Ideas for Liberia's Internet Ecosystem

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Executive Summary

This is a key moment for investment in and progressive policy toward the Internet in Liberia. The Africa Coast to Europe (ACE) project is expected to land within the next two years, bringing Liberia its first access to a submarine cable. Combined with low-cost, last-mile wireless solutions and the falling cost of Internet-enabled devices, the Internet has the potential to reach broad segments of the Liberian population.

Growth in Internet adoption is a key pillar of economic development and sustainable growth. A recent World Bank study found that a 10% change in broadband adoption is associated with a 1.38% increase in GDP per capita growth in developing countries (Qiang and Rossotto 45). Furthermore, access to the Internet enables improved human development outcomes through increased efficiency in the public and non-governmental sectors. In the absence of progressive policies and a competitive telecommunications market environment, however, regulatory and commercial landscapes can impede this development opportunity.

Section one of this paper provides background on the current Internet landscape in Liberia. Section two lays out best practices that Google has observed across developing markets that, if applied in Liberia, could accelerate the growth of its Internet ecosystem.

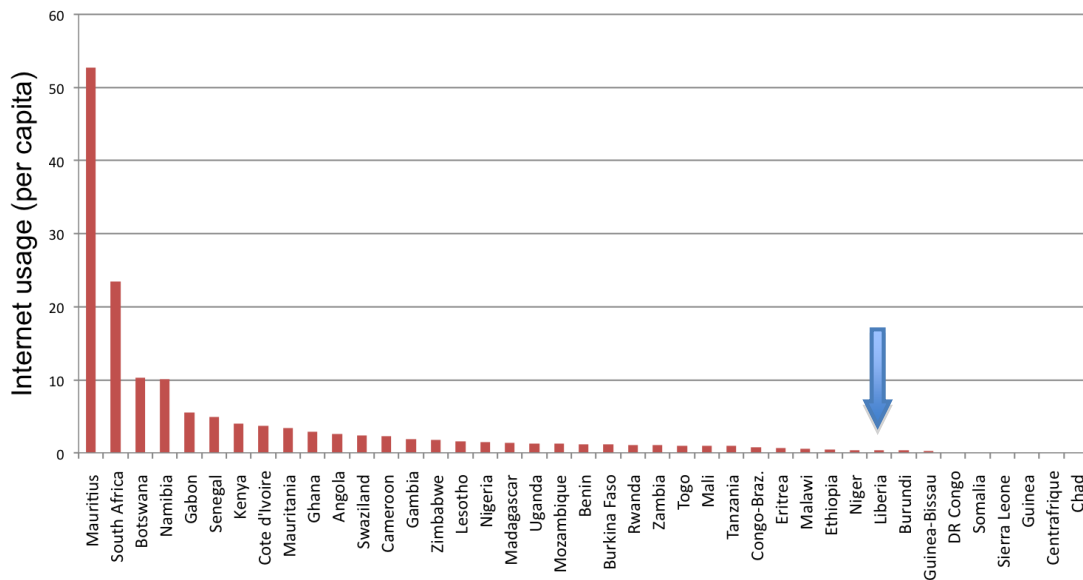Ideas appropriate for Liberia's state of development include:

- Establishing open access principles for connections to submarine cables and domestic backhaul networks.
- Creating an effective Internet Exchange Point and caching popular content and applications.
- Allowing open use of available WiFi spectrum.
- Implementing projects to foster the growth of user and developer communities.
- Getting public sector information online and making it easily accessible.

