hosting content that they do not create, and thus want clarity as to the liability for that content.

In interviews with CDN employees in several focus countries, customs was also mentioned as a problem to the running of a CDN. It can often take a long time to clear the importing of generally standard replacement computer parts. In some places the situation is problematic to the extent that even non mission-critical spare parts have to be kept inside the country, without actually being used. Considering the speed of technological development, and therefore write-offs, this can be costly, which again unnecessarily slows the rate of expansion for CDNs.

The aforementioned problem of a relative lack of experienced engineers is less pressing for clients of CNDCs, such as CDNs, since they typically need experienced staff only for setting up their facility, which can from then on be administered remotely. For CNDCs however, much of the work required is on-site.

Today the number of CDNs and the points of presence in Sub-Saharan Africa is limited, with most of them being placed in South Africa and some in Kenya and Nigeria. As noted above, Akamai recently placed a cache in Rwanda, with significant benefits in terms of increased download speeds and usage. Google is one of the more active companies in terms of hosting content locally, in caches as described in box.

Rwanda content hosting
As an illustration of this, in an ongoing project, Rwanda is hoping to move 10,000 websites from foreign hosting, to local hosting providers. An issue that emerged during the pilot phase of the project is that some of the systems that were migrated to new local hosting systems from very large North American providers is the lack of an email filter. Many of the system running are somewhat outdated and therefore have known vulnerabilities that are actively exploited by using these systems to distribute spam. The large hosting providers that previously hosted these systems took this into account and automatically filtered outgoing email for spam. The hosting systems that were set up in Rwanda, initially did not have such a filter and as a result, certain IP addresses were blacklisted by other providers. After setting up such an outgoing spam filter, the IP addresses were whitelisted again, after which the migration was successful.

Google Global Caches
Similar to CDNs, certain large content platforms create their own selective content delivery services. A well-known example of this is the Google Global Cache, which can provide localised access to any static content. In practice, the most demanding of static content is generally YouTube videos.

YouTube provides access to a very large number of videos. However, since anyone can upload content to YouTube, a great amount of this available content is not relevant to most users. Almost all YouTube views are generated by a very small number of highly popular videos.

In order to minimise loading times, as well as fees for long distance transmission of the same content, YouTube caches the most popular videos in a great many locations around the world, which allows for fast access to users. Global caches such as these fulfil a similar role as CDNs, improving loading times and eventually hopefully lowering the cost of Internet access to customers.

Local Solutions

Hosting providers generally offer a variety of services. At the lowest level, this means providing rackspace for a self-managed server. More managed solutions include a virtual private server, which provides similar functionality to a private server, at a lower cost. The most managed options are shared-server hosting of a website, or a platform such as Wordpress.

In Sub-Saharan Africa, many of the hosting services tend to be provided to local clients by local hosts, but are physically hosted abroad, often in the United States or in Europe. The cost of this hosting to the local developer is lower and this option is therefore preferred, despite the fact that this might adversely affect visits to the website. However, this ignores the benefits of local hosting as mentioned in the introduction of section 2, including better user retention and the eventual drop in cost of Internet access.

In order to host locally, the management of the server requires that qualified local engineers need to be available. It is often possible for webmasters to train themselves in many of the skills required for this, which in itself shows that the bar is fortunately relatively low. However, this does lead to the situation where many webmasters lack formal training, potentially causing them to miss out on some follow-ups beyond the setting up of the server, such as updating the system and checking for intrusions (see sidebar on Rwanda). Fortunately, a number of relevant courses are available fully online.

Nonetheless, local hosting providers recognize that they must address perceived or actual shortcomings in offerings compared with overseas competitors, in order to attract customers back from abroad and win new customers.

IXPs

An Internet exchange point (IXP) is widely recognised as a critical piece of local infrastructure. In general, the IXP makes traffic exchange more efficient, by enabling local interconnection between networks that are connected to the same IXP. This avoids having to exchange traffic outside the country, thereby lowering the cost of traffic exchange, since expensive international links are not required, while also lowering the latency of traffic exchange, since the local exchange is much closer to the local networks.[57]

The general benefits of an IXP extend to the specific case of local content hosting, as locally hosted content can be exchanged through the IXP to lower the cost and latency of accessing local content.[58] These benefits are apparent for local websites that are hosted locally, as well as for large caches of international content, such as the case of the Google Global Caches (see box above) that deliver popular YouTube videos locally. The content may be delivered indirectly through an ISP that is

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57 For more details on the impact of an IXP, see Kende, Michael and Charles Hurpy, "Assessment of the impact of IXPs: empirical study of Kenya and Nigeria," April 2012, ISOC paper, at
https://www.Internetsociety.org/sites/default/files/Assessment%20of%20the%20impact%20of%20Internet%20Exchange%20Points%20–%20empirical%20study%20of%20Kenya%20and%20Nigeria.pdf
58 For more details on the benefits of local content hosting, see Kende, Michael and Karen Rose, "Promoting local content hosting to develop the Internet ecosystem", January 2015, ISOC paper, at https://www.Internetsociety.org/news/local-Internet-hosting-opportunities-key-furthering-Internet-development-emerging-economies

connected to the IXP, or the content provider may connect directly to the IXP for traffic exchange.

