Report to: Communications Commission of Kenya
Review of Apoyo ICT Access Gaps Report

I. Introduction

This report provides the review and analysis of the USAID Global Broadband and Innovations (GBI) team to the Communications Commission of Kenya (CCK) concerning the recent Report on the "Study on ICT Access Gaps in Kenya" delivered by consultants Apoyo Consultoria. This report is provided as part of the cooperation between GBI and CCK on developing Universal Service Fund (USF) and Broadband policies and practices in Kenya.

The purpose of this analysis is to provide GBI's comments, findings, and recommendations on the key substantive results and outputs of the Apoyo study and report. Specifically, it addresses that study's assessment of access gaps in voice and data telecommunications services in Kenya, and related economic calculations, policy proposals, and recommendations regarding the implementation of the CCK USF.

(Note: The Apoyo report also addresses matters relating to the Postal sector in Kenya, but these are not addressed in this review. An additional chapter concerning the National Optical Fibre Backbone Infrastructure (NOFBI) is also not addressed by GBI at this time.)

This report follows the structure of the Apoyo report, and provides a summary explanation of the methodologies, data, and findings in each chapter, followed by GBI's analysis of each key topic.

Summary Findings and Recommendations

This report presents a number of significant comments and findings on the results and recommendations contained in the Apoyo study report, which are described in detail in each section. In summary, the GBI team has reached the following findings:

1. The study appears to overstate the size and scope of voice and data access gaps in Kenya, for several reasons. It employs very conservative assumptions about current cell site coverage, and about the characteristics of sublocations that may attract commercial investment without subsidy. Recent growth trends suggest that operators are still expanding into unserved areas. Consequently, the overall size of the access gaps is likely significantly smaller than what Apoyo has identified. (See Section III.)

2. The report proposes a useful and generally appropriate framework for the different approaches that CCK should take to closing the access gaps, both utilizing the USF and through additional measures such as waiving spectrum fees in certain cases. Some ideas, such as encouraging operators to propose their own project designs but then putting these up for competitive bid, may not work well in practice, and may have to be modified. (See Section IV.)

3. The study contains several questionable assumptions and findings regarding the economic structure of the identified access gap areas. The capital cost inputs and calculations relating to constructing new wireless networks in unserved areas appear to yield results that are significantly lower than typically seen in other country experience. The simplistic assumption for operating expenses is especially low and unjustified. On the other hand, the study's forecast of expected demand and revenues to be achieved from new voice and data service access are dramatically below recent trends. These understated revenue results are potentially much greater in magnitude than the cost underestimations, such that the study's overall findings regarding per-site subsidy amounts, and total USF subsidy requirements, are much higher than the likely real-world result, by as much as perhaps 50%. (See Section V and Appendices 1 and 2.)

4. The proposed Institutional structure for the USF within CCK is reasonable, although it may need to grow over time. The proposed Implementation Plan, however, places too much near-term emphasis on closing only the voice access gap, while postponing for several years direct attention to the data gap and capacity building initiatives. A more balanced approach is recommended, so that the USF will address all inter-related objectives at the same time. Also, the study's estimates of the amount of income that the Fund will earn from the sector, and will be able to use toward supporting various projects, are very conservative, suggesting that additional resources will likely be available for more diverse and aggressive subsidy projects. (See Sections VI and VII.)

5. Ultimately, a more complete and formal Strategic Plan is still required for CCK to be able to implement the USF and to follow the recommendations of this report, including GBI's proposed modifications. The accompanying Operations Manual provides considerable detail on the tasks and activities required to operate the Fund, but a formal Strategic Plan must identify priority programs and projects, and more precise budget forecasts and allocations for the first few years of the Fund's operation.

II. ICT Situation in Kenya

We have reviewed this section and find the information to be generally useful and informative. The primary data source and time frame of the study inputs is the 2009

National Census, reinforced with additional data from an ICT sector survey, operator interviews, and other sources. Some updates have been included to incorporate more recent data, but in other cases the latest trends have not been included in portions of the analysis, as discussed in the sections that follow.

III. Identification of ICT Gaps

A. Study Methodology and Results

This chapter provides a summary of the methodology and assumptions used in the study to identify and quantify the extent of access gaps for voice and data services in Kenya. It then provides the results of applying this methodology, estimating the size and locations of these gaps.

III.1 Methodology:

Apoyo uses a 4-step process to determine the current level of coverage of voice and data services (with data defined as 3G mobile, minimum 256 kbps):

1. Map the precise locations of all mobile base stations in the country.
2. Determine the geographic coverage areas of the base stations, based on frequency, with average radius estimated from 2km-10km
3. Identify towns that are within or outside identified coverage areas
4. Determine the characteristics of towns without access (population, access to roads and electricity)

III.2 Characterizing voice and data gap:

Based upon the above methodology, Apoyo's study provides overall estimates of the voice and data gaps throughout Kenya. (Reference Map #12 and Table 5, pages 37-38):

- The voice gap consists of 1,119 sublocations, covering 11% of the national population and 66% of territory.
- The data gap consists of 6,256 sublocations, covering 72% of the population and 97% of territory.

