RESEARCH TRIANGLE INSTITUTE
Center for International Development

Information Systems Assessment

Ghana National Electoral Commission

Date Prepared:
24 April 2000

Prepared for:
United States Agency for International Development (USAID)
Education for Development and Democracy Initiative (EDDI)

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Acknowledgements

The authors thank USAID/Ghana and the USAID Africa Bureau for their support and patience while this report was in progress. Special thanks are due to the Ghana National Electoral Commission for being extremely helpful in completing the assessment. The staff of the NEC data center spent considerable time answering our questions, as did personnel in every NEC regional office.

Executive Summary

All objectives stated by the Ghana National Electoral Commission (NEC) in their request to the United States Agency for International Development (USAID), Ghana, can be met with appropriate technology. Achieving all objectives will require time, and may require resources beyond those provided by USAID. It takes time to develop staff skills, deploy equipment, develop applications, and establish telecommunications. In particular, it is not reasonable to expect to automate voter registration and voting at district or constituency level in one year. However, it is possible to achieve important objectives in 2000 while preparing to meet other objectives in 2001 or 2002.

The NEC has a mature data center capable of expansion. The data center does not have adequate server or network capacity and has no dedicated Internet connection. NEC regional offices have minimal computer equipment. One or two secretaries in each office have personal computer (PC) skills. Regional offices require only minor improvements before installing new computers. Regional offices will depend on the NEC data center for all technical support and supplies for the foreseeable future.

Internet Service Providers are currently limited to major commercial centers (Tema, Accra, Takaradi, and Kumasi). Outside these locations trunk-call dial-up access is the only moderately affordable short-term solution.

Intranet development should be divided into at least three phases. Phase I establishes core Intranet capacity and a dedicated Internet connection in the NEC data center. It provides new computer and communications equipment to each regional office, and establishes secure dial-up access to the new NEC Intranet via the closest Internet access point. Regional offices will have access to the Intranet Web site and secure e-mail with the NEC central office. Phase II builds on this foundation, adding voter registration and vote tally modules and improving capacity and connectivity in regional offices. Phase III extends automation to district offices.

Phase I is described and specified in detail. The implementation plan calls for completing this phase before the end of August 2000. Procurement and site preparation in regional offices should begin now. Computer-based training materials should be purchased soon to strengthen technical skills in the NEC data center. Total cost, not including training and technical assistance, is estimated at 161,000 USD. Total annual operating costs are estimated to be between 46,000 USD and 88,000 USD. These estimates do not include consumable supplies or depreciation.

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Acronyms and Abbreviations

AAEA ..... African Association for Election Authorities
AC ..... Air Conditioner
APC ..... American Power Conversion
ASP ..... Microsoft Active Server Pages
ATM ..... Asynchronous Transfer Mode
AVR ..... Automatic Voltage Regulator
AVS ..... Automatic Voltage Switch
BDC ..... Backup Domain Controller
CBT ..... Computer-Based Training
CD-ROM ..... Compact Disc Read-Only Memory
CEDECOM ..... Central Region Development Commission (Cape Coast)
CEDEP ..... CEnter for DEvelopment of People (Kumasi)
CHRAJ ..... Commission on Human Rights and Administrative Justice
CLC ..... Community Learning Center
CRCCnet ..... Central Region Co-ordinating Council Network
CSU ..... Channel Service Unit
DES ..... Data Encryption Standard (IBM)
DLT ..... Digital Linear Tape
DSSS ..... Direct Sequencing Spread Spectrum (radio transmission)
DSU ..... Data Service Unit
EDDI ..... Education for Democracy and Development Initiative
FHSS ..... Frequency Hopping Spread Spectrum (radio transmission)
GB ..... Gigabyte
GT ..... Ghana Telecom
HP ..... Hewlett-Packard, Inc.
IDEA ..... International Foundation for Elections Systems International
IEEE ..... Institute of Electrical and Electronics Engineers, Inc.
IIS ..... Microsoft Internet Information Server
IP ..... Internet Protocol
IPP ..... Internet Printing Protocol
IPSec ..... Internet Protocol Security
ISDN ..... Integrated Services Digital Network
ISP ..... Internet Service Provider
Kbps ..... Kilobits per second
L2TP ..... Layer 2 Tunneling Protocol
LAN ..... Local Area Network
LOE ..... Level of Effort
MB ..... Megabyte
Mbs ..... Megabits per second
MPPE ..... Microsoft Point-to-Point Encryption
NCS ..... Network Computer Systems
NEC ..... National Electoral Commission
NTFS ..... Windows NT File System
OMR ..... Optical Mark Recognition
PC ..... Personal computer

PDC..... Primary Domain Controller
PIE..... People in Education (Accra)
POP ..... Point of Presence
POP3 ..... Post Office Protocol 3
PPTP ..... Point-to-Point Tunneling Protocol
RAID..... Redundant Array of Inexpensive Disks
RAM ..... Read-Only Memory
RAS..... Remote Access Service
RFQ..... Request for Quotations
RTI..... Research Triangle Institute
SMDS ..... Switched Multi-megabit Data Service
SQL..... Structured Query Language
TCP ..... Transmission Control Protocol
UPS ..... Uninterruptible Power Supply
USAID ..... United States Agency for International Development
USD ..... U.S. Dollar
UTP..... Unshielded Twisted Pair (wiring)
VAC..... Volts Alternating Current
VPN ..... Virtual Private Network
VRA..... Volta River Authority
VSAT..... Very Small Aperture Terminal (satellite transmitter/receiver)
WAN..... Wide Area Network
Y2K..... Year 2000

Information Systems Assessment

Ghana National Electoral Commission

1. Introduction

On 6 October 1999 the Ghana National Electoral Commission (NEC) submitted a funding request for information technology to USAID/Ghana. The request thanked USAID for providing information technology used in the 1996 elections, but stated that this equipment and technology was no longer sufficient for year 2000 election needs. The NEC specifically requested a Wide Area Network (Intranet) connecting all 10 regional and 120 district offices. The NEC cited the increased availability of commercial leased line operators.

The purpose of the task documented here is to determine whether the NEC's vision of an Intranet connection regional and district offices is feasible. If so, what resources – time, materials, human resources, and money, will be required to implement it. USAID has committed to helping the NEC build the foundation of this system by providing the following resources:

- Computing and telecommunications equipment for the NEC national headquarters and all ten regional offices,
- Training for designated staff in use and application of the computers for Internet access, and
- Help in the development of a Web Page and training to designated staff to maintain the Web Page.
- Internet access for 1.5 years

This document is designed to provide USAID with the information needed to put this foundation in place before general elections in December 2000.

2. Objectives

Major objectives cited by the NEC coincide with broad strategic objectives of the USAID Education for Democracy and Development Initiative (EDDI). These include the following:

- Facilitate long-term sustainability of the electoral process
- Speed distribution of voter education material
- Enhance public and political party confidence in the electoral process

NEC and EDDI objectives coincide with USAID/Ghana Strategic Objective #4: *Public Policy Decisions Better Reflect Civic Input.*

In its request to USAID, the NEC described the following specific objectives:

- Facilitate communications with civil society
- Facilitate data transfer from field to headquarters central data bank
- Enhance internal communications
- Better flow of information from headquarters to regional offices
- Improve NEC administration
- Secure vote tabulation transfer

The NEC intends to establish a public Web site to facilitate communications with civil society. The public Web site would include the following content:

- Links to other election authorities in Ghana and around the World
- International Foundation for Elections Systems International IDEA (Sweden)
- African Association for Election Authorities (AAEA)
- On-line training
- Community outreach for voter education

The NEC intends to establish a wide-area network (WAN) linking its ten regional offices and 120 district offices to meet the remaining objectives. This WAN would serve as the foundation for an Intranet system with the following applications:

- Automated transfer of votes
- Automated transfer of election results
- Continuous voter registration
- Electronic mail and data transfer

The NEC asks USAID to help in this effort by providing new computer hardware and software for the NEC data center and remote offices, and telecommunications to support Intranet applications and a public Web site.

This document assesses current NEC information systems, central and regional. It describes a system implemented in several phases. It includes detailed specifications for hardware, software, training, and site preparation for the first phase, which can be implemented quickly. Quality and cost of telecommunications and dependence on Accra for most technical support are major constraints to expansion. Meeting these challenges is the key to extending this system in subsequent phases.

3. Site Assessments

3.1. Methodology

One or both of the authors visited the central NEC data center and each regional office to conduct the assessment. The assessor explained the purpose of the visit to the office director, deputy director, or acting director. The assessor examined the interior and exterior of the facility using a set of written guidelines. Annex C contains a copy of the site assessment guidelines.

The Director, Deputy Director, other officers, and secretaries were interviewed to gauge computer literacy and experience, and to answer many of the questions in the assessment outline. The assessor conducted a quick test of dial-up communications by dialing the nearest ISP POP, checking connection speed and reliability. Local training resources were identified by interviewing staff in the NEC regional office, the regional office of the Commission on Human Rights and Administrative Justice (CHRAJ), and by crosschecking other sources.

Annex D contains individual assessments for the NEC data center and each regional office. General findings are summarized in the following section.

3.2. Summary Findings

Conditions in regional offices are very uniform. Standards and support from central NEC offices in Accra are evident. Staffing and equipment are relatively standardized. The central NEC office has arranged Training and equipment support, and may coordinate some consumable supplies. There appears to be a good organizational foundation for gradual expansion of automation in regional offices. However, dependence on Accra for equipment repair and consumable supplies, and limited telecommunications options, should be considered in the pace and scale of expansion.

Table 1 presents basic statistics collected during this assessment. Numbers of registered voters and distances shown in this table are estimates.

Table 1 Basic statistical profile of regional offices.

Region	Constituencies	Estimated Registered Voters	Ave. Registered Voters per District	Staff in Regional Office	Districts	Staff per District Office	Max. Distance District to Regional Office (km)	Max. Distance District to Regional Office (mi.)
Central		800,000	66,667	15	12	4	110	68
Ashanti	33	1,600,000	76,190	20	21	4	40	25
Brong-Ahafo	21	1,000,000	76,923	25	13	4	129	80
Eastern	26	950,000	63,333	24	15	4	93	58
Greater Accra								
Northern	23	800,000	61,538	28	13	4	200	124
Upper East	12	340,000	56,667	21	6	4	80	50
Upper West	8	280,000	56,000	10	5	3	135	84
Volta	19	1,000,000	83,333	20	12	4	387	240
Western		700,000	53,846	24	13		346	215
Total	**142**	**7,470,000**	**594,498**	**187**	**110**	**31**	**1,521**	**945**

Most regional offices are in good condition. Each office has at least one room suitable for three or more computers and one or two laser printers. Most offices require only minor changes, and perhaps some additional tables and chairs.