Current Internet Market Landscape in Liberia

A. Internet Traffic and Usage

Liberia has one of the lowest volumes of Internet traffic per capita in the world, and ranks in the bottom quintile within Africa (see Figure 1).
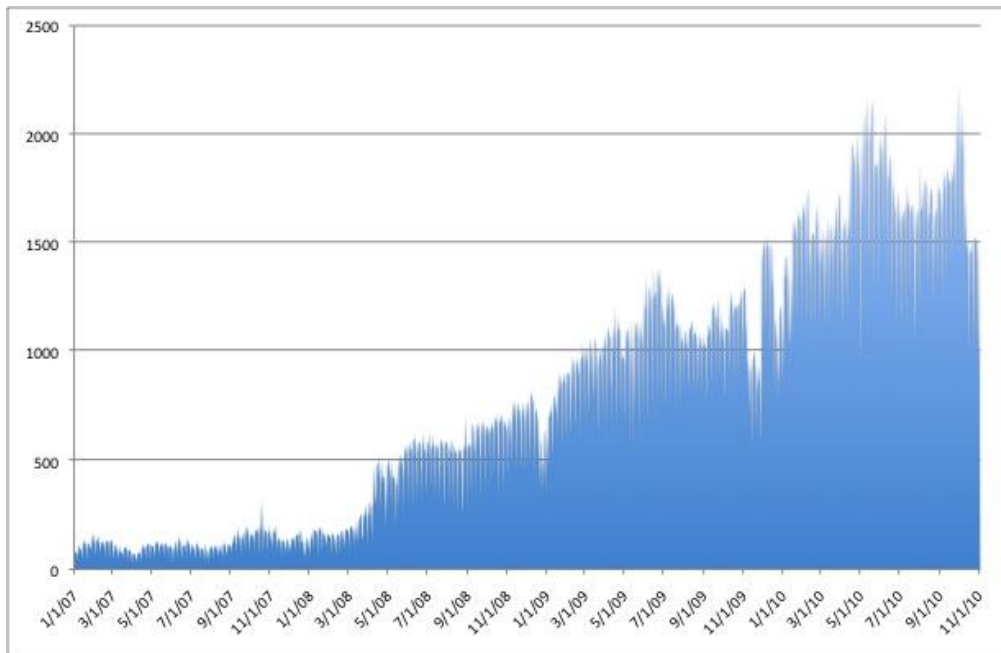
Figure 1: Google Internet Activity Per Capita (2010)

Note: This chart is based on traffic through a basket of Google services in 2010 and represent total Internet usage, not number of users. (Source: Internal Google data)

On a positive note, Internet usage has more than doubled in the past twelve months and grown fifteen times since 2007 (see Figure 2), aided by declining costs of devices and bandwidth.

Figure 2: Estimated Internet Usage in Liberia (2007-2010)

Note: This chart is based on traffic through a basket of Google services from 2007-2010 and represents total Internet usage, not number of users. Jan 2007 = base 100 (Source: Internal Google data)

Fewer than one percent of Liberians currently access the Internet (CIA World Factbook). The number of Internet hosts (an Internet host is a computer connected directly to the Internet) is also low—1 per 450,000 people (CIA World Factbook). Typically an Internet service provider's (ISP's) computer is a host, and Internet users connect either directly or remotely to the ISP's host computer, meaning that fewer hosts generally indicates less connectivity. The number of Internet hosts in a country does not typically include VSAT connections, which are prevalent in countries like Liberia.

Figure 3: Internet-Related Demographics of Liberia and Select African Countries

Country	Population	# of Internet Users	Internet penetration rate	# of Internet hosts
Liberia	3.6M	20,000	0.5%	8
Sierra Leone	5.2M	14,900	0.3%	281
Ghana	24.3M	1,297,000	5.3%	41,082
Kenya	40M	3,996,000	10%	47,676