The study goes on to conduct extensive analysis of the sublocations within these gaps, based upon their relative populations, the average distance from the nearest road, and the extent of private access to electricity. Key assumptions and findings include:

- Sublocations without voice are on average 3.4 km farther from the nearest road than those with voice access; sublocations without data are only 0.6 km more distant from roads, on average.

- The study defines “access to electricity” on a yes/no basis, based on whether the number of households in a sublocation with electricity is above or below 45% (the national average). Thus, a sublocation with 44% HH electricity is treated as “no access to electricity”.
- Only 6% of sublocations with voice have electricity, according to the above assumption, vs. 0.5% for sublocations without voice.
- Locations that are already served by voice service, but do not yet have access to data service, have the highest potential to upgrade soon to data access.

To evaluate the nature of the gaps, the study classifies sublocations between those that are above or below the median level for each of the three characteristics: population, road distance, and electricity access. Those areas that are above the median for at least one element, for voice or data service, are considered to have “private investment potential”. Those that are above the median for two characteristics have the most potential (no unserved sublocations were above the median for all three elements).

This latter standard (above the median for 2 characteristics) is the basis on which the study determines that a sublocation is within the “market gap”. Very few areas meet this criterion for voice service, leading Apoyo to conclude that the voice market has nearly reached its potential. A larger proportion of areas have potential for market-based investment in upgrading to data service access, specifically in areas where voice service is already present.

B. GBI Analysis

The methodology and assumptions applied by Apoyo to calculate the size of voice and data access gaps utilizes a number of simplifying assumptions. In general, any such study requires many assumptions to compensate for inadequate data and constantly changing market conditions. Interestingly, Apoyo evidently had access to a large scope of data on the telecommunications markets throughout Kenya, and other valuable information from the national census, which was more extensive than is typically available for a study of this nature. Some of the simplifying assumptions used in the study may have been unnecessary, given this wealth of available data.

On the whole, the study methodology appears to produce very conservative results, both for the estimates of current levels of access, and for the likely market potential to reduce the gaps further. This observation is based on several factors:

1) Cell site coverage

The study assumes that cell site coverage typically reaches only a 2km to 10 km radius around the BTS. This is a quite conservative assumption, especially for relatively flat and open terrain, which characterizes much of Kenya. Cellular signals can often extend more than 20 km from a tower with adequate signal strength, particularly for voice or

sms service. By employing these low-end standards, the Apoyo study undoubtedly counts as within the voice and/or data access gaps many towns where in fact there are likely already numerous active users. It would have been useful for the report to provide low-end and high-end calculations of the gaps, based on including towns within different potential signal ranges.

2) Conservative approach to estimating market potential:

The study's approach to determining the likelihood that commercial incentives will lead private operators to expand services into areas currently defined as within the access gap is quite conservative. As explained above, the study considers that sublocations have "investment potential" for voice service only if they exhibit traits above the median for all sublocations, in terms of distance to roads and population, and/or if they are above average in access to electricity. The conclusion is that, since only a handful of areas meet at least two of these criteria, the voice market has essentially reached its full market potential.

This is a very indirect way of determining market opportunity, as it contains no specific analysis of costs or revenue potential for any of these sublocations (even though the study later incorporates that type of data in its estimates of subsidy requirements). In reality, it would seem that many such areas could be potentially attractive to commercial operators. For example, any sublocation that has less than 45% HH electricity use, and is below the median population would, by this approach, be considered commercial unviable. Yet there are undoubtedly numerous sublocations in Kenya that are already served by cellular mobile networks, which fit this description.

These observations are generally similar for the study's findings on the data access gap, although the conclusion is that many more locations – specifically those where voice access is already available – are within the commercial market frontier. Those with no current network are virtually all considered unattractive for private, unsubsidized investment. Yet there are certainly many where potential demand relative to likely costs will be enough to spur continued network expansion for both voice and data services.

3) Lack of growth estimates and market trend reconciliation:

The study is based on 2009 data, and the only forward-looking adjustments have been to reflect overall population growth. This is another conservative assumption, which does not reflect actual recent market trends. In fact, the mobile voice market in Kenya has continued to grow very strongly in the past two years, and shows little sign of slowing. According to CCK data, mobile subscriptions increased by 25% from June 2010 to June 2011, from 20-million to 25-million. At least some of this growth has undoubtedly been in sublocations that were previously without service, where network operators have expanded their presence.

Despite indicating that the study team conducted extensive interviews with operators, there is no mention of any review of these companies' investment plans for unserved areas, either current or future. The finding that basic network expansion has reached its limit in Kenya could be readily validated or modified by examining these recent investments.

Conclusions:

The net conclusion arising from the above observations is that the size and scope of the access gaps that the Apoyo study identifies are almost certainly larger than is realistically the case. The various assumptions utilized will tend to place numerous sublocations where mobile telephone coverage is in fact already available into the unserved category. Recent growth trends appear to confirm this conclusion. However, CCK should be able to test the findings more directly by conducting sample surveys of some of the sublocations designated as unserved by the study report, and also by reviewing operators' recent and future expansion plans.