3.2.1. Electrical Systems

Electrical systems appear generally adequate. Most outlets appear to be grounded, and AC units appear to be on separate circuits. Computer equipment will probably operate just fine on existing circuits, provided they are protected against high voltage transients. However, a qualified electrician should check the condition of the electrical system at each office. In some cases it may be necessary to install a new circuit and additional outlets for the computing equipment. Guidelines have been provided in this document under the section on Site Preparation.

3.2.2. Air Conditioning

Many rooms are equipped with room air-conditioners. All buildings are equipped with louvered windows, which will make temperature and dust control difficult even with air conditioning. Other than covering these windows with plastic, there is no quick solution. As long as broken louvers are replaced, and louvers are closed tightly, it should be fine.

3.2.3. Physical Security

Buildings and rooms can be locked, but the strength of the doors and locks should be checked, particularly on the selected computer room. All offices have metal security screens outside the windows. In most cases these screens are not strong enough. They should be replaced with a strong grid of burglarproof bars.

3.2.4. Staffing and Training

Regional offices have from 10 to 25 staff members, with the average office having 21 staff members. Each district office has a standard staff of four. Regional offices typically have one or two secretaries who have received basic training in Microsoft Windows and Office. Regional directors and deputy directors have often attended basic computing courses, but have not been able to use what they learned. Some staff members have attended training on their own.

3.2.5. Telecommunications

Each office has two to three telephone lines. One line is used by the Director for telephone and fax communications. The Deputy Director uses a second line.

3.2.6. Equipment

In general, each regional office currently has one Intel 80486-based PC and one dot-matrix printer. The computer is running Microsoft Windows 3.1 and Microsoft Office 4.3. These systems are used for general word processing. The computer is not Y2K-compliant and cannot be upgraded easily to support current software versions. Each office has one photocopier.

All equipment is covered under maintenance and repair agreements managed by the central office. Equipment must be sent to Accra for repairs, even from the most distant regional office. Most consumable supplies also come from Accra.

4. Telecommunications Assessment

There is no national Internet backbone provider in Ghana. Ghana Telecom (GT) operates the country's fixed telephone infrastructure, and to date has not been active in the Internet services arena. The country has three full-service ISPs as follows:

Internet Service Provider	Web Site URL
AfricaOnline	http://www.africaonline.com.gh
Network Computing Systems Ltd.	http://www.ncs.com.gh http://www.ghana.com
InternetGhana	http://www.internetghana.com

These three providers account for roughly 5,000 subscribers and an aggregate Internet bandwidth of less than 4Mbs.

4.1. Dial-up Connections

All three ISPs offer dial-up accounts for Internet access and e-mail. The quality of service varies over time, with first one provider experiencing serious problems then another. This is characteristic of a young market in which service providers lack redundant fault-tolerant systems, have difficulty keeping qualified technical staff, and are sometimes overwhelmed by demand.

Points of presence (POPs) are limited to the commercial centers of Tema, Accra, Takaradi, and Kumasi, where commercial activity generates revenues needed to pay off loans for expensive telecommunications equipment. InternetGhana prepared to provide a dial-up POP in Cape Coast, but reported a power transient damaged the equipment.

AfricaOnline and InternetGhana have both announced ambitious projects to provide dial-up and dedicated connections in all regional capitals through the use of Very Small Aperture Terminal (VSAT) satellite dishes. From there they intend to offer high-speed spread-spectrum and leased line access to corporate customers first, then dial-up access to the general public. Natel, an Accra firm specializing in VSAT technology, has been working with AfricaOnline. It is impossible to predict with any certainty when these projects might offer access alternatives to NEC regional offices.

The quality of dial-up access is limited by the quality of GT landlines. All dial-up access is through local GT lines and switch exchanges. Access outside the major commercial centers must pass through GT trunk lines and one or more GT exchanges. Line and exchange quality varies widely, but is improving as GT installs new digital exchanges. The closest POP geographically does not always provide the best connection.

GT is nearing completion of a new intercity loop of all digital lines and exchanges passing through Accra, Kumasi, Tarkwa, Takaradi, Cape" Coast, and back to Accra. Work between Cape Coast and Accra is incomplete, and connection quality between these points is very poor. GT is now roughly 18 months behind schedule on this project and appears to be struggling to finish it. Most regional capitals now have digital exchanges.

Author Kwabena Gyamfi tested dial-up connections to the Internet from each regional capital during the site assessments. Connections were established to Internet Ghana POPs in Accra, Takaradi, or Kumasi, depending on the closest point, from the regional offices of the Ghana Audit Service. In Tamale the connection tested was to AfricaOnline in Accra. In nearly all cases connections were established at 24Kbps or higher. There were some

problems connecting from the Volta Region office of the Audit Service in Ho. Dial-up connections from Cape Coast to Accra have been particularly poor in recent months. However, the authors believe dial-up access will work from most NEC regional offices now. Most offices will need to make trunk calls to Takaradi, Kumasi, or Accra, depending on which connection proves best. This situation should gradually improve, but it is impossible to predict with any certainty when GT will complete upgrades, and when ISPs will offer service in other regional capitals.

Single-user dial-up ISP accounts cost from 35 USD to 60 USD per month. NCS charges an additional 100 USD "registration" fee. Five or six users can use a single account over a single telephone line by networking PCs and using a proxy-server. The proxy server establishes a dial-up connection only when needed by one or more users. Depending on the proxy server, two or more telephone lines can be used at the same time to improve access speed. This requires multiple logins on the same ISP account. Since most ISPs attempt to prevent account sharing, a special "corporate" dial-up account may be required. This may cost 150 USD per month. In addition, there is the cost of the additional phone line and calls. The nature of Web communications typically allows four or five users to share a connection and still have adequate response.

4.2. Wireless Connections

A variety of wireless technologies are available to circumvent landline problems for local connections within regional capitals and from regional capitals to district offices. Many regional offices are equipped with radio voice communications only. Most wireless data products use Frequency Hopping (FHSS) or Direct Sequence (DSSS) Spread-Spectrum radio to achieve speeds from 1.5Mbs to 11Mbs. Most new products adhere to the Institute of Electrical and Electronic Engineering (IEEE) 802.11 standard, which defines FHSS and DSSS standards for 1Mbs, 2Mbs, and 11Mbs speeds using the unregulated 2.4GHz frequency range. This is still an immature technology with respect to standards, so that equipment from different manufacturers will often not work together. In general, wireless access points and network interface cards are not expensive. All three ISPs in Ghana offer this kind of connection within Accra, Kumasi, and Takaradi, for about 2,000 USD per month after an installation cost of over 13,000 USD.

The range of these technologies is limited to about 25 miles (about 40km) line-of-sight. Two buildings within site of each other can be connected quickly at low cost. Intermediate transceivers on poles or towers would be needed to guide the signal over obstructions and extend the signal to most district offices, which are typically more than 40km from the nearest regional office. The small low-power transceivers could easily be powered by solar panels. A qualified engineer would need to survey each route to estimate the number of towers required. Then it would take some time to install the towers and equipment. Finally, there is the question of who maintains the system. Recurrent costs would include this maintenance, as well as ISP connection services for each regional office.

4.3. Dedicated Connections

All three ISPs offer high-speed dedicated Internet access to corporate customers. This is normally provided through telephone circuits leased from GT. ISPs add value by providing and supporting connecting equipment, creating and maintaining Internet domain registration, and providing Domain Name Server (DNS) and POP3 electronic mail services. The cost of this kind of dedicated connection ranges costs about 7,500 USD to install and 1,500 USD or more per month in ISP fees. Monthly ISP fees include installing

a connecting modem and IP router, configuring and maintaining this equipment, registering the Internet domain, DNS and e-mail services, and Ghana Telecom (GT) charges for the dedicated circuit.

All three ISPs also offer high-speed wireless access in Accra, Takaradi, and Kumasi via microwave or spread-spectrum radio links. These links connect to GT leased circuits or to VSAT satellite dishes. This type of connection can cost more than 13,000 USD to install and 2,000 USD or more each month in ISP fees.

InternetGhana provides a dedicated connected to the Central Region Intanet via a connection to the Volta River Authority (VRA) fiber optic network. However, this connection has not been reliable, largely due to poor support by InternetGhana.

4.4. Summary Findings

The total cost of dedicated connections to all regional offices would be about 15,000 USD per month. This is most likely beyond the reach of the NEC operating budget, and not justified on a continuing basis. However, dependable dedicated high-speed access to the NEC data center is needed by regional offices and to provide public access to information about the election process. Time and cost make it impractical to attempt to install wireless connections to regional offices in time for the next general election. Dial-up access from regional capitals should be sufficient for Web browser-based applications and POP3 electronic mail, and would allow regional offices to select the nearest access point as ISPs extend service. Dial-up access for regional offices would cost an estimated 3,000 USD to 5,000 USD per month total, including GT telephone call charges. The best compromise is therefore likely to be a dedicated leased line connection for the NEC data center and dial-up access for regional offices. It should be possible to have this kind of system up and running quickly at reasonable cost.

Since communications between regional offices and the central NEC data center will travel the public network, it is important to know how these transmissions can be secured. Virtual Private Networking (VPN) technology was created for this purpose. VPN software at both ends of the connection is used to authenticate the other party, and to encrypt and decrypt all communications between. This allows private transmissions to be sent across public networks securely. It would be foolish to claim this security could never be breached, but accurate to say it would be very difficult.

5. General Strategy

On 6 October 1999 the Ghana National Electoral Commission (NEC) submitted a funding request for information technology to USAID/Ghana. The request thanked USAID for providing information technology used in the 1996 elections, but stated that this equipment and technology was no longer sufficient for year 2000 election needs. The NEC specifically requested a Wide Area Network (WAN) Intranet connecting all 10 regional and 120 district offices. The NEC cited the increased availability of commercial leased line operators.

The NEC stated that the Intranet would be used for the following purposes:

- Automated transfer of votes
- Automated transfer of election results
- Continuous voter registration
- Electronic mail and data transfer

It should be possible to achieve all these objectives with a WAN encompassing all ten regional offices. However, achieving all objectives will require time, and may require resources beyond those provided by USAID. It will take time to develop staff skills, to deploy equipment, to develop applications, and to establish and test telecommunication systems. In particular, it is not reasonable to expect to automate voter registration and voting at district or constituency level in one year.

5.1. Major Conclusions

This strategy described in this document is based on the following conclusions from site and telecommunications assessments:

1. It will take time to connect districts and collation centers. Many districts currently lack wire-line telephone connections. Wireless networking products are available to connect districts and even collation centers during elections. Current technologies will require intermediate powered transceiver stations to negotiate distances and line-of-sight obstructions. Transceivers can be powered by solar cells, but it will take time to test and deploy this infrastructure. RTI is currently trying to arrange testing of this type of system in Ghana. Wireless network connections currently operating in Ghana link commercial customers to VSAT or wired Internet connections over relatively short distances in areas with access to the power grid. Data can also be transferred using cellar telephone systems, but bandwidth is narrow and many districts are out of range.