Note: The number of Internet users is as of 2010, the number of Internet hosts is as of 2011.
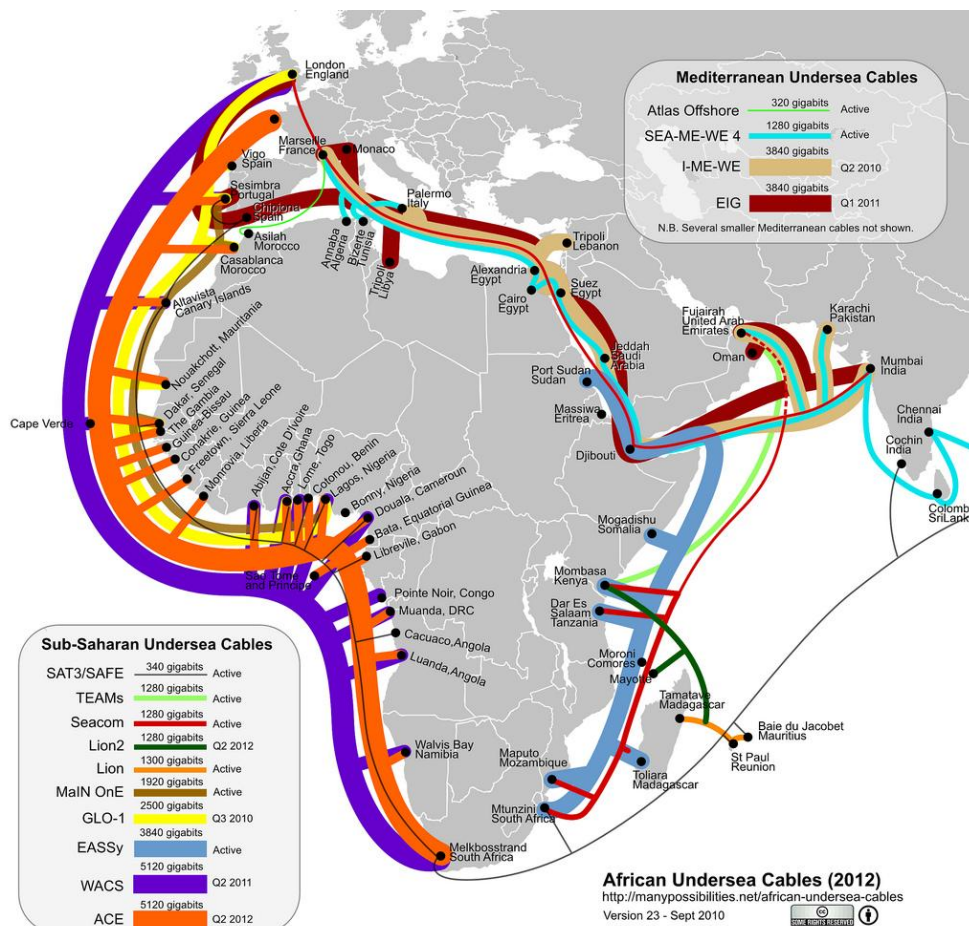Source: CIA World Factbook.

Universities, which have frequently been early adopters of the Internet, were decimated in Liberia during the civil war. The University of Liberia's newly constructed Fendell Campus has some network infrastructure, but may still have to solve gaps in its fiber backbone and device access.

B. Internet Service Providers and Mobile Operators

Mobile penetration in Liberia is 40%, or around 1.2 million people, with Lonestar (MTN) and Cellcom having the bulk of the subscribers (Various conversations with regulators and Liberian mobile operators). Libtelco, the government-owned telecommunications provider, has a few thousand fixed-line subscribers (Various conversations with regulators and Liberian mobile operators). Mobile operators are expanding to broadband, with plans for fiber networks, Internet cafes, and WiFi on their cell towers. No operator currently has a 3G network, although licenses have been granted. According to a representative of the Liberian Internet Association, there is a small, fragmented ISP market with roughly 2,500 subscriptions (Parker). Active fixed-line ISPs include Comium, Consolidated Group, ElectroShack, LibTelCo, NAS Global, and West Africa Telecom. Mobile providers also offer Internet services via USB dongles.

Liberia relies on satellite connections to access the Internet. It is both slow and expensive—most providers pay roughly $3000/Mbit/month (Various conversations with regulators and Liberian mobile operators). However, as Figure 4 illustrates, the telecommunications landscape along Africa's West coast is undergoing radical change, with four new submarine cables scheduled to start operations soon. The Liberian government, World Bank, Libtelco, Lonestar, and Cellcom have created a consortium to invest in a connection to the ACE cable, expected to land in 2012. To build redundancy and lower prices, operators also have the option of building a microwave or fiber connection from neighboring countries.

Figure 4: Existing and Planned Fiber Networks in Africa

Ideas for Growing the Internet Ecosystem

A. Facilitate a Cost Efficient, Competitive Telecommunications Infrastructure

Much of the infrastructure required to deliver Internet connectivity requires significant capital expenditure, such as submarine cables, landing stations, fiber backbones, and back-haul wireless networks. These capital requirements lead to high barriers to entry and could create incentives for anti-competitive market practices. In some countries, a single entity monopolizes access, resulting in high prices in spite of high capacity network infrastructure. This can happen in various areas of the ecosystem (e.g., fiber ownership, rights for landing station access, and cross-connections that different providers have with each other) and can increase consumer prices when it does.