Given these conclusions, it would be best to treat the access gap findings of the Apoyo study as a high-end boundary for the likely size and scope of these gaps in Kenya at this time. The actual level of these gaps is quite likely much smaller, although it is impossible to estimate by how much. A reasonable presumption for the low end of actual access gaps might be 20% to 40% below the Apoyo findings. Accordingly, the subsequent findings concerning the USF funding required to close gaps should be adjusted to reflect this notion of a range of likely results, with the Apoyo figures at the very high end of this range.

IV. Options to Close ICT Gaps

A. Study Findings and Recommendations

This section of the report describes the general findings of the study concerning the factors that underlie the current gaps, and options and recommendations for how CCK can help close the gaps.

IV.1 Hindering factors:

Apoyo conducted in-depth interviews with telecoms operators to determine the factors that prevent them from expanding into certain areas. The main concerns include:

- High Operating and Maintenance costs (for energy, roads, security)
- Low population density
- License and spectrum fees
- Lack of adequate spectrum policy for rural areas
- High interconnection fees, especially for smaller operators

- Low education and lack of PC access restrict Internet demand
- Low literacy levels limit SMS demand

Operators also indicated that they would prefer a “pay or play” system for implementing Universal Access projects, which would allow them to design and fund projects internally, rather than have to bid for USF funds.

IV.2 Technical Options:

The report describes the main technology platforms that could be deployed to provide voice and data access in unserved areas. These consist of the following options, with indicated costs and constraints. These are also addressed in Appendixes 1 and 2 to the report.

Voice Networks:

- Conventional (3G) base stations: $100k to $300k, can cover a radius of 10km
- Femtocells: Cost less than $100k, but only cover a radius of 0.5km, and hence can typically only serve areas with 1,000 population or less
- For transmission network, microwave is far less costly: estimate an average of 3 hops per access gap area at $100k per hop
- More remote areas require satellite transmission, but without broadband capacity, at a cost of $3,500 per Mbps per month above the microwave cost.

Data Services:

- Data will be provided by upgrading sites with voice access only to 3G; in the 2100 MHz band, this cost is $30k/site
- Where there is no voice or data, all new installations will be 3G BTS, for which the additional cost of including broadband data together with voice access is minimal

IV.3 Proposed Strategies:

The report proposes the following basic Principles as a foundation for all strategies to close access gaps:

a) Subsidies should focus on supply-side support
b) Include private operators in the process of making decisions
c) Use the USF effectively and efficiently

The report then proposes three complementary strategies for closing the identified access gaps (which should be verified through site visits for each project):

1. First-come first-served scheme:

- Under this plan, CCK would waive certain spectrum fees for operators willing to provide service to designated remote areas (one operator per area).
- No USF funds would be required, just the incentive of lower spectrum fees.
- Operators would apply for the fee waiver, and would be approved based on qualifying criteria.
- The first qualifying operator to apply for a given area would be granted the waiver, in return for commitment to build out service; all others would not receive the waiver, but could serve the area on their own initiative.
- This method would help fill some short-term gaps, and save operating costs for the selected operators.
- Applications would be likely only for areas where anticipated net costs will be relatively small, making the fee savings sufficient to create the incentive to invest in service in those areas.

2. Private initiative scheme:

- Under this plan, operators would take the lead in designing and proposing USF-funded projects, which would then still be subject to competitive bid.
- The operator that designs and submits a project could be given "bonus" (e.g. 10% on price) in the competitive bid for such project.
- Project design and proposals would have to be approved by CCK.
- This scheme is intended to address short- to medium-term projects. The expectation is that operators will propose projects that are of most potential value to themselves, but less likely for the most remote and costly areas.

3. Lowest-subsidy auctions:

- Under this plan, the USF would take the lead in designing projects that meet CCK's priorities for extending service to areas that do not attract interest under the first two schemes.
- The USF Director identifies priority access gap locations, potentially with outside consultant support, and develops project plans, including funding estimates, based on field research in the affected areas.
- The projects are put up for competitive bid, with the contract and subsidy going to the qualified operator that proposes the lowest total subsidy.
- This scheme is aimed at medium- to longer-term projects, which involve higher costs and more remote areas; subsidies are likely to be higher and USF administrative costs greater.

IV.5 Capacity Building Strategy:

Finally, the proposed strategy includes recommendations for addressing CCK's objectives to support ICT capacity building among Kenyans. This includes allocation of some USF funds to support public capacity building, such as the following:

- School IT labs ($20k each)
- IT facilities at health clinics ($12K), hospitals ($25k)
- Public ICT facilities ($12k)
- Private “bottom-up” telecenters ($11.5k)
- ICT training centres ($75k)
- Collaborative content initiatives ($30k)
- Higher ed collaboration research, incubation ($125k)

Two options are proposed for channeling funding support to these various capacity building projects:

1. Connectivity obligations for broadband funded projects, which would require all new networks built with USF funds to connect schools, health and other facilities free of charge, and operators to provide capacity building workshops.