2. Distributed database applications are complex. They must be carefully designed and tested before deployment. This takes engineering skill and time.

3. Regional offices will need to provide support for district offices, but most regional offices have only one or two outdated PCs, and few staff with more than basic computing skills. It will take time to build capacity in regional offices and support capacity in the NEC data center.

4. It is important to improve current voter registration and vote reporting systems now to support the democratic process. More sophisticated systems connecting district offices and collation centers can be built later.

The recommended application strategy in each area is described below:

5.1.1. Continuous Voter Registration

This application should allow voter registration forms to be scanned in regional offices. Information from the forms would be transmitted to the central office in Accra over the network, and added to the master voter registration database. The regional office would retain an electronic copy of the voter registration records for that region in the form of a database. This would give the regional office quick access to these records, and would allow it to print voter registration rolls. The software would need to allow registration records to be corrected either by the regional office or the central office. Differences between central office and regional office records would need to be arbitrated and synchronized. An audit trail would need to be maintained to track all changes. However, the NEC has faced significant problems maintaining their existing scanning equipment in Accra. The authors do not recommend a distributed optical mark scanning system, as described above unless reliable OMR equipment is available with good local support.

It is possible, and common, to distribute registration databases among regional offices using database replication. This improves performance for users in distributed offices. However, it introduces complexities that would make it difficult, if not impossible, to produce a robust system before the end of calendar 2000.

The NEC already has a centralized voter registration database, and centralized printing of voter registration rolls. This database can be made available to regional offices through an Intranet Web site. Regional offices with access to this site could enter and check voter registration through a Web browser interface. Regional offices could also generate reports through the Web site to print voter registration rolls for district offices and polling stations. It should also be possible for the center NEC office to print these rolls in each regional office remotely using Internet Printing Protocol (IPP) from any software application, provided regional offices have dedicated connections. This approach should enable access to the centralized voter registration database, continuous voter registration, and distributed printing of voter registration rolls.

5.1.2. Automated Tally and Transfer of Votes

In 1996 national elections, the ballot card displayed a photograph of each candidate beside their respective party symbol and name. Voters placed a thumbprint beside the candidate of their choice.

Currently vote tallies are calculated by each polling station, district, and regional office, and then sent by fax to the central office. Voter registration is checked against registration rolls printed by the central office in Accra.

Rugged portable optical mark scanning computers are available. Forms list or show the candidates. Voters insert their completed form in the scanning computer. The computer scans the form immediately, depositing the forms in a locked container below the scanner. Voters use a pen to connect open arrows beside the candidates of their choice. Staff at the polling station print the final tally from the computer, sign it, and seal it. The computer is then connected to the nearest telephone line, where it transmits results directly to election commission computers. The locked container with the original ballots is then sealed and

sent to the election commission. It might be possible to deploy this type of system. Vehicles, small generators, or solar panels could power the scanning computers. They could be transported to district or regional offices to transmit their results. Questions concerning complexity, training, reliability, and maintenance must be answered.

Collation centers could enter results on laptop or handheld computers and transmit results to district or regional offices using wired or wireless connections. Results from collation centers could also be entered in district offices directly. In either case, many sites will require wireless data transmission capability. As explained earlier, this is technically possible, but will take time to develop. In addition, the NEC will need an effective support system for hundreds of computers distributed throughout Ghana. This task is an order of magnitude greater than automating regional offices.

An Intranet Web application would allow regional offices to enter vote tallies as they are received from each district. This system could be put in place quickly and could scale easily to allow tallies to be entered at district when districts have the necessary network connections. Tallies entered at different levels could be crosschecked for consistency, and checked against the number of registered voters. This would decentralize entry of vote tallies to the regional, and later district, level, and would make results available immediately in the central office. This is a practical interim solution; efforts should continue to investigate and test technologies to transmit results from districts and collating centers, and even simple, rugged ballot scanning systems.

5.1.3. Electronic Mail and Data Transfer

The proposed Intranet includes Web, database, and electronic mail servers maintained by the central NEC office. This allows the NEC to offer secure electronic mail and data transfer services through the proposed Intranet to regional and district offices. These capabilities can be integrated with vertical Intranet applications, such as voter registration and vote tally and transfer. Integrating all these facilities with a well-design Intranet Web site framework should make them more accessible and easier to maintain and manage. Rather than program a custom Intranet Web site framework locally, I recommend the NEC start with a good commercial foundation that includes e-mail, scheduling, notice board, document archive, and discussion group modules, Web-based content management, a good roll-based security framework, and the ability to add custom-developed modules to the framework. Catouzer Synergy, which meets these requirements at a reasonable cost, and is the basis of the CRCCnet Internet Web site. There are also other products on the market that could meet these requirements.

5.1.4. Telecommunications

Dedicated wide area network connections will be needed by the central NEC office and each regional office. The NEC currently has no dedicated Internet connection.

Options vary by location, and change rapidly as ISPs and other players in the telecommunication market develop their own infrastructure and technical capabilities. Current options include leased or dedicated circuit telephone lines and spread-spectrum radio. Local ISPs use spread-spectrum technologies to connect customers to regional VSAT installations, to Ghana Telecom wire-lines, or to the VRA fiber optic network. Transmission methods include ISDN and perhaps ATM. Typical bandwidth is 56/64Kbps, which will be sufficient for the NEC central office. Regional offices may operate adequately with 33.6Kbps of shared bandwidth if they are equipped with only one or two

PCs. More PCs, and certainly regional servers, will require 56/64Kbps connections in regional offices also.

Leased or dedicated telephone lines are available only through Ghana Telecom (GT); ISPs package GT lines with e-mail, domain registration, address translation, e-mail, and other services. The central NEC will require some ISP value-added services. This could be included in a contract for dedicated connection support for all ten regional offices. NCS, AfricaOnline, InternetGhana, Ghana Telecom, natel, and perhaps other local providers may submit competitive bids. This contract will need to be renegotiated every few years in concert with the election cycle, and allowing one year to change providers if necessary before the next major election.

As the system expands, district offices will require dial-up or wireless network connections, either directly to their respective regional offices, or to the Internet. Collation centers will require wireless data transmission to district or regional offices if voting is automated at this level.

5.1.5. Security

A reasonable level of security can be provided in the following areas:

- User authentication
- Transmission integrity
- Internet intrusion

Database security can be enforced through the database server software, as well as file system permissions managed by the central NEC domain controller. The recommended system includes a strong, dedicated firewall protecting the central private NEC local area network. Routers for the central NEC office and all ten regional offices support the IPsec protocol and an internal firewall feature set. This combination will authenticate regional offices, encrypt all transmissions between these offices and the central network, and provide a reasonable level of protection against intrusion. Sensitive Intranet Web applications can also use Secure Sockets protocol to encrypt transmissions, but this should not be necessary if IPsec routers are functioning properly.

5.2. Key Concerns

There are three key concerns with the approach described in this document. They are as follows:

1. Response time
2. Reliability of the connection
3. Security

Response time will depend on network bandwidth and variable traffic. Use of a single large centralized database over this connection will be slower than using a portion of that database located on a server within the regional office. However, regional offices have no direct access to this database now. And, as mentioned previously, the complexity of distributing the voter registration database and supporting regional servers are beyond current resources.

The reliability of dedicated connections supported by the ISP will be vital to NEC operation. Regardless of the ability and good intensions of the ISP, these connections will fail periodically. The NEC should modify their current registration and tally procedures and systems to serve as a viable backup.

Data security should also be a continuing concern. Centralized systems, as well as regional offices, will have persistent Internet connections, and sensitive information will be transmitted over the Internet. As described above, some care has been taken to protect these offices from intrusion, and to encrypt all data transmission.

5.3. Project Phasing

The NEC needs to improve communications with regional offices and begin the process of automation quickly. The initial phase must be in place and working before December 2000. It must meet important NEC objectives, but within limited time and budget. It should be possible to expand on the initial system, adding function and capacity, and extending the system to districts and, ultimately, to collating centers. The NEC will make any changes necessary in facilities in regional offices to prepare them for computers. USAID needs the critical requirements and accurate information from field assessments to give to the NEC so they can get started. USAID needs detailed procurement specifications and training requirements now so they can begin the procurement process while the NEC is preparing regional offices.

The following plan divides development into three distinct phases. It should be possible to complete Phase I before December 2000. These phases are described in the following sections.

5.3.1. Phase I

Enable regional offices to communicate with the central office and each other using secure electronic mail. Enable regional offices to access a secure Web site hosted by the central office. Provide for security in regional offices, and secure communications between regional offices and the central office. Provide initial computer training to regional offices. Train technical staff in the central office in Intranet development and operation. This phase requires the following:

- Dial-up Internet access for each regional office
- Electronic mail for each regional office
- Dedicated Internet access for the central office
- Electronic mail access for the central office

5.3.2. Phase II

Enable the central office to create and operate mission-critical Intranet applications for regional offices. Improve connectivity and increase capacity in regional offices. This phase requires the following:

- Add mission-critical server capacity to the central office
- Add intranet applications for on-line voter registration and vote tallies
- Add dedicated secure connections to regional offices
- Add PC capacity in regional offices

5.3.3. Phase III

Enable district offices to register voters and submit vote tallies online. This phase requires the following:

- Add PC capacity in district offices
- Add dial-up remote access capability to regional offices
- Add dial-up Intranet access for district offices

The remainder of this document focuses on the details of implementing Phase I.

6. Phase I Strategy

6.1. Capabilities

Each regional office will be able to dial the nearest Internet Service Provider (ISP) Point of Presence (POP) to access the Internet from either of two new PCs. Ideally this will be a local telephone number. In some cases this will require a trunk call to POPs in Kumasi, Takaradi, or Accra. Regional offices will use this connection to communicate with the central office quickly, easily, and relatively securely, using electronic mail. They will be able to access the NEC Intranet Web site as soon as it is available. User logins and secure sockets protocol can be used on the Web site to provide an acceptable level of security. Virtual Private Networking (VPN) technology will secure all communications between regional offices and the central office.

6.2. Limitations

Each regional office will be provided with perhaps as few as two PCs and one laser printer. Each regional office could use as many as six or seven PCs and at least two printers. The Regional Director in each regional office could use a PC and printer for confidential work. This first phase will lay a foundation for expansion. Additional phases could add up to five PCs and at two or more laser printers per regional office.