Given the small size of the Liberian Internet market, one of the government of Liberia (GoL)'s key challenges will be to balance competition with efficiency within these segments of the telecommunications market. The following practices could foster competition while also leading to lower costs for consumers:

- Encouraging access to more than one independent submarine cable, either through multiple landings in Liberia or overland/wireless connections to landings in other countries like Sierra Leone or Cote d'Ivoire.
- Implementing "open access" principles for connections to submarine cables and domestic backhaul networks. This includes full and equal access to these networks for all licensees in the market, as well as reasonable cross-connect fees. Appendix A elaborates on the implications of such policies for the ACE consortium.
- Instituting a universal operator license that is technology agnostic. A universal license would allow operators to make more efficient and rapid capital investments.
- Promoting infrastructure sharing to reduce capital expenditure requirements for domestic infrastructure, including regional fiber and cell towers. This is particularly critical given the state of Liberia's market; in rural areas this reduction in cost structure may enable extending service where it would otherwise be unprofitable.
- Piggybacking on non-telecom infrastructure investments to create synergies. For example, many countries have successfully leveraged railways and electricity networks to deploy domestic fiber. This opportunity is significant in Liberia given investments in roads and power networks are central to the country's development agenda. Building conduit for fiber under national highways could dramatically reduce the costs and time of deploying a fiber network in the future. The building of the West Africa Power Pool—depending on the timing—may also provide a good opportunity to deploy fiber cheaply.
- Allowing land-locked nations to access Liberia's international bandwidth at a reasonable fee. In addition to lowering bandwidth costs in neighboring countries, this will also allow Liberian firms to share the fixed capital costs of laying the fiber.

B. Create an Effective Internet Exchange Point

An Internet Exchange Point (IXP) is critical to a healthy local Internet environment. An IXP is a rack of routers that different ISPs use together to exchange local traffic. It has the dual benefit of substantially lowering the cost of accessing locally hosted data and applications while greatly increasing the speed of delivery. Without an exchange, local traffic typically goes over international links twice (all the way out and then back in). Popular content and applications are also currently fetched over international links each time they are accessed, which clogs Liberia's limited bandwidth and adds latency to each round trip.

To develop an effective IXP, Liberia's ISPs can:

- Agree upon an appropriate location, backhaul cost sharing, and IXP management. In some countries such as Botswana, Kenya and Ghana, ISPs have created a neutral IXP association to provide effective coordination and management.
- Cache locally accessed content. Google would strongly consider deploying a cache in Liberia if an IXP existed. Other global Internet companies could also consider caching.
- Increase hosting of local content, either by helping local ISPs host better, or by encouraging "anchor tenants". These could be NGOs, embassies, universities or other large entities that could buy local hosting rather than hosting everything in Europe or the U.S. as they do now.

C. Open Spectrum

Many developing countries are "going mobile" from the beginning, as India and Indonesia have done, by not investing in land-line infrastructure other than those connections necessary to get Internet access to the country, such as undersea cables and core fiber infrastructure. Instead, governments are opening spectrum in WiMax, WiFi and/or TV white spaces for wireless providers to use to give consumers Internet access. These policy changes don't displace radio or TV service, but would take advantage of unused spectrum for Internet connectivity.

The Liberian government could consider the following:

- Open WiFi spectrum. The most important short-term option is to enable ISPs to use open spectrum to provide connectivity, typically through WiFi. The true value of open spectrum is not so much its low cost, but rather the "freedom of operation" -- i.e. the ability to deploy a new network without the approval or cooperation of a carrier. Many entrepreneurs have built interesting WiFi-based rural networks with thousands of users, in some cases tens of thousands; others have built campus or health clinic networks or connected schools. Ideally, both the 2.4 GHz spectrum and the 5.2/5.8 GHz spectrum should be open for use at a reasonable power level (e.g., up to 1 amp in the US).
- Open more WiMax spectrum. After WiFi, the next immediate step is enabling more use of WiMAX, which can operate in licensed or unlicensed bands. This is in use in the Philippines and Malaysia. Liberia has already provisioned some WiMax spectrum to mobile operators but could expand licensing at low/zero cost.
- Open TV spectrum for Internet use. TV spectrum can travel long distances without much degradation, which enables deployment of very high speed (more than 150 Mbps) wireless broadband connections at very affordable costs. Manufacturers in Taiwan and other countries are developing affordable equipment for this spectrum. The U.S. Federal Communications Commission is currently opening up white spaces, and other countries will likely do so as well. Early adopters of this approach could surpass effective speeds offered to consumers in many developed markets and become a leading example of this technology for the world to follow.