2. Establish a Capacity Building Fund to subsidize 50% of ICT facilities, telecenters, and training centres together with co-funding partners, and 100% of ICT content and research projects. The Fund would provide support on a competitive basis.

B. GBI Analysis

There are a number of good recommendations in this chapter, although the specifics are not always fully developed, and there are other options that can also be considered. These recommendations can generally serve as a starting point for a more complete Strategic Plan for the USF. The comments below describe some concerns and additional ideas for CCK to address in adopting its ultimate strategy for closing ICT gaps.

1) Technical Options

The study assumes a narrow set of options for delivering voice and data services to unserved areas: specifically 3G cellular mobile networks for most locations and low-power femtocells for the smallest areas, with microwave backbone transmission where possible, and satellite access in the most remote locations. For the most part, these are reasonable assumptions, at least for cost forecasting purposes, but they tend to limit the range of options that operators may actually consider in many areas. As technology continues to evolve, for example, it is likely that some operators will begin to deploy 4G systems as a preferred option for achieving true broadband access. Similarly, WiMax networks are proving viable in many markets, and could provide a valuable alternative access infrastructure in the Kenyan rural sector.

The proposed deployment of femtocells in small village sites is a forward-looking, innovative idea, which could result in significant cost savings for many areas. This type of micro-cellular system is still relatively new as a solution for small and remote public

locations, but has begun to prove viable and affordable, and it is worth encouraging via the USF. Ultimately, of course, it will be the operators who will decide which technology platforms to propose when responding to USF procurements, and the net costs and effectiveness of these solutions which will determine the choices to be deployed.

2) Proposed Strategies

The set of three strategic schemes proposed in the report generally represent a reasonable approach to creating necessary incentives to close Kenya's access gaps. The main emphasis will undoubtedly be on USF subsidized investments, with a combination of approaches to project definition and design.

The first scheme, "first-come, first-served," provides an opportunity for near-term new infrastructure development with little cost and effort by the Fund. The challenge will be to ensure that operators propose plans for new service areas that truly require the incentive of reduced spectrum fees, rather than markets that they might have served anyway. Other rules and restrictions will likely be required to ensure this incentive works as intended.

The second scheme, "private initiative," as defined in the report, presents some different challenges. It calls for individual operators to make the effort to propose and design specific rural access projects, but then requires that these projects be put out for competitive bids. This creates a dilemma: companies may be reluctant to invest cost and time in designing a potential USF project if they will then have to bid against their competitors for the right to implement the project with USF subsidy. The report proposes to address this concern by granting a bidding advantage (e.g., 10%) to the operator that has introduced a project. However, this remedy would likely cause other potential competitors to lose interests in bidding for most such projects. Also, any operator that proposes a self-designed project would tend to structure the service and infrastructure components to its greatest advantages. Thus, truly balanced competitive bidding for these "private initiative projects would probably be rare.

The third approach, "lowest subsidy auctions," is generally the most common method used by most USFs in developing countries to finance new infrastructure investment on a competitively neutral and fair basis. The challenge is that the USF itself must take the lead in designing projects, which can be difficult and time-consuming. The Apoyo report assumes that the majority of projects will have to fall into this category, covering the most remote areas of the country.

Perhaps the most realistic way to take advantage of industry input while ensuring competitive bidding wherever possible would be for the CCK to combine the #2 and #3 approaches. This would involve inviting general proposals and expressions of interest by operators for the development of projects, but ensuring that these submissions are within the general scope of USF-designated project parameters and criteria. The Fund managers should be responsible for soliciting formal suggestions and input from

operators, through public consultations, for all projects that are to be implemented with USF support. But they should not typically ask those operators to design the projects themselves in detail. Exceptions might be made for some of the most remote areas, where possibly only one major operator would be willing to invest even with USF funding; in such cases, the Fund should have the flexibility to avoid unnecessary bidding procedures. Otherwise, all competitions should be on an equitable basis, with no advantage to any party.

3) Capacity Building Strategy

The ideas contained in the report's Capacity Building Strategy section are important components of the overall USF strategy, and should probably be given even higher priority than what is proposed.

The report identifies a wide range of options for the USF to finance at least part of the cost (typically 50%) for establishing ICT facilities and other resources in public locations, including schools, health clinics, training centers, telecenters, and the like. Many of these facilities would in fact provide far more than just capacity building: they might often represent the primary source of connectivity, particularly to high-speed Internet access, for many rural citizens. As such, support for these types of public access ICT projects should be central to the CCK USF strategy, not only an adjunct component.

The report proposes two mechanisms for providing support to establishment of these various ICT facilities and programs: requiring them as mandatory components of USF network infrastructure projects, and creating a Capacity Building Fund to finance additional projects outside of those USF network areas. Both of these ideas have merit, and should ideally be reinforced as high priority aspects of the CCK strategy.