Internet access will be limited by the capacity of the nearest ISP POP. If ISP capacity is insufficient, the regional office must wait until a connection becomes available. Connection speeds are likely to be slower than 33.6Kbps, and may average 24.6Kbps or lower. This bandwidth will be shared. Due to the nature of most Internet communications, performance should be adequate for most Web applications, even if the number of PCs is increased to four or five. However, poor performance should be expected if several PCs download files simultaneously over this shared link. The regional office can add capacity by adding a second or third phone line, but the ISP must allow simultaneous logins on the same account, and the NEC must pay for the additional lines.

Reliability and quality of these connections will be determined by the connection between the regional office and the nearest Ghana Telecom (GT) central office (exchange). From this point on, reliability and quality should be very good over the new GT intercity digital loop. There are exceptions: the portion of this loop between Cape Coast and Accra is still incomplete and unreliable. It is not possible to say with any certainty when this situation will be resolved. It is possible dialing one of several available POPs in Takaradi will produce better results than dialing POPs in Accra from Cape Coast.

6.3. General Strategy for Regional Offices

6.3.1. Computers

Install two PCs and one printer in each regional office. The PCs will be used for general office automation (Microsoft Office Professional 2000), electronic mail using a POP3 or IMAP mail client (Microsoft Outlook 2000 or Outlook Express), and Web browsing (Microsoft Internet Explorer). Performance and capacity requirement are moderate, but it is important to buy good quality computers from reputable local sources. Purchase Microsoft Windows 2000 Professional or Windows NT Workstation 4.0 installed. Both operating systems are more secure and more reliable than Windows 98. Use Windows 2000 Professional if possible. It is very stable, is a good performer, and will lengthen the

useful life of the system. Each PC should be equipped with a 10BaseT Ethernet card, and should support advanced remote management features. Remote wake-on-LAN and management features could ease management from the central office later, when regional offices are equipped with dedicated Internet connections.

6.3.2. Internet Access

Negotiate a package with a local Internet Service Provider including service and support for ten dial-up access accounts for the ten regional offices, and a 54/64K dedicated connection for the central NEC. The ISP should support the connecting telecommunications equipment in the central NEC office. The dedicated connection is necessary for Phase II of development, and given the existing network in the central NEC information center, they can make good use of a dedicated connection now while preparing for Phase II.

Allow the PCs to share a single telephone line. It will be hard enough to get one telephone line. Use a stand-alone proxy server to share a single line. It costs much more, but is simpler and more transparent than a software proxy server. It should be easy to set up, and reliable. Select a model with some flexibility in the types of connections supported. This may increase ISP alternatives. It should be possible to use two or three telephone lines at the same time to increase bandwidth if necessary. (Note that this would increase telephone charges, and would need to be supported by the selected ISP.) The proxy server should support secure communications with a server supporting Point-to-Point Tunneling Protocol (PPTP) in the central office. This will create a Virtual Private Network (VPN), authenticating both ends of each link and encrypting all communications between them. Once configured this security should be transparent to regional offices. Without this security it would not be difficult for anyone with moderate technical skill to manipulate voter registration and vote tallies from anywhere on the Internet. It may be necessary to use a step-down-transformer to provide 110VAC power to the proxy server, since it may be difficult to find models with 220VAC power supplies quickly.

Equip the proxy server with at least one good quality external fax/modem. This can be used to establish a dial-up connection to the Internet, ideally through a local ISP point of presence.

6.3.3. Printing

Provide a reasonably fast laser printer. Expect to increase the number of PCs later, and possibly to print registration rolls in the regional office, and size the laser printer accordingly. Make sure the printer has sufficient paper capacity, and can print on both sides of the paper (duplex). Make sure the printer duty cycle matches the expected size of voter registration printouts for elections.

Support for Internet Printing Protocol (IPP) could allow registration rolls to be printed in regional offices from the central database. This would eliminate the need to transports printouts from Accra. Printing could be initiated by request of each regional office, or could be initiated according to a schedule set by the central office. Due to the number of registered voters in most regions, it could take four to five days of continuous printing and twenty or more reams of paper to print the complete registration roll. Regional offices could control printing by district to spread this task over a longer period. Dial-up connections would need to be stable during printing, and telephone charges would be incurred. These could be high if ISP access requires a trunk call. Remote printing of registration rolls in regional offices may not be practical until dedicated connections are

established, and may require additional printing capacity. These questions can be resolved through testing.

6.3.4. Printer sharing

Equip the printer with a network print server. This allows the printer to be shared efficiently by two or more PCs in the regional office, and does not require one PC to be operating as a print server as well as a PC workstation. Select a print server that supports Internet Printing Protocol (IPP). This may allow the central office in Accra to send output to printers in regional offices while the Internet link is active. In later phases dedicated Internet connections to regional offices may make this a valuable capability. If possible, integrate the print server and the printer. This will eliminate the need for a separate power supply for the print server.

6.3.5. Local Area Network

Connect the PCs, proxy server, and print server, using a small, good quality, 10BaseT hub. The hub should have at least four ports: two for the PCs, one for the proxy server, and one for the print server. Provide one additional port for expansion. This can be used to connect an additional PC, or an additional network hub. Make sure the hub has port that allows a second hub to be connected in a cascading arrangement. 10Mbs of shared network bandwidth is more than adequate for this small LAN. It would be useful if the hub supports basic remote management. It may be necessary to use a step-down-transformer to provide 110VAC power to the hub, since it may be difficult to find models with 220VAC power supplies quickly.

6.3.6. Electrical Protection

Equip each PC with a UPS and automatic voltage regulator. This adds between $400 and $500 to the cost of each PC, but should prevent some serious equipment losses. An automatic voltage regulator will help keep input voltage within the accepted range for the UPS, conserving battery backup power. Protect telecommunications equipment and laser printer with an automatic voltage regulator. This is critical to prevent equipment failure due to electrical disturbances. Install an automatic voltage switch on the room air-conditioner to prevent damage to the AC unit from high voltages.

6.4. Critical Success Factors for Regional Offices

Communications depend on stable, reasonably reliable dial-up connections from each regional office. In some cases, regional offices will be able to dial a local ISP access number. In other cases, regional offices will need to make trunk calls to Kumasi, Takaradi, Accra, or other Internet access points. Connection speeds need to be 9.6Kbps or higher for electronic mail, and consistently 24.6Kbps or higher for Web browsing. Inadequate ISP capacity, a poor quality local loop, and poor quality intercity lines and exchanges could result in reliability and access speeds lower then required for this application.

Dial-up communications were tested from each regional capital during the assessment phase of this effort. In most cases, tests were conducted by dialing an InternetGhana point of presence in Accra. In virtually all cases communications were stable and connections were made at least 24.6Kbps. Some problems were encountered in Ho.

Only one or two secretaries in each regional office have basic computer literacy training and use a PC regularly. Some other personnel have received training, but have not used it. Four or five selected personnel in each regional office must participate in basic computing

skills training and specific operational training after the computing equipment has been installed.

6.5. Equipment Needs and Specifications for Regional Offices

Figure 1 shows the proposed equipment configuration for a regional office in Phase I. Annex E contains a detailed list of the required equipment and software. All components have been carefully selected for capacity and compatibility. Following paragraphs describe this configuration in detail.

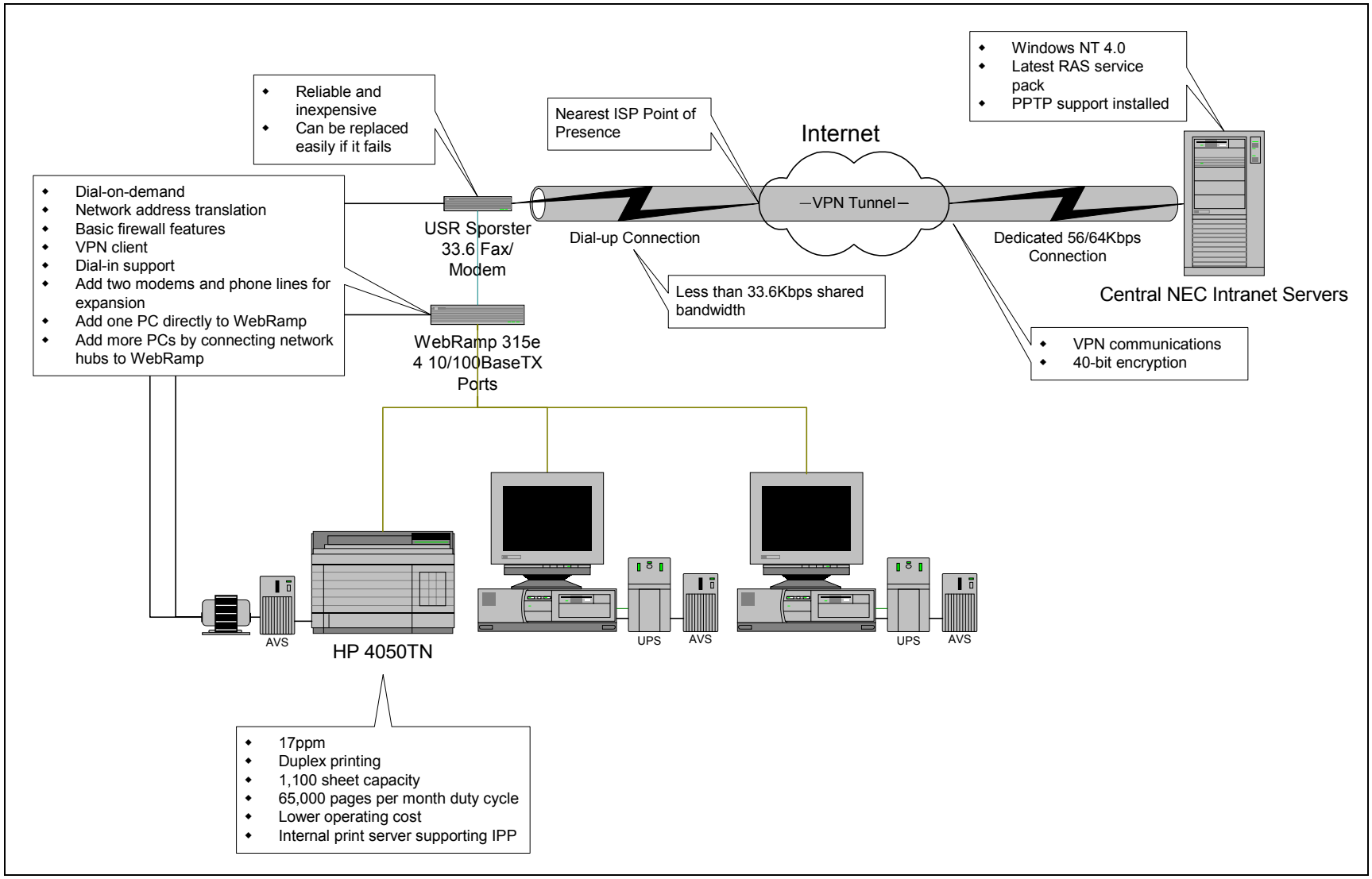

Figure 1 Phase I equipment configuration schematic for a regional office.