Either way, the IXP is critical for delivering content locally. As discussed above, we have seen that when Google installed a cache in Kenya, or when Akamai installed a server in Rwanda, usage increased significantly, resulting in significantly more traffic through the IXP.[59] The main reason for the increase in usage is that latency decreases, which makes it easier for users to access the content and results in more usage. At the same time, ISPs no longer have to effectively 'import' that content from abroad over expensive international links, and thus save significant resources.

Countries with a well-functioning IXP are well placed to benefit from local data centres, CDNs, and hosting providers, who can provide the content that benefits from the IXP. On the other hand, countries that do not have an IXP, or only one that is rudimentary, should take steps to develop or strengthen their IXP as a first step to developing a local content infrastructure. The Internet Society has devoted significant resources to helping IXPs establish and grow, and more details can be found on our website.[60]

Mobile Requirements

Smartphones play a key part in Internet access in Sub-Saharan Africa, often being the primary means of connecting for users. We discuss a number of issues of Internet access through smartphones that are particularly important in Sub-Saharan Africa.

Placing content in local data centres helps to reduce costs significantly. However, as of today, most mobile data in emerging countries is charged according to usage, and does not differentiate between data that is sourced locally and what is sourced internationally. As a result, users tend to be very careful about how they use the Internet in order to minimise their expenses. Thus, along with locally hosting content, it is important to minimise the bandwidth of the content - this is true whether the content is viewed through a website or a mobile app.

The way the Internet is used in many Sub-Saharan African countries can be different from how it is used in the developed world. As often mentioned, the vast majority of content is consumed on smartphones.[61] Yet the way smartphones are used themselves is also different. Phones are often not switched on and the Internet connection is most certainly not, in order to save money on data and power.

If we consider for instance a news app, that requires constant refreshing to be relevant, this app would be able to vastly increase its usage by taking a few steps to adapt to the local environment.

First, it should be designed to work well when there is no active Internet connection, meaning that all parts of the app should be available offline. Most news apps will have the ability to save articles, however, in this case it would be preferable to save

59 See respectively Kende and Hurpy (2012) and Kende and Rose (2015).

60 See http://www.ixptoolkit.org for more details.

61 http://www.brookings.edu/blogs/future-development/posts/2015/03/18-africa-mobile-connectivity-handjiski Borko Handjiski and
http://qz.com/214307/mary-meeker-2014-Internet-trends-report-all-the-slides/ and
http://www.emarketer.com/Article/Internet-Users-Middle-East-Africa-Choose-Mobile-Access/1012695

all content that was downloaded at least for a certain period, allowing the user to revisit the article without downloading it again.

Second, it should not download information in the background. In many cases, news apps in the developed world will 'predict' which article(s) the user wants to read next and decrease loading time (to increase retention) by preloading these articles. In a context where data is charged by volume, this would be unnecessarily run up costs for the user, downloading articles that might not even be read.[62]

Third, since this app might be localised in English, French, and a local language, it would need a setting that would make it possible to switch to a different language from within the app. Many apps in Europe simply rely on the default language of the mobile OS to inform them which language they should display. Yet, unlike in Europe, not all local languages are included in the mobile OS in Africa, and these language preferences therefore cannot be used. For instance, in Senegal the news app might default to Wolof (spoken by about 80% of the population as a first or second language) or French, while at the same time providing the user with the option to manually switch the language to another language spoken in Senegal that might not be included in the mobile OS.

Lastly, as users are generally charged by the amount of data downloaded, content needs to be provided as efficiently as possible, using image and website compression when possible.[63]

There are some interesting examples of apps that have these features. Google built a public transport app for the Delhi public transport system that completely works offline, unlike its Google Maps app, where this functionality was originally included. This is taken even further by an app that mapped bus routes of Nairobi's Matatu bus line system.[64] Another good example is the Wikipedia app, which allows users to download articles in order to read them offline.