For USF infrastructure projects, specifically those that provide (broadband) data services, the requirement to include end-user equipment, facilities, services, and training should be a mandatory obligation for all such projects. Some projects may in fact focus primarily on institutional connectivity and facilities, for example school ICT programs. In this respect, it may be difficult to differentiate between standard USF projects and those that the Apoyo strategy considers "Capacity Building".

With larger-scale facility and infrastructure initiatives covered under the main USF programs, the proposed Capacity Building Fund should probably focus more on true capacity building initiatives, such as training, content and service development, rural ICT business incubation, and the like. These can be implemented separately from core USF projects, or in conjunction with them, on a case-by-case basis.

V. Funds Required to Close Gaps

A. Study Methodology and Results

This chapter summarizes the study's calculations of the amount of subsidies, in various forms, that would be required to close the identified voice and data access gaps. The results are based upon the methodologies described in Appendix 1 to the report, as well as the cost assumptions in Appendix 2. See the discussion under these Appendices for further review.

Voice Gap (see Table 17):

- The total USF target gap = 889 sublocations without voice access (3.6m population)
- Of these, 22 need only the spectrum fee waiver (= $9,500 per site)
- The remaining 867 subloactions will need $169-million in subsidy (+ fee waiver)
- If only sublocations above 2,000 inhabitants are included subsidy = $129m
- There are another 212 sublocations within the market gap, surrounded by nearby served locations

Data Gap (see Table 18):

- The total USF target gap = 4,374 sublocations without data access (22.8m population)
- Another 930 sublocations will obtain data access under voice program
- A further 952 sublocations have population < 2,000, and are not targeted
- Total subsidy = $687m for all sublocations (+ fee waivers)
- Report proposes addressing higher population areas first (>20k, 10k, 5k, 2k)

Capacity Building Fund:

- Report proposes allocating $14.3m through 2030 ($800k/year) for various projects

B. GBI Analysis

The figures presented in this section are dependent upon the assumptions and findings of the various other chapters. The combined total level of subsidies required for all projects and all sublocations, under these findings, comes to about $870-million, and would require implementation through the year 2030. As the discussion in the other sections of this analysis explains, GBI feels that these figures are much higher than will actually be necessary, for a variety of reasons. Our estimate is that the total required subsidy is likely to be closer to one-half or less of the Apoyo forecast. The one exception is the Capacity Building Fund, for which we would propose allocating significantly more resources, in coordination with other USF projects.

VI. Institutional and Legal Framework

A. Study Findings and Recommendations

This chapter introduces various recommendations for establishing the institutional framework for the USF within CCK, as well as other policies to promote increased ICT access.

VI.1 Institutional Recommendations:

- Create an independent department within CCK for USF
- Additional staff required: 1 manager + 3 officers to design and manage projects; and elaboration of access gap studies; 1 manager + 1 officer for Capacity Building Fund; financial assistant, legal assistant
- The report provides a proposed organizational chart (p. 96)

VI.2 Policy Recommendations for Voice and Data Services:

Key policy recommendations in the report, intended to accelerate deployment of voice and data services, in addition to USF projects, include:

- Waive spectrum and license fees (under scheme 1)
- Include obligations in broadband data projects to connect schools, etc. for free
- Promote neutral competition in USF projects
- Promote national roaming
- Promote network sharing

B. GBI Analysis

This section provides only a basic outline of the proposed institutional framework for the USF. More detail is included in the separate Operational Manual. What is proposed here is reasonable, although the size of the Fund staff will likely have to grow larger as projects and funding expand.

The policy recommendations are reasonable, if fairly generic.

VII. Implementation and Action Plan

A. Study Findings and Recommendations

This chapter reviews the range of goals and objectives for Universal Access in Kenya, then proposes specific objectives for the USF, based on the findings of the study. It

includes a budget forecast for available Fund resources, and the proposed priorities for allocating funds.

VII.3. Proposed USF Strategic Objectives:

There are three recommended priorities for Fund allocation:

- First priority = voice (and data) to 889 sublocations
- Second priority = broadband data (upgrades) in 4,374 unserved sublocations (start with sublocations > 20,000 population)
- Third priority = capacity building projects, linked to broadband access

The report then recommends that the Fund's goals should be implemented in two phases:

- First phase = meet first priority in 5 years
- Second phase = meet second priority by 2030

  Implementing the 3rd priority (capacity building) depends on progress with the second (broadband data access). Apoyo recommends not initiating the second phase immediately, but waiting a few years to observe progress of the broadband data market, then revise these objectives.

VII.4 Budget Analysis:

The study estimates the potential available USF funds to support these programs as follows:

- Estimated Fund revenues per year: $14m-$18m from 0.5% levy + 25% of CCK surplus before tax (close voice gap in 10 years, data gap in 47 years).
- If the levy is increased to 1%, revenues increase to $18m-$26m (close voice gap in 7 years, data gap in 36 years).
- If the Fund can utilize 100% of the CCK surplus (together with a 1% levy), revenues increase to $43m-$56m (closes voice gap in 4 years, data gap in 15 years).

B. GBI Analysis

The USF strategy proposed by the Apoyo report provides a useful starting point for implementation of the Fund's objectives, but requires further elaboration and potential revisions on several points.