6.5.1. Personal Computers

The PCs have sufficient capacity and are designed for enterprises requiring reliability. They include good quality network interface cards. The PCs are equipped with physical floppy drive locks to prevent unauthorized use. These PCs should have a four to five year technical lifespan. They will operate at 110VAC or 220VAC. Make sure to check the setting on the power supply switch before plugging them in.

6.5.2. Printer

The printer is a monochrome laser printer with sufficient speed (17ppm) and paper capacity (600 sheets) for a workgroup of ten to fifteen users. Paper capacity can be expanded to 1,100 sheets. It can print on both sides of the paper automatically. It has a duty cycle of 65,000 pages per month. It should have an operating cost of less than about 0.03 USD per page. The printer should be ordered with a 220VAC power supply.

6.5.3. Printer Sharing

The printer is equipped with an internal print server (HP JetDirect 600N). This allows the printer to be connected directly to the WebRamp proxy server/hub device, or to any 10BaseT network hub. The internal print server does not require a separate power supply. HP JetAdmin software, which is included with the printer, is installed and configured on each client PC. This allows the PCs to share the laser printer locally. Any PC connected to the Local Area Network (LAN) in the regional office will be able to print on the printer, even if all other PCs are turned off and there is no connection to the central office.

6.5.4. Internet Access

The WebRamp 315e is a combination router, proxy server, and 4-port hub. It supports up to three external analog or ISDN modems. It establishes a dial-up connection to the ISP automatically when any computer on the network needs Internet access. It terminates this connection after a specified time of network inactivity. This timeout period can be adjusted to minimize telephone charges. This device provides a reasonable level of protection against intrusions from the Internet.

This device includes VPN client software that can secure communications through the Internet to the central office using Point-to-Point Tunneling Protocol (PPTP). This security feature will be transparent to the PCs on the LAN. The central office will need a Windows NT server with PPTP support installed and a dedicated connection to the Internet. The WebRamp can also be configured to provide dial-in access. The device is easy to configure and can be monitored remotely. It is likely to come with an 110VAC power supply.

The USR external modem is a good quality, inexpensive, external modem that can also be used to send fax messages. It is capable of communicating at the highest speeds expected for the dial-up connection. It can be upgraded through software to 56Kbps capability. It is likely to come with an 110VAC power supply.

6.5.5. Electrical Protection

Each PC and PC display is connected to an uninterruptible power supply (UPS) unit. Each PC is also connected to its UPS with a serial communications cable. Windows 2000 includes the software components to monitor the selected UPS and shut the PC down automatically before battery power is exhausted. The UPS has replaceable batteries. Each UPS is connected to an automatic voltage regulator (AVR). These are locally made and are designed to keep voltage levels within limits acceptable to the UPS. This will prevent

UPS units from switching to battery power so frequently that batteries are depleted and cannot be recharged. The WebRamp device and modem may not be available with 110VAC power supplies, and it may be difficult to find compatible power supplies. Expect to connect both devices to a small voltage step-down transformer. The printer and the step-down transformer are connected to an automatic voltage regulator for protection.

The room air-conditioner (AC) is equipped with an automatic voltage switch (AVS) to cut power to the AC unit when it exceeds acceptable limits. *An electrician must install the AVS.*

A telephone line surge suppressor protects the modem against damage from high voltages that may enter through the telephone line.

The total estimated power draw (load) for this equipment is 1,328 VA or 930 Watts. The electrical circuit must have this capacity.

6.5.6. Fault Tolerance

If the external modem fails, it can be replaced easily. *Equip the central office with two spare modems for rapid replacement.*

If the WebRamp fails, the external modem can be connected directly to one of the two PCs. *Equip the central office with one spare WebRamp for rapid replacement.*

If an AVR fails, the UPS can be connected directly to the electrical outlet. If a UPS fails, the PC can be connected directly to the AVR. If the AVR also fails, the PC can be connected directly to an electrical outlet, but with increased risk of data loss and equipment damage. *Equip the central office with two spare UPS units, two replacement UPS batteries, and two spare AVR units for rapid replacement. Note that UPS batteries should be disconnected in stored UPS units. All batteries in storage should be connected for a full recharge cycle every four to six months. If not, they will discharge to the point where they become unusable.*

Two PCs with independent UPS units provide some redundancy. If one PC fails, the remaining PC can be used until the damaged PC is repaired or replaced.

If the laser printer fails, it must be sent to Accra for repair. When printing capacity becomes mission-critical for printing voter registration rolls, or for other applications. Each regional office should be equipped with two laser printers. The two printers should be similar, if not identical, to simplify operation, supply, and maintenance.

Regional offices have not been provided with a high-capacity backup device. Users in these offices must backup local files to diskettes. If these PCs will be used for applications that store large amounts of important data on local fixed disks, then one or more higher capacity backup devices (Iomega Zip or Jaz drive, cartridge tape drive) should be added to the configuration.

6.5.7. Security

Physical security is addressed in the section of this document addressing site preparation. Loss of equipment in a regional office would be damaging. Loss of data would be even more damaging. Unauthorized manipulation of voter records and vote tallies would be catastrophic. The configuration recommended for Phase I includes tools to secure PCs,

servers, and communications, but these tools must be deployed and managed properly to remain effective.

The WebRamp device provides a reasonable level of protection against Internet intrusions (network address translation, packet filtering, access controls). Provided the server in the central office supports PPTP, this device will secure all communications with the central office, including electronic mail, file transfers, and communications with the Intranet Web site. Windows NT server meets this requirement.

The WebRamp and modem can be configured to accept or deny dial-in access, and can be configured to require a username and password for dial-in access. Both devices can be configured for dial-back for increased security for dial-in connections.

Inexpensive intrusion detection software has been specified as part of the NEC central office configuration. This software should be installed on all NEC PCs connected to the network, including those in regional offices. This software can detect and stop electronic intruders, and can notify system managers.

Windows 2000 Professional and Windows NT Workstation provide a higher level of security than Windows 98. PCs can be configured to require a password on boot-up (BIOS), will require a password to login (Windows 2000 Professional or NT Workstation), and will require password re-entry after a set period of inactivity. The PCs can be configured to prevent booting from diskettes, and are equipped with physical diskette drive locks to prevent unauthorized access.

Windows 2000 Professional also supports transparent encryption of local folders on NTFS volumes. There are caveats to this encryption; it should be approached with great care.

Windows 2000 Professional also supports Microsoft Point-to-Point Encryption (MPPE) and Internet Protocol Security (IPSec) on network and dial-up connections. These protocols provide secure communications with compatible servers, including Windows NT and Windows 2000 servers. (Note that Microsoft's implementation of IPSec in Windows 2000 Professional is compatible with Windows 2000 Server, but is currently incompatible with IPSec products from other companies.) Windows 2000 ships with 40-bit and 56-bit encryption. On January 14, 2000, the U.S. Government issued new regulations allowing export of "strong" 128-bit encryption software to all but a few embargoed countries. Microsoft's High Encryption Pack for Windows 2000 can be downloaded free to add 128-bit encryption protocols.

Widows 2000 Professional also supports both Point-to-Point Tunneling Protocol (PPTP) and Layer 2 Tunneling Protocol (L2TP) for VPN communications.

6.5.8. Expansion

Two additional modems (and telephone lines) can be added to the WebRamp. Provided the ISP allows multiple simultaneous connections to the same account, the WebRamp will establish additional dial-up connections automatically and will combine these connections for higher communication speeds. Of course, communications costs will increase.

Three out of four ports are occupied on the WebRamp. The fourth port can be used to connect a third PC or a second printer, or can be used to connect a separate network hub to

connect additional PCs and printers. The WebRamp can support up to 253 devices on the LAN.

When dedicated high-speed Internet connections are established, the modem and WebRamp device will need to be replaced with a router and DSU.

6.6. General Strategy for the Central Office

6.6.1. Computers

Install new PCS running Windows 2000 Professional for applications development, database management, report generation, electronic mail (Microsoft Outlook 2000 or Outlook Express), Web browsing (Microsoft Internet Explorer), and support of regional offices. Performance and capacity should be sufficient for general Web and client/server application development. Purchase Microsoft Windows 2000 Professional or Windows NT Workstation 4.0 installed. Use Windows 2000 Professional if possible for performance and stability. Most key development tools have been or will soon be Windows 2000 compatible. Each PC should be equipped with a 10BaseT or 10/100BaseTX Ethernet card.

6.6.2. Servers

Install one new server suitable for small to medium enterprises. The server should be sized to act as the primary database server, and should have considerable expansion capability, including dual-processor capability and the capacity to accommodate additional fixed disk drives internally. The server will also act as the Primary Domain Controller, e-mail, file, and print server until these functions can be divided among at least three separate servers optimized for specific tasks. The server should have fault tolerant features, including redundant hot-swap power supplies and RAID 5 hot-swap disk drives. It should be equipped with a 1.44MB diskette drive and a CD-ROM drive. It should also be equipped with a tape backup drive with the capacity to backup other servers as they are added to the configuration in subsequent phases. It should be equipped with a standard 15" color display, keyboard, and mouse. The server should be protected by an uninterruptible power supply (UPS) allowing the server to monitor UPS power status and shutdown normally before battery power is exhausted.

6.6.3. Internet Access

Negotiate a contract with a local ISP to install, configure, and support a 56Kbps or higher speed dedicated connection between the NEC LAN and the Internet. The connection should be made using a high-quality router that supports strong firewall security features and VPN connections via IPSec. Though the configuration specified for regional offices provides VPN capability through PPTP, the NEC may require IPSec capability later when some regional offices are equipped with dedicated Internet connections.

6.6.4. Local Area Network

Install a high-performance 10/100BaseTX Ethernet switch with at least 12 ports. Use this switch to provide high-performance connections to and among servers as they are added to the Intranet configuration.

6.7. Critical Success Factors for the Central Office

A reliable high-speed (56Kbps or higher) connection to the Internet is necessary for regional offices to access centralized voter registration and vote tally applications and

databases. The reliability and performance of this connection depends on the performance of the ISP and their coordination with Ghana Telecom.

Weak LAN security on PCs, network ports, network devices, and network servers makes it easier for NEC staff, or unauthorized visitors, to disrupt operations, corrupt or tamper with databases, or otherwise break the integrity of the NEC information system. Studies indicate that employees carry out most electronic security breaches. Electronic security holes at the Internet connection and on internal servers could allow malicious parties to tamper with NEC database records or disrupt information system operation. Even suspected tampering with voter registration or vote tally records could be disastrous. The NEC must be aware of these security risks.