D. Develop Internet Power Contributors

Internet "power contributors" can make the Internet more widely available and relevant, helping countries reap the Internet's social and economic benefits. These contributors typically include computer science faculty and students, application and website developers, bloggers, and creators of digital content. They break the perception that the web is a read-

only experience and make the Internet more applicable to local users. This community of power contributors builds applications for unique local problems and opportunities, develops data, and gives a voice to an otherwise silent community.

Because most of Liberia's educated population fled during the civil war and universities are still rebuilding themselves, Internet power contributors are few and far between in Liberia. There are a variety of steps that can be taken to sow the seeds for such a community, including:

I. Connect universities to the Internet

- Consider appointing a Chief Information Officer for top universities to develop and drive the vision for ICT on campus. Tech companies, bilateral and multilateral donors, foundations and others would likely be willing to provide support. This could materialize more rapidly and substantially if universities provided a clear plan and leadership for the network, devices and applications.
- In the interim, work with ISPs or Internet cafe owners to set up private fee-based access points on campus. Faculty and students can receive free email and collaboration tools, allowing online coursework, curriculum and communication to start. Universities also could deploy Ethernet and/or WiFi within its campus and link to other campuses in the country, allowing for local storage and data serving and priming content for future connectivity.
- Help make PCs, notebooks and other Internet-enabled devices widely available. One successful model is for the university to negotiate a discount bulk rate with a distributor and identify a partnering bank to provide low interest loans to students.

II. Begin to build developer and ICT entrepreneur networks

- Partner with global universities to develop computer science curriculums and establish faculty exchange programs that build capacity locally.

Once there's a basic level of capacity, the following best practices can serve to strengthen the community and accelerate innovation:

- Establish technology and innovation centers, which are physical locations where developers can gather to work, exchange ideas, and meet potential funders. These collaborative spaces can reduce barriers to innovation by providing a location with consistent connectivity, a focus on open source, and open doors to the tech community. They are often sponsored initially by an ICT board, regulators and other multinational donors, and are starting to spring up across Africa.
- Utilize local developers where possible to provide solutions for social and government needs. Competitions, investments in, and promotion of locally-bred tech solutions can provide momentum for developers and community awareness of technology.

E. Make Public Sector Information Easily Available

Up to four out of five Internet users reach government websites through search engines (Comscore, internal research). Unfortunately, government websites often provide information in ways that search engine "crawlers" cannot index, such as in database applications. This means that a significant amount of public information is excluded from search providers' indexes, making it difficult for citizens to discover official data. The easiest way to ensure that government web pages can be crawled and indexed by search engines is to produce and implement Sitemaps. Sitemap 0.90 is offered under the terms of the

Attribution-ShareAlike Creative Commons License and has wide adoption, including support from Google, Yahoo!, and Microsoft. Note that using the Sitemap protocol does not guarantee that web pages are included in search engines' indices, but provides hints for web crawlers to do a better job of crawling websites.

Allowing access to their information is the doorway for public agencies to ensure transparency and accountability, and expand their reach. The web provides free, easy-to-use tools for agencies to manage their presence on the Internet and mobile devices. Some agencies in Liberia are already doing this. For example, the Liberia Institute of Statistic and Geo-Information Services (LISGIS), has been embracing the open geospatial data movement by making its roads, cities, and administrative boundaries data available in the public domain. As a result, users and organizations in country are increasingly looking to the web for their local geospatial information. Government departments in Liberia, and elsewhere in Africa, should follow the path laid out by LISGIS.

For more details, see http://www.google.com/publicsector/content/index.html.

Appendix A: ACE Consortium Considerations

The imminent landing of the ACE cable in Liberia can both dramatically lower the cost and increase the speed of international bandwidth relative to the VSAT connections the country relies on today. How the landing station is managed and operated, however, will determine to what extent the Liberian population ultimately benefits from the connection to the ACE cable.

If the result is high pricing for international bandwidth, interconnection, and/or collocation in the landing station, Internet development in Liberia will be unnecessarily constrained. This appendix elaborates on best practices for management of the ACE cable landing station. We also highlight potential areas of concern.