If implemented as proposed, the Fund would concentrate for its first five years of operations exclusively upon delivering voice and data service to sublocations that

currently have no access to either. While this is clearly a top priority objective, targeting only these areas, while postponing any initiatives to upgrade to data access or to establish broadband public ICT facilities in other regions, would minimize the Fund's effectiveness and impact in the near term.

A better approach would be to establish several simultaneous programs, which the USF could implement concurrently, delivering a range of benefits and opportunities to different underserved market segments at the same time. Thus, for example, while the first program would still concentrate on expanding basic network access, a second program would emphasize deploying broadband access and facilities in marginal locations, and a third could underwrite capacity building initiatives. Taken together, these inter-related programs would be more likely to spur overall growth and development in the rural ICT sector in Kenya as a whole.

It is difficult to estimate the actual cost, and available budget, to implement these programs over the short or the long term. As explained elsewhere in this analysis (see Section III), the Apoyo report's estimated size and locations of the access gaps, as well as the net costs required to subsidize each unserved sublocation, appear to represent a substantial overstatement of the actual scope of the challenge.

At the same time, the forecasts in the report for the level of USF income that will be available also appear to be very understated. The report assumes maximum yearly income to the Fund (at the 0.5% levy) of Kshs 500-million (about $5.5-million). This is based on an assumption of maximum total annual industry revenues of Kshs 100-billion, with no provision for future growth in this revenue base. However, CCK's own sector results for the year from June 2010 to June 2011 already show industry revenues surpassing Kshs 104-billion, an increase of nearly 16% from the previous year, and this revenue level is likely to continue to grow steadily in the foreseeable future. Thus, the amount of income available to the USF, even without changes in the levy or allocation of other CCK surpluses, are likely to be well in excess of the Apoyo estimates. The consequence is that the range of projects that the Fund will be able to support per year, as well as the time frames for fulfilling various objectives, should be much more optimistic than indicated in the Apoyo findings.

Ultimately, CCK will need to develop a more detailed and formal near-term Strategic Plan (e.g., 5-years) for the USF, which defines more specifically the programs that will be implemented, identifies the priority target regions, describes the range of projects to be supported, and determines more reliable budget estimates and allocations among programs. The findings and recommendations of this study – together with the accompany Operations Manual – provide an important foundation for such a formal Strategic Plan, but more needs to be added before it can be officially adopted and implemented. (NOTE: GBI is prepared to assist CCK in preparing this more formal Strategic Plan.)

VIII. Extending Utilization and Reach of NOFBI

TO BE CONSIDERED SEPARATELY UNDER BROADBAND STRATEGY

X. APPENDIX I. Investment Subsidy Estimation

A. Study Methodology and Results

This Appendix contains three sections, which describe: (1) the study's methodology for evaluating potential demand for voice and data services in currently unserved areas; (2) explanation of the technology platforms and scenarios utilized in forecasting supply of these services; and (3) a brief description of the financial model used to bring together these inputs to produce estimated subsidy requirements.

X.1 Demand Assessment:

The first step, the demand assessment, seeks to estimate the numbers of new users and the revenues they would generate, when voice and data services become available in various sublocations.

For Voice service, Apoyo created an econometric model using 2009 Census data on key household characteristics of users of mobile telephones (radio ownership, electricity, education level). Based on these factors, the model projects the numbers of users in each sublocation that will purchase service when it becomes available.

For Data service, current user levels are insufficient to project future demand, so the study assumes that the worldwide average proportion of data-to-voice users in 3G markets will apply (=21% of voice users will purchase data service).

The results from the 2009 census were extrapolated to 2011 based on population growth. No further growth was forecast, however. Total estimated demand for new access areas using these methods was forecast to be 1-million voice users and 2.5-million data users (see Table 28).

To forecast revenues, the study utilized current ARPU averages in Kenya (estimated at $3.74 per month for voice, $1.12 per month for data), adjusted for the estimated spending levels of the unserved sublocations, based on a recent ICT survey. (These adjustments are not clearly explained.)

Resulting total forecast new expenditures for all unserved areas that will receive access = $731K per month for voice, $438K per month for data. (See Table 29. Note: we assume that these are per-month figures; the report does not specify the time period.)

X.2 Supply Assessment:

This section describes the basic technology choices that the study has used to define the likely range of services and associated capital costs required to deliver voice and data access to unserved areas.

The study considers only two types of long-term solutions for network architectures: 3G BTS's for most locations, and Femtocells for areas with less than 1,000 inhabitants (one Trx per 500 inhabitants). Backhaul transmission is either microwave or satellite where necessary. Solar power facilities are added where no commercial electric power is available. The study assumes that each new 3G BTS will operate at 900Mhz, which is the most efficient option.

The assumed options to close the data gaps involve the same technologies as for voice, given that each platform can incorporate data services. Where no mobile coverage is possible, the study assumes that VSATs will be deployed and connected to local Internet cafés.