Security technologies have been included in Phase I specifications, but the NEC must exercise due diligence to make sure the system is as secure as possible. This means configuring servers, PCs, and network devices carefully, monitoring server and network logs for suspicious activity, monitoring technical resources constantly for new security risks, installing security fixes promptly. The NEC is likely to need some expert technical assistance in this area.

Technical support personnel in the NEC data center will be responsible for making sure the system operates smoothly. This includes central operations as well as those in regional offices. The NEC data center will also be involved in designing and developing an Intranet Web site, and mission-critical Intranet applications. Technical personnel must have the technical knowledge and skills to carry out these responsibilities. Continuing technical education should be an integral part of data center operations.

6.8. Equipment Needs and Specifications for the Central Office

Figure 2 shows the proposed equipment configuration for the NEC data center in Phase I. Annex E contains a detailed list of the required equipment and software. All components have been carefully selected for capacity and compatibility. Following paragraphs describe this configuration in detail.

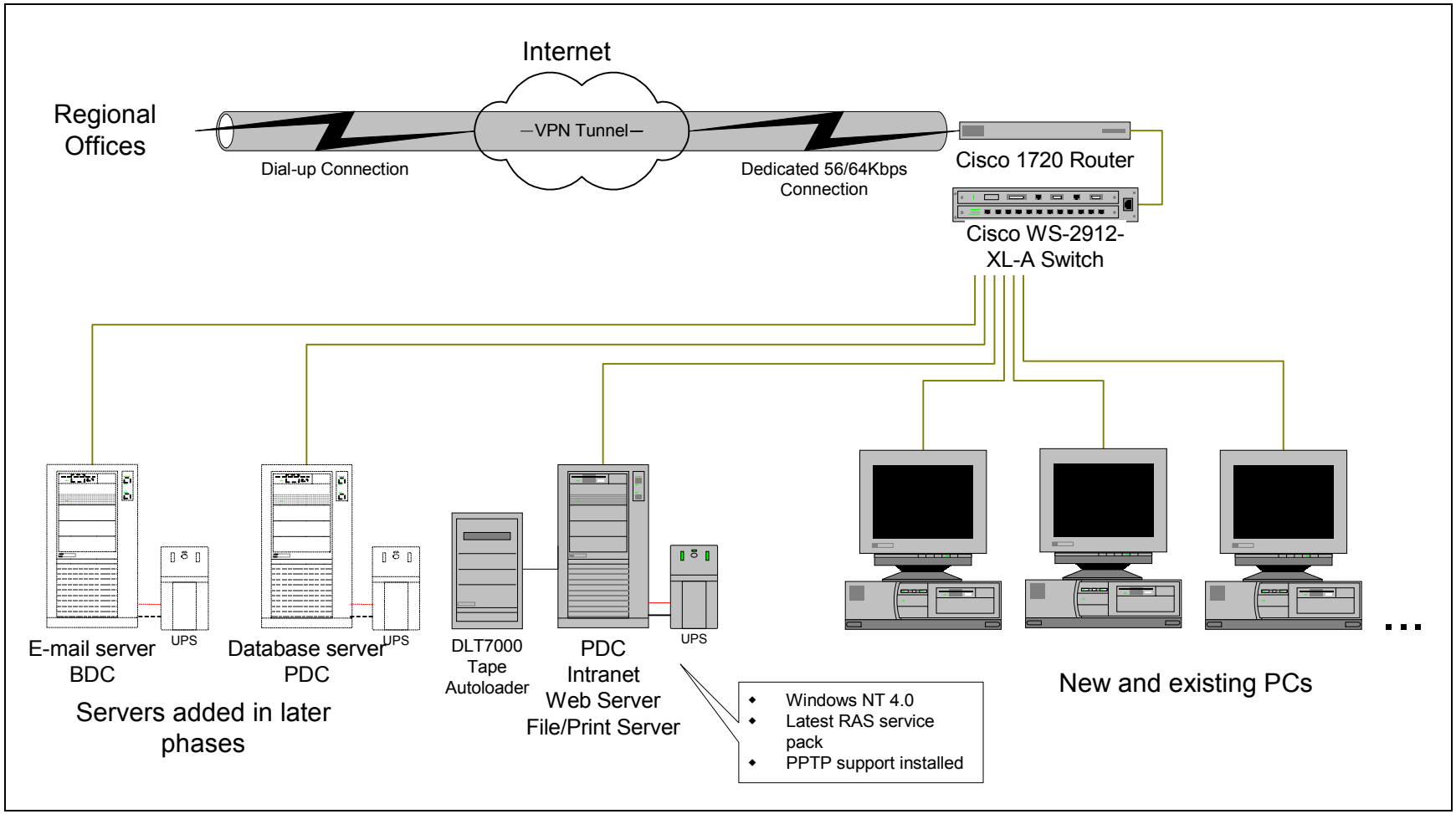

Figure 2 Phase I equipment configuration schematic for the NEC data center.

6.8.1. Internet Access

Connection to the Internet is made using a Cisco 1720 router. This small modular router has two WAN interface slots, allowing it to be configured to connect to the following types of high-speed dedicated links:

- Integrated Service Digital Network (ISDN)
- Asynchronous serial
- Synchronous serial
- Leased lines
- Frame Relay
- Switched 56
- X.25
- Switched Multi-megabit Data Service (SMDS)

This router supports the secure IPSec protocol and includes basic firewall features. It has slots for two WAN interface cards and is configured with an integrated 56/64Kbps 4-wire DSU/CSU and serial connection.

6.8.2. Server Connection

A 12-port Cisco 2900 series workgroup switch provides server connections and connections for high-speed workstations. All ports support 10/100BaseT full duplex communications. This should provide good performance from Intranet applications using servers connected to this switch. *Existing network hubs should be connected to the new switch.*

6.8.3. Intranet Web Server

The central office currently has three Windows NT servers, any one of which could host an Intranet Web site. However, these servers do not have the performance, capacity, or fault tolerance required for mission-critical applications. Only one of the servers has a backup tape drive. While these servers could be used as-is to host an Intranet Web site, this should be considered a stopgap strategy. More appropriate servers are specified for Phase II. If possible, install a new Intranet Web server in Phase I.

The specified server is designed for use as a dedicated database server. Until Web, e-mail, and other services can be moved to other services, the new server may need to perform all these functions. SQL Server 7 performs well with more than one processor, but is normally on a dedicated server. ColdFusion is a multi-threaded application that can make heavy use of more than one processor. Handling PPTP for remote office VPN connections may place a particularly heavy burden on the processor. The new server has been configured with this in mind. However, it may be necessary to tune or "throttle back" SQL Server to release enough processor capacity for other tasks. Web and e-mail services, and perhaps PPTP, should be moved to other services as soon as possible. Dividing functions among several servers should produce much better performance and reliability, and allows each server to be optimized for its task.

The new server includes two Pentium III 600MHz processors and is configured with 1GB RAM and a total of 72.2GB of fault-tolerant hot swappable fixed disk storage across five separate disks. The first two disks are 9.1GB each and should be configured as mirrored drives for the operating system and applications. The remaining three disks should be

configured as a RAID 5 array and used for data storage. Table 2 illustrates the recommended partitioning arrangement based RTI experience.

Table 2 Recommended server disk configuration

Disk Grouping	Partition	Contents
Mirrored Disk 1 (9.1GB)	1 (2GB)	Operating System ▪ MS Wndows NT 4 Server
Disk 2 (9.1GB)	2	Applications ▪ MS Exchange ▪ MS SQL Server 7 ▪ MS IIS ▪ Allaire ColdFusion
	3	SQL Server log devices
RAID 5 Disk 3 (18GB) Disk 4 (9.1GB) Disk 5 (9.1GB)	1	SQL Server Data Devices
	2	Exchange mail databases
	3	Web applications

The server is equipped with dual power supplies. If one fails, the other can power the server until the failed power supply is replaced. Power supplies can be replaced without stopping the server. The server is also equipped with an external 35/75GB DLT7000 tape autoloader. This tape system is designed to be used to backup additional servers as they are added to the configuration. Tape backup software includes component to backup SQL Server and Exchange databases. The server is equipped with a matching APC UPS unit. The UPS unit will communicate power status to the server, allowing controlled server shutdown before battery power is exhausted.

Plans for Phase II call for adding lower-cost servers for Intranet Web applications and electronic mail. However, until those servers can be installed, the database server can be configured to perform all three major functions. It is also possible one of the two existing Windows NT servers in the NEC data center can be configured as an Intranet Web server. One of the existing servers could also function as the Primary Domain Controller (PDC) or Backup Domain Controller (BDC).

6.8.4. Intranet Software

Intranet applications combine Web technologies with databases, electronic mail, and other capabilities. There are many tools available for this purpose. I have selected those with which I have the most experience.

Catouzer Synergy is an "Intranet in a box." It includes Intranet news notices, group calendar, document sharing, online discussion, an electronic mail interface applications. The company is in the process of changing its name from "Catouzer" to "Evolution B." The Synergy Intranet Web site foundation can be customized and expanded by programming new modules using the Synergy framework and ColdFusion. ColdFusion is a Web application server used by Synergy. It is comparatively easy to learn to develop

Web applications using ColdFusion, and the product powerful. I have included companion tools for developing custom Intranet applications.

Synergy is not inexpensive, but it cost-competitive with similar products in its class. It can be installed and configured very quickly, but provides a well-designed foundation for expansion and good tools for developers writing custom modules. It could pay for itself by saving time and the cost of contracting a custom developer to write similar relatively common Intranet modules.

NetAfrique (http://www.netafrique.com) represents Catouzer/Evolution B in Ghana. David Maldima of NetAfrique created the CRnet Intranet Web site using Synergy. Contact Tetteh Padi or David Maldima at NetAfrique for more information:

Tetteh Padi, CEO
padi@netafrique.com

David Maldima, Developer
david@netafrique.com

Intranet Web applications would be based on relational databases managed by Microsoft SQL Server 7. This relational database is included with Microsoft BackOffice. Voter registration records, vote tallies, and many other types of information can be managed securely, reliably, and efficiently this way. This database software has the capacity required for these applications.

Other tools besides those I have specified could also be used to develop Intranet Web applications. For example, the specified server already includes Microsoft Internet Information Server (IIS). IIS supports technologies similar to ColdFusion called Microsoft Active Server Pages (ASP). Microsoft FrontPage 2000 and Visual Studio could be used in place of the Allaire and Catouzer products specified. The Intranet developers should be given a budget and consulting, if necessary, to select appropriate tools.

6.8.5. Printing

No additional printers have been specified for Phase 1. The NEC data center appears to have adequate printing capacity. If this is not the case, the authors recommend including one Hewlett-Packard LaserJet 4050TN monochrome laser printer identical to those specified for regional offices.