Ideas for a landing station include the following:

- Allow any domestic licensed carrier to build fiber into the landing station and co-locate in the landing station at prices based on a cost plus model (cost plus simply means determining the cost of the service and then adding a predetermined percentage of those costs to provide a profit margin).
- Publish prices—known as reference interconnect offers (RIOs)—for interconnection in the landing station. If the landing station is operated on a cost plus basis, the interconnection prices should decline on an annual basis as fixed costs are shared and usage increases.
- Allow all operators to do full circuit activation in the Monrovia landing station. This will ensure that licensed operators are not forced to buy the Liberian half circuit from a local monopoly at exorbitant prices.

The ACE consortium includes the major players in Liberia's telecommunications market (Libtelco, Lonestar, and Cellcom). Because Liberia's Internet market is so small, it may be difficult to attract a new entrant willing to invest in infrastructure competitive with the ACE connection. As a consequence, there is a good chance that the ACE consortium will have a monopoly over connection to international bandwidth. Since Libtelco, Lonestar, and Cellcom also compete in the retail Internet market, they could have an incentive to utilize the ACE connection to impede competition downstream. This would likely manifest itself in excessively high wholesale prices for international connectivity via the ACE cable as well as raised barriers to interconnection and collocation in the landing station facility for other ISPs.

There are several ways to protect against the emergence such anti-competitive practices. Requiring that the landing station and connection to the undersea cable be operated based on open access principles will promote full and equal access for all licensees in the market. If the government enforces these provisions and prohibits profiteering practices, Libtelco, Lonestar, or Cellcom's direct involvement in the management of the landing station would be less of a cause for concern. In Liberia's case however, the GoL may have difficulty meeting resource and capacity requirements for enforcing open access principles. Furthermore, if there is a lack of trust in the market between ISPs, landing station investment could suffer even if open access principles are in place.

An alternative approach is to require an independent third party who does not compete in the telecommunications market to operate and maintain the landing station. This aligns incentives rather than create oversight requirements, since the entity in control of the landing station will want to give access to all providers in the market in order to maximize revenue. If there is a lack of trust in the market, neutral party landing station management provides additional incentives for ISPs to invest in their own networks. The consortium could

determine this third party through a competitive bidding process, with the condition that they operate on a cost plus basis.

The GoL itself may be tempted to use the ACE cable connection as a revenue source. Many governments tax entry to their countries by putting a high cost on the RIO and/or half circuit. This approach is detrimental not just to all licensees in the market but also to government objectives, since it typically deters investors from buying capacity into the country at all and artificially reduces international capacity. The GoL also may have incentive to favor Libtelco over other entities for management of the landing station, since Libtelco is the government owned national operator. Doing so, however, risks creating mistrust between the GoL and the private sector and impeding competition across the market.

Although this appendix focuses on the ACE cable consortium, the principles outlined herein also apply to the management of domestic fiber networks.

Appendix B: Selected Countries' Telecommunications Policies

Below are examples of three countries that Google believes have progressive telecommunications polices and Internet ecosystems that may be applicable in Liberia.

- Singapore: Singapore is creating Netco type organizations and related policies for their new deployments. Details can be found at: www.ida.gov.sg.
- Indonesia: Indonesia is the first country in the world where the traffic from mobile devices exceeds the traffic from desktop/laptop computers. Details can be found at: metrics.admob.com.
- India: In India, legislation exists that encourages tower and other infrastructure sharing, which reduces costs to consumers. It took pressure to make this happen, however--industry participants were initially reluctant. Details can be found at: www.ictregulationtoolkit.org/en/PracticeNote.3157.html.

Works Cited

Bykowsky, Mark. "A Market-Based Approach to Establishing Licensing Rules: Licensed versus Unlicensed Use of Spectrum." Federal Communications Commission, Office of Strategic Planning and Policy Analysis. Feb. 2008.

Comscore, July 2006.

Liberia Telecommunications Authority. Interview with Google. August 2010.

Qiang, Christine Zhen-Wei and Rossotto, Carlo M. "Economic Impacts of Broadband." In Information and Communications for Development 2009: Extending Reach and Increasing Impact, 35-50. Ed. Christine Zhen-Wei Qian. Washington DC: World Bank Publications, 2009.

Parker, Philip. Liberia ISP Association. Interview with Google. August 2010.

US Central Intelligence Agency (CIA). The World Factbook: Liberia. 11 January 2011. 8 February 2011. https://www.cia.gov/library/publications/the-world-factbook/geos/li.html