Finally, in order to lower the cost of access, some content providers are entering into arrangements with mobile operators to 'zero-rate', that is, to provide access to their content without data charges. Examples include Wikipedia Zero, allowing users to download Wikipedia content without being charged for the cost of the data, and Free Basics, offered by internet.org to allow access to a suite of content services including those of Facebook. The Internet Society position on such services is to welcome those that, by design and result, increase the number of users of the Internet and their usage of the entire range of content, and not just those in the zero-rating bundle.[65]

Summary

This chapter looked at the infrastructure needed to deliver content in Sub-Saharan Africa. Three key levels of infrastructure are discussed. First, Carrier-Neutral Data

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62 http://www.tomsguide.com/us/chrome-preloading-links-google-search,news-11537.html
63 Several browsers such as Chrome and Opera have data compression services (for non-https websites). If apps are built using HTML5, as many of these apps are, data can be compressed by chrome, these services can be used to save the user data charges. Otherwise image compression algorithms are also available to be used outside of these services.
64 https://medium.com/@transitapp/hello-nairobi-cc27bb5a73b7#.p4dh8py31
65 Internet Society Zero Rating Policy Brief forthcoming: http://www.internetsociety.org/policybriefs

Centres provide a location where servers can be securely operated and connected to several different carriers, creating a competitive market. Second, a CNDC can serve local hosting of content, but also international content through Content Delivery Networks. Third, in order to make sure no connections between content demand and supply are needlessly routed abroad, an Internet Exchange Point is needed to arrange local traffic flows.

The building of CNDCs can benefit from greater information about fibre routes, and clear legal frameworks describing the intermediary liability would remove a large risk factor. Governments can increase demand by acting as anchor tenants for new CNDCs. By hosting content locally with a CNDC, greater certainty about demand for CNDC services is provided.

Further, Content Delivery Networks and local hosting solutions both increase the amount of domestically available content. This lowers latency and means that ISPs need to purchase less capacity on submarine cables. Eventually, prices for Internet access could be reduced. In order to make sure that connections between content demand and supply are made domestically, a well-functioning Internet Exchange Point is critical.

Recommendations

Many countries in Sub-Saharan Africa are seeing that the growth of Internet adoption is not always keeping pace with the availability. Adoption levels are well below saturation levels, and this is in part caused by a lack of locally relevant and available content. There are a number of platform as well as infrastructural causes for this lack of content availability. This report discusses some of the key issues to local content development. Based on this discussion, we present a number of recommendations that can help promote content in Africa.

Relevant Content Availability

Language
- An increased focus on local language content can engage Sub-Saharan users in all aspects of the Internet, including websites.
- Governments can fulfil a leading role by making their websites available in the official national languages, leading by example.
- Platforms such as social media can provide support for posting items in multiple languages, allowing users and posters to interact more easily between languages.

Legal Considerations
- In order to limit the amount of content blocking and filtering, governments should be well informed about the adverse consequences and limited effectiveness of such policies.
- Clear frameworks for intermediary liability can help remove uncertainty for content platforms and even data centres.

Payments
Several solutions are needed for issue of payment for content.
- Availability of Gift or Prepaid Cards for app store credit allows users to purchase content such as apps using cash money.
- Payout to content developers for apps or ads on e.g. websites can be achieved using intermediaries such as Google, Facebook and Apple using a method whereby credit can be converted into currency.
- Transferring of app store credit could help solve the demand and supply side problems simultaneously, by allowing developers to transfer their earned credit in return for cash payments.
- Regardless of the means, we support seeking a solution that allow everyone to be able to buy and sell content, through websites or apps, in order to be able to monetise the development of local content.

Advertising
- Advertising can monetise services without the need for direct payments by users, however, currently there are no African languages that are supported by any major ad platform.
- Policies expressly forbidding advertising on websites where the content is in a non-supported language acts as a further barrier. Removing this restriction would allow websites to at least include advertisements in a supported language.

- In order to fully utilise the potential of advertising, advertising platforms should start supporting advertisements in African languages, so that effective targeting is made possible.

Innovation Hubs

- Innovation hubs can become a focal point for innovation, governments could help by providing some space or funding for the hub to be started.

Content Infrastructure

Carrier-Neutral Data Centres

- Carrier-Neutral Data Centre construction can benefit from greater transparency about the location of fibre-optic cables of possible connectivity providers, through the creation of an Atlas of Passive Infrastructure.
- Vague and bad regulatory environments deter the building of CNDCs, so creating a clear legal environment helps remove uncertainty.
- Governments can act as anchor tenants in CNDCs.

Local Content Delivery

- Local hosting lowers the capacity need of ISPs on submarine cable, eventually lowering the cost of Internet access to users.
- NOTE we need a recommendation here.

Internet Exchange Points

- In order to make sure content does not needlessly leave the country, a well-functioning IXP is critical.

Mobile Requirements

- Apps should be designed to function without Internet access, and also be able to store content offline for later viewing.
- Content delivery should be as efficient as possible, image and website compression can help with this.