6.8.6. Network Wiring

Specifications in Annex E do not include wiring components to connect the router, switch, server, and additional PCs. These components will include Category 5 unshielded twisted pair (UTP) cable, RJ-45 connectors, and perhaps equipment racks, Category 5 patch panels, wiring and testing tools, and other installation hardware. The NEC data center has a large computer room and already has a LAN in place. They should determine where they will place the new equipment and how they would like to arrange the necessary wiring.

As the NEC LAN expands, the NEC data center should consider installing one or more floor-mounted 19-inch standard equipment racks to mount networking equipment and connections. Future servers and UPS units can also be mounted in these racks. This will simplify trouble-shooting and maintenance, and will conserve floor space.

6.8.7. Fault Tolerance

The gateway router and workgroup switch are unique devices in the configuration. If they fail, they must be replaced with equivalent devices. No electrical protection has been included for these devices, assuming existing electrical protection in the data center is sufficient. If this is not the case, an additional automatic voltage regulator and uninterruptible power supply may be needed.

The specified server has two power supplies. If one fails, the other carries the entire load until it can be replaced. Power supplies can be replaced without shutting down the server. The server uses a high-performance fault tolerant disk system. If a disk drive fails, it can be replaced without shutting down the server. All data on the disk is rebuilt automatically from information stored on the remaining disks. The software and tape system specified can backup the entire server automatically and unattended. The server is equipped with an uninterruptible power supply and is connected to it through a serial communications interface. The server monitors UPS power status and will shutdown smoothly and automatically before battery power is exhausted.

6.8.8. Security

The gateway router includes Cisco IOS Firewall, which supports dynamic firewall filtering, denial of service detection and prevention, Java blocking, and real-time alerts. This router also supports IPSec ESP DES and Triple DES and includes an expansion slot for future high-speed hardware-based encryption. IPSec Enables creation of virtual private networks (VPNs) by providing industry standard data privacy, integrity, and authenticity as NEC data traverses the public Internet. The WebRamp 315e specified for regional offices can be combined with PPTP support in Windows NT on the server to provide the same security independent of the gateway router.

The specified anti-virus software includes components to detect and clean viruses from Windows NT servers, Microsoft Exchange e-mail systems, and client PCs running Microsoft Windows 9x/NT/2000. The software can be configured to update virus signature files over the Internet. A two-year subscription provides updates to the virus scanning technology for that period.

The intrusion detection software specified is capable of detecting electronic intrusion attempts on servers and client PCs in the central data center and regional offices. It can notify system administrators automatically. It can also block intruders and notify all other computers on the NEC network to block intruders when they are detected. Management software included with this product can install intrusion software on new PCS automatically when they are connected to the network.

6.8.9. Expansion

Additional servers can be connected directly to the 12-port switch. Additional PCs and printers can be connected to the 12-port switch, or to other interconnected switches and hubs.

The specified server can be expanded to two processors and can accommodate an additional disk drive. Adding a separate disk drive enclosure can expand disk space further. Adding a second network interface card can expand network bandwidth to the server.

Servers of varying capacities and configurations can be added to the switch to divide the functions of file and print sharing, Web serving, database management, and security,

among separate systems. This will improve performance and capacity. The existing tape backup system can backup additional servers over the network.

7. Costs

Annex E includes detailed cost estimates. Total hardware and software costs for all offices are estimated to total 161,000 USD. This amount could be reduced by reducing the number of new PCs provided to the central office, and by delaying introduction of a new server in the central office. Roughly 85,000 USD of the total amount is for hardware and software for the central office. The remaining roughly 76,090 USD is for hardware, and software for regional offices. The estimated cost of preparing regional offices for the computing equipment is 30,000 USD. This amount may be high, and the NEC may pay some of this amount. Training and technical assistance costs have not been estimated.

Total operating costs, including only contract maintenance and telecommunications, are estimated to be between 46,000 USD and 88,000 USD per year for the entire Phase-I system. This does not include costs for operating existing equipment, and does not include consumable supplies or depreciation. The wide range of these estimates is due primarily to uncertain communication charges. Of this, as much as 24,000 USD may be required for a dedicated connection and ISP services for the central office. Regional offices may incur between 2,800 USD and 5,300 USD each in annual communications charges.

8. Technical Support

The NEC currently negotiates a central maintenance contract for photocopiers and similar equipment in central and regional offices. The central office manages this contract. Regional offices believe this arrangement meets their needs.

The computer equipment will be covered under *warranty* for from one to three years, depending on the equipment and purchase agreement. Required support from the vendor(s) must be managed during the warranty period. After warranties expire, repairs must be arranged as needed, or covered by a *maintenance contract*. Given the nature of this system, the NEC should negotiate an annual maintenance contract with authorized representatives of equipment manufacturers, as has been done for photocopiers. Normally it is best to negotiate this contract with the selected vendor as part of purchase.

Regional offices are almost entirely dependent on the central data center for technical support. Relatively poor telecommunications and long travel distances to many regional offices increases the importance of standardizing equipment and software configurations, providing redundant equipment, stocking a small supply of replacement units, and establishing a single point of contact for regional offices. If they do not have one already, the central NEC data center should establish a "*help desk*" to support regional offices. The help desk should be staffed by two or more persons, and should have a single telephone number and e-mail address for contact by regional offices.

The central office has a mature information center. The central NEC data center in Accra should be responsible for supporting computing capacity in regional offices. Specifically, they will be responsible for the following:

- Ensuring standard configurations
- General helpdesk trouble-shooting and technical support
- Training users in regional offices to use NEC Intranet applications, including electronic mail
- Coordinating equipment repair and replacement with regional offices and vendors
- Supplying regional offices with consumable supplies, including paper, printer ribbons, printer toner cartridges, removable media such as diskettes and tapes.
- Monitoring performance of the selected ISP(s) and coordinating with regional offices and ISPs to resolve communication problems.

The NEC information center should appoint a single contact in each regional office from among the existing staff. This person will server as the "*First Responder*" for the regional office for operational support of the computer equipment in that office. The NEC information center will train the First Responder in operating procedures and trouble-shooting simple problems. In the future, the First Responder may have additional duties, such as managing tape backup cartridges for a regional server. The First Responder will contact the NEC information center regarding any problems they cannot resolve, or are not expected to resolve, by e-mail, telephone, or fax.

Depending on the nature of the problem, the NEC information center may coordinate diagnoses and resolution with the contracted vendor, or with the manufacturer.

9. Training Requirements

Technical support and training are closely related. In general, better user training lowers technical support costs. The NEC data center should recognize this relationship.

Four types of training may be needed:

1. Basic computer literacy training for users in regional offices, as well some users in central NEC offices
2. Training for network operators in NEC data center in configuring and operating new network and server technologies
3. Training for developers in the NEC data center in Intranet Web site development
4. Training for users in regional offices in use of the Intranet Web site and custom modules developed for it (e.g. voter registration, vote tally)

The order listed above is also the recommended order of priority.

None of this training should be provided until the hardware and software is in Ghana, and USAID is confident it can be installed before training is finished. Training for network operators and developers in the NEC data center is an exception. The data center already has three Windows NT servers and a small 10BaseT Ethernet network. This would allow them to exercise new skills in these areas. Developers could build stand-alone development environments using limited versions of the necessary development tools (e.g. Microsoft Personal Web Server, Allaire ColdFusion Express, trial version of Synergy, etc.) This could allow them to build knowledge and skills while waiting for equipment and software to arrive.

The NEC data center should ensure that basic computer literacy training curriculum and materials are standardized for regional offices. Ideally training should be conducted using software and hardware identical to that specified for regional offices. However, it is likely training will need to be done using Microsoft Windows 98 and Microsoft Office 97. Training in Office 2000 is more important than training in Windows 2000. Even if this is not possible, differences in versions should not create a major problem when trainees begin working with the new computer systems.

Note that qualified instructor-led training in key technologies for NEC data center personnel will be difficult if not impossible to arrange locally. Web-based training is available, but requires a good Internet connection and can be expensive. Computer-based training (CBT) materials on CD-ROM can be shared over the existing network, and can be used repeatedly at the convenience of the student. *CBT materials should be ordered first, separate from the rest of the equipment, so it is available to the NEC data center as quickly as possible. The NEC data center should also be provided with licenses for Microsoft Windows 2000 Professional and Office 2000 Professional as quickly as possible so they can become familiar with these products.*

The following sections discuss training needs, alternatives, and recommendations in more detail for regional offices as well as the central NEC data center.

9.1. Regional Offices

9.1.1. Training Needs

The authors were able to assess the general level of computer literacy and experience in regional offices. Each regional office has one or two secretaries who have received basic personal computer training, including basic operating procedures, Microsoft Windows 3.1, WordPerfect, and Lotus 1-2-3. The central NEC office organized this training in 1992. Some secretaries have also attended training in Microsoft Office 4.3, with an emphasis on Microsoft Word and Excel. In some cases the Regional Director and Deputy Director have attended some PC training, but have not been able to exercise this knowledge. (Most regional offices are equipped with only one Intel 80486-based PC running Windows 3.1 per an average of 21 staff members.)

All intended users in regional offices need basic training in PC operation, Windows 2000 Professional, and Office 2000 Professional. Users who already have some training will have some advantage.

9.1.2. Trainees

Initially the two new PCs in each regional office are likely to be used for general word processing, Web browsing, and e-mail. The objective is to enable e-mail communications with central NEC offices, and access to the NEC Intranet Web site as soon as it is available. As applications are added to the Intranet, the new facilities will be used for voter registration, vote tally reporting, and related communications with the central NEC office. These factors should be considered when selecting personnel to be trained. Usage should not be limited to one or two secretaries, but should increasingly involve other positions in regional offices.

Initial training should include least two registrars, one election officer, the Director, the Deputy Director, and one secretary. The six recommended trainees in each regional office are as follows:

- Director (1)
- Deputy Director (1)
- Registry (2)
- Election Officer (1)
- Secretary (1)

Six trainees from each regional office is a reasonable number considering the number of PCs provided in Phase I, and that many training organizations are equipped to train six to twelve persons at a time with a single instructor and six or more PCs.

One of the selected trainees should be the "First Responder" selected by the NEC data center for that regional office, as explained in the previous section on technical support.

The Director and Deputy Director need a basic understanding of the capabilities of the new computing facility. The secretary will use the new PCs for general document preparation. Registrars and election offices will use e-mail to communication with the central office, and will use the PCs for voter registration and vote tally reporting when those applications are deployed. Voter registrars and election officers are expected to use the system to register voters, verify voter registration, print registration rolls, and submit vote tallies when these applications are developed.

These recommendations are based on the limited assessment included in this document. The NEC has much better knowledge of personnel and operations in regional offices and may select other trainees.

9.1.3. Training Courses

Table 3 lists suggested courses for personnel in regional offices. These are prioritized. Priority "B" courses are less important. Course names and descriptions are typical examples; specific names and syllabus content will vary depending on provider.