Table 30, p. 142 shows the distribution of sublocations within the study's estimated access gap, according to the technology solutions that would be deployed in each. Of the total 5,735 sublocations, the vast majority (4,794) would require a new 3G BTS, including solar power. There are also some 491 sites that would obtain service indirectly, due to installation of a BTS in a neighboring sublocation.

X.3 Estimation of Required Subsidy to Close Gaps:

This section describes the calculation of the subsidy amounts required to close the voice and data access gaps identified by the study, according to the economic and financial assumptions used. Note that the unit cost inputs of these calculations are described in Appendix 2 (see below).

The methodology involves a financial model that takes into account expected income, CAPEX, and OPEX for each sublocation, based upon the various characteristics and assumptions that have been used to determine technology choices and revenue forecasts. The model creates a 5-year cash flow calculation, beginning with up-front CAPEX, and adding income and subtracting OPEX for each year. The totals are combined into a single net present value result for the overall (5-year) cost of serving each sublocation. (The report does not specify what discount rate is used in calculating the NPV, nor does it indicate whether any growth or inflation figures are included in the forecast.)

The model thus calculates the net subsidy required for those sublocations that are considered within the access gaps, based on the NPV of the 5-year cash flow analysis. The total subsidy required for a given subset of areas, or for the entire country, is the sum of the individual subsidies for all included sublocations. Some areas are not

included within the subsidy calculation, as they would receive service by deployment of facilities in a neighboring area. Subsidies are calculated separately for voice and data services.

B. GBI Analysis

Demand Assessment:

The main concern with the methods and assumptions in this section has to do with the revenue calculations. This method appears to yield very conservative results, which are difficult to reconcile with the methodology described, and may be far lower than will likely occur in reality.

As summarized above, the study used an econometric model based on 2009 census data to forecast the number of customers that will obtain voice service when it becomes available in unserved areas. For data customers, it used a fixed percentage of voice customers (21%). It then multiplies the number of customers in a given sublocation by an estimate of revenue per user (ARPU) based on current spending averages in Kenya (Safaricom) of $3.74 per month for voice and $1.12 per month for data. (Although the report does not state that these are monthly figures, this is the only reasonable interpretation given known revenue patterns.)

It is difficult to evaluate the Apoyo methodology directly, as the underlying data and calculations are not provided, although in principle this is a reasonable approach to estimating new service revenues. However, the results reported seem to be extremely low. In terms of the number of users, the study projects that about 1.0-million new voice users, and 2.5-million new data users, will obtain these services once all areas are covered. These figures represent about 22% of the total population of 4.5-million not served by voice networks today (by Apoyo's calculations), and 8.5% of the 29.5-million not currently covered by data services. Given that current penetration of voice service is around 65% of Kenya's population (even including unserved areas), while Internet users are estimated at over 30%, these forecasts are extremely conservative. Even taking account of lower income levels in more remote areas, there is little reason to expect that penetration of voice service in particular would rise to only one-fifth of the population in these regions, especially over time.

Beyond the low user forecast, however, the estimated revenue results provided in this Appendix are even more inexplicable. As shown in Table 29, the combined total revenue forecast for all 1-million new voice users is only $739,000 per month, or an annual level of $8.9-million. This equates to an ARPU of $0.74 per month for all new voice service, far below the national average and the figures on which the study supposedly based its estimates. Similarly, the data revenues from 2.5-million users come to $438,000 per month or $5.3-million per year, for a monthly ARPU of less than

$0.18. Again, lower incomes in remote areas would be expected to yield lower ARPUs, but not such dramatically smaller amounts than the national averages.

The most plausible finding here is that, for whatever reason, the Apoyo study has significantly understated the likely levels of demand for new ICT services in unserved areas of Kenya, in terms of both numbers of users and expected revenues. For purposes of analyzing the overall study findings and their implications for the USF, it will be important to treat these demand results as at best a lower boundary for expected new service revenues. A higher end boundary could be determined based on current average revenues for the 90% of the population that already receives service, and generates about Kshs 100-billion ($1.0-billion) per year: this would imply a potential revenue ceiling of up to $100-million from the unserved population, or ten times the Apoyo estimates. The realistic result is probably well below that figure, but certainly far above the study forecast, by a multiple of at least three or four.

Supply Assessment:

The assumptions regarding technology choices contained in the Supply Assessment are addressed under Section IV above. The information added in this Appendix mainly deals with the estimation of how many locations will require which type of technology, with the overwhelming majority expected to deploy 3G service.

The cost components of the supply side analysis are addressed in Appendix 2, as discussed below. Note that the finding in that section is that both Capex and Opex are likely understated for most locations: i.e., actual costs will probably be significantly higher.

Estimation of Required Subsidy:

It is somewhat difficult to reconcile the opposing effects of the different findings regarding the Apoyo methodologies and assumptions. On one hand, the unrealistically low levels of projected demand and revenues would tend to diminish the subsidy required for any given location, and to close all access gaps. On the other, the understatement of costs tends to drive up the required subsidy estimate. From the available information, however, it appears that the revenue effect would significantly outweigh the cost adjustments. As described above, the combined effect of underestimating both the number of potential users and the ARPU implies that actual potential revenues could be 3 to 4 times the Apoyo results or more. By contrast, the impact of the cost understatements might be an increase in the range of 35% to 65% overall.

These findings, combined with the previous finding that the Apoyo study has likely overestimated the size of the access gaps themselves, suggests that the total combined USF resources that will be required to help close these gaps, and the time frames for doing so, should be substantially below the Apoyo forecasts. Exact adjustments are not

possible, but it is not unreasonable to assume that the net cost of achieving all the major USF objectives could be about one-half (50%) of the Apoyo figures, on average.

APPENDIX II. Estimated Costs (CAPEX & OPEX)

A. Study Methodology and Results

This Appendix provides tables showing all of the components of capital costs (Capex) for various telecommunications network facilities and systems, which have been utilized by Apoyo as inputs to the subsidy analysis and forecast. The first table provides unit costs for each major element of microwave and satellite transmission systems, mobile BTS and femtocell transmitters, supporting infrastructure, and other network and service components. Subsequent tables illustrate how these components are combined for various deployment scenarios, such as BTS or femtocell with satellite or microwave transmission, and solar energy systems where required.

As an example, the combined capital cost of deploying a BTS with a microwave link utilizing solar energy is given as:

BTS (with antenna)	$ 32,321
MW carrier class (complete link)	$ 149,222
ADM (Add-Drop Multiplexer)	$ 12,928
Auto-supported tower (30 m)	$ 21,715
Security system	$ 5,537
Solar energy system (carrier class MW)	$ 64,641
TOTAL	$ 286,365

The report does not provide any source references or other explanations as to the basis for these capital cost inputs, nor does it offer any range of costs for each element under different assumptions or conditions. It does note that VAT and (import) tariffs are not included in the cost estimates.

As for operating expenses (Opex), the Appendix identifies only a single figure of $360 maintenance cost per site per year for all scenarios, with no explanation of the assumptions underlying this amount. However, in Appendix 1 (X.3), it implies that a separate operating expense is included where commercial power is utilized, as opposed to solar power.

B. GBI Analysis

CAPEX:

The unit capital costs of most components of the various equipment and facilities indicated in these tables appear to be somewhat low in some cases, compared with typical costs for rural telecommunications networks in many developing markets. In particular, for example, the indicated cost for a 30-meter radio tower is $15,000 ($21,715 when all related costs are included), while capital costs for such towers have been known to reach the range of $75,000. Similarly, the complete cost for a cellular BTS is given as $32,321; this is also rather low compared with common experience, especially when labor and installation costs are included.

The largest component of capital costs in the Apoyo model is for the microwave backhaul network. The figures used assume a single 50 km link as the typical or average connection required, at a combined total cost of $149,222 per site covered. This is a reasonable estimate for such a microwave link. However, the prior assumption in the study that each BTS only serves a radius of less than 10 km, may in effect result in the model underestimating the average distance required between microwave transmission links. This could also understate the overall cost per-BTS, although it would also mean that fewer BTS's would be required on the whole.

The unit costs for satellite and VSAT equipment, and for femtocell transmitters, also appear to be on the low side. On the other hand, costs have generally been declining in the mobile sector, and it may be possible for innovative operators, seeking to achieve efficient deployments, to achieve significant savings over historic, or even recent capital expenses for network facilities.

On this basis, it is reasonable to treat the capital cost findings of the Apoyo study as a lower bound for these costs in Kenya, at least on a per-site basis. A reasonable upper bound would be anywhere from 25% to 50% higher than the per-site results determined by the Apoyo report.

OPEX:

The simplified assumption presented in the report regarding Operating Expenses for network cell sites does not appear to be realistic. As mentioned, the report only indicates that a single assumption was used for all services in all locations: $360 per year in maintenance costs.

The ongoing costs of operating a rural wireless telecommunications network typically entail more than just minimal maintenance costs per site. Other Opex cost elements for such networks typically also include energy and security costs. For energy, the study has found that nearly all locations will utilize solar generators, which are included in the Capex for each site but don't require regular operating expenditures. However, the use

of solar panels, not to mention backup gas-powered generators, will increase the likely need and cost for site maintenance work and inspections. Security costs for some rural cell sites can also be significant, if there is any local risk of sabotage or theft.

The average levels of these costs will vary considerably across different types of locations, but the figure used by Apoyo, which comes to only $30 per site per month, is far below what rural operators generally report for ongoing network operations costs. In some settings, these costs can amount to thousands of dollars per site per month. Even if security and energy costs are kept to a minimum, average maintenance costs should be much higher than $30, especially as these will tend to increase over a five-year planning horizon. A more realistic assumption would be to treat the Apoyo figure as a minimum level, with a higher end average Opex in the range of $1,000 per site per month, and a mid-range estimate of perhaps $400 per site per month. Over the five year financial model period, this translates to an additional $24,000 in Opex per site, or more than $120-million in total subsidy costs for all projected USF sites (about 15% of the report forecast).