Table 3 Suggested training courses for personnel in regional offices.

Course Name	Duration	Priority	Description
Introduction to Personal Computing	½ day	A	Protecting equipment from dust, liquids, temperature extremes, and electrical extremes. Principle PC and printer components. Good operating procedures: startup, shutdown, use and storage of diskettes, loading paper in the printer, changing printer toner cartridge, basic printer front-panel operations, etc.
Windows 2000 Professional Introduction	1 day	A	Basic operating procedures: startup, login, logout, and shutdown; Windows desktop layout and indicators; using the mouse; starting and ending programs; navigating windows; managing files and folders; backing up your work; Windows maintenance
Introduction to the Internet	1 day	A	Origins; terminology (hypertext and hyperlinks, URL, browser); starting Internet Explorer; navigating Web sites; using search engines; communicating with others (e-mail, mailing lists and discussion groups and forums, chat rooms)
Outlook 2000 for Windows 95/98/NT/2000 Introduction	1 day	A	Creating and sending messages; reading and replying to message; managing addresses; managing message folders; working with appointments and events; using the task and contact manager
Word 2000 for Windows 95/98/NT/2000 Introduction	1 day	A	Word basics; navigating in a document; additional editing techniques; character and paragraph formatting; introduction to tabs and tables; controlling page appearance; tools and printing
Word 2000 for Windows 95/98/NT/2000 Intermediate	1 day	B	Document sections; tables; merging; styles and Autotext; introduction to templates; introduction to macros
Excel 2000 for Windows 95/98/NT/2000 Introduction	1 day	A	The paper spreadsheet; opening a file; entering and correcting data; saving a file; navigating worksheets and workbooks; working with ranges; working with functions; editing cells; modifying and copying data; formatting a worksheet; printing a worksheet
Excel 2000 for Windows 95/98/NT/2000 Intermediate	1 day	B	Working with charts; sorting and filtering data

A total of 5 and ½ days of high-priority (Priority A) training are recommended for each of six trainees in each regional office, totaling 330 trainee hours. On-the-job on-site training in short doses separated by realistic applications of lessons-learned is ideal. It is unlikely this can be arranged for all ten regions. Five days of continuous training is certainly not ideal, but might be necessary if trainees must travel outside their regions for the training. It

is critical equipment be installed and ready for use by trainees when they return to their offices. Three days of intermediate level (Priority B) training might be given several months later, *after trainees have had a chance to exercise what they learned in introductory courses*.

9.1.4. Training Arrangements

Basic computer literacy training for regional offices could be arranged through local or regional providers, or be conducted by the NEC data center. Logistics may require this training to be delivered in several locations around the country, if not in each regional office.

The site assessment for each region in this document includes a list of local organizations providing basic computer training. The authors did not evaluate these training providers. In general, public-sector providers of basic computer literacy training in Ghana do not provide good quality instruction, materials, or facilities.

Basic computer literacy training could be conducted in the NEC data center. This would depend on installation of new PCs in the data center. The data center might need to hire additional experienced instructors and acquire tested lesson plans. However, it would be comparatively easy to standardize curriculum and materials. The data center could accommodate as many as 30 trainees using 15 computers and five instructors. Training could be done in as little as two to three weeks. Trainees would incur travel and per diem expenses, and would be away from their offices for more than a week.

Training in regional offices would minimize travel and per diem costs, as well as disruption of regional office operations. Basic training in each regional office would depend on installation of new equipment in each site. Five to six trainees would need to be trained on two computers – a poor student/computer ratio. The NEC data center would need to provide as many as ten qualified trainers, perhaps through a combination of data center staff and trainers hired from other organizations. Many trainers would incur travel and per diem expenses. Training curriculum and materials would need to be standardized.

Training in three or more sites around the country may be a good compromise. This would allow the NEC to take advantage of training capacity in locations such as Kumasi, Cape Coast, and Accra. Compared to centralized training, travel and per diem for many trainees would be reduced. Compared to training in regional offices, travel and per diem for trainers or training monitors from the NEC data center would also be reduced. Training could be conducted in several locations simultaneously. Curriculum and materials could be standardized by the NEC data center.

Based on the authors' observations and on trainee evaluations, the CEDECOM Community Learning Center (CLC) in Cape Coast, and the CEDEP CLC in Kumasi could provide good quality training for users in the Central and Ashanti regions. The University of Cape Coast computing department is also equipped to provide training to larger groups, though quality should be assessed carefully before committing to this source. (The authors' were not impressed during their assessment of this program in 1998.) Trainees from Upper West, Upper East, Northern, Brong-Ahafo, and Ashanti regions could be trained at the CEDEP CLC in Kumasi, two regions and up to twelve trainees at a time. Western and Central offices could both train at the CEDECOM CLC in Cape Coast, perhaps at the same time. Eastern, Greater Accra, and Volta offices could train at the NEC data center or another selected provider in Accra. (The PIE CLC in Accra may be

prepared to provide training, but the authors' have not yet assessed that program.) *If training can be conducted in at least three separate locations simultaneously, basic computer literacy training for all regional offices could be completed in three to five weeks if conducted in three or more locations.*

Distance Learning via the Web is also available to build basic computer literacy skills. A list of Web sites offering these services is included at the end of this section. Dial-up connections and the cost of trunk calls will make on-line distance learning cumbersome and expensive for regional offices. Computer-based training (CBT) distributed on CD-ROM disks is more likely to be an effective method for building skills in regional offices through self-study.

Computer-based training (CBT) could be used to supplement instructor-led training and train new staff members at their own pace. Appropriate CBT products have been specified in Annex E with the hardware and software specifications. The specified PCs have CD-ROM drives and audio systems. *Quantities of CBT materials in Annex E would need to be adjusted to provide copies to all regional offices and the NEC data center.*

The NEC data center should be involved in arranging and conducting training for regional offices, since they will support these users. Similarly, if CBT materials are provided, the NEC data center is expected to manage distribution of these materials to regional offices. As use of computers increases in NEC regional and district offices, basic computer skills training and application-specific skills training will be a continuing need. The NEC data center should be closely involved, if not responsible, for the following:

- Reviewing and approving training content
- Evaluating and selecting training providers
- Coordinating training schedules with regional offices
- Monitoring the quality and effectiveness of training by observing or participating in classes and reviewing course evaluations and entrance/exit questionnaires

Training for users in regional offices in *Intranet applications* should be designed and conducted by the NEC data center. These will be mission-critical applications for the NEC, and the data center will be responsible for supporting them.

9.2. NEC Data Center

9.2.1. Training Needs

The authors did not conduct a detailed formal assessment of technical support staff in the NEC data center. Technical personnel in the NEC data center appeared generally knowledgeable, and are operating a basic Windows NT network. They used these facilities for the 1996 election. They may need more or less training than is included in the following set of recommendations.

The equipment and software specified for Phase I includes several new elements. The NEC will have a dedicated Internet connection via a router with firewall and VPN capabilities. Support personnel should understand the configuration of this router, particularly the security configuration, thoroughly. The Cisco switch specified in Phase 1 introduces Ethernet switching technology. Support personnel may also need better skills in Windows NT Server configuration and management, Microsoft SQL Server configuration and management, and Intranet Web application design and development. Network

components and servers will come with manuals, but additional training is necessary to use this equipment properly.

9.2.2. Trainees

Technical training should include network and server operations staff, and personnel selected to design and develop the Intranet Web site. At least two network and server operations staff should receive additional training. If some Web site development is out-sourced, training is still necessary for personnel responsible for Web server and Web site management and developing custom add-on modules for the Web site. At least to staff members should focus on learning Intranet Web site design, development, and testing methods and technologies.

Note that the NEC data center will also be engaged in arranging, monitoring, and conducting training for personnel in regional offices. Two or more staff members will need to focus on this task. These staff members will need some of the same training materials recommended for staff in regional office.

9.2.3. Training Courses

Depending on experience and skill level, technical staff may need training in the following areas:

- Microsoft Windows NT Server configuration and administration
- Microsoft SQL Server 7 configuration and management
- Microsoft Internet Information Server (IIS) configuration, and management
- Microsoft Windows 2000 Professional installation and configuration
- Microsoft Office 2000 installation and configuration
- Ethernet and TCP/IP networking
- Cisco router configuration
- Cisco IOS and Firewall Feature set configuration
- Cisco switch configuration
- Allaire ColdFusion application development

9.2.4. Training Arrangements

Training for network operators and developers in the NEC data center could be arranged through providers in Accra. On-site technical assistance in the form of on-the-job training would be most efficient considering the tight implementation schedule. *Providers of server and networking equipment, as well as the ISP providing the dedicated Internet connection should provide some on-the-job training as part of the purchase agreement.*

According to Microsoft there are no Microsoft Certified Technical Education Centers (CTECs) in Ghana. Cisco also does not list any Cisco certified training providers in Ghana. Local vendors should be able to provide some practical training in these technologies, but this training is unlikely to meet rigorous Microsoft and Cisco certification standards.

Computer-based training (CBT) materials on CD-ROM disks can be very cost-effective for students with the discipline to use them. They do not require an Internet link. In addition, they can be used repeatedly by any number of staff at any time. Purchase specifications in Annex E include some appropriate CBT products for technical staff in the NEC data center.

When the NEC data center has a relatively high-speed dedicated Internet connection, *Web-based distance learning* may also be a cost-effective way of building technical staff skills. Web-based technical instruction in appropriate topic areas is available from several sources. Table 4 lists some sources of online Web-based training and CBT materials for relevant Cisco and Microsoft technologies, as well as general technical instruction in networking and Intranet development.

Microsoft lists many sources of Web-based Microsoft technical training at the following Web address:

http://www.microsoft.com/train_cert/providers

Cisco lists Web-based technical training courses at the following Web address:

http://www.cisco.com/pcgi-bin/front.x/wwtraining/enh_learning_offers.pl

Web-based training may be updated frequently, and may allow student-teacher and student-student interaction, but it is often more expensive than CD-ROM-based CBT and requires a reliable Internet connection. CBT training on CD-ROM should be more cost-effective and more flexible. Cisco CBT in particular has a reputation for being effective.

CBT materials should be ordered first, separate from the rest of the equipment, so it is available to the NEC data center as quickly as possible. The NEC data center should also be provided with licenses for Microsoft Windows 2000 Professional and Office 2000 Professional as quickly as possible so they can become familiar with these products.

Table 4 Computer-based training and distance learning sources.

Source	URL	Description
Microsoft	http://mspress.microsoft.com/	Combinations of books and CBT
Smart Planet	http://www.smartplanet.com	Based in the USA. Spin-off of Ziff-Davis University. Membership is free. Instructor-led and self-study course. Most technical courses cost 29 USD each with a free membership. For 89 USD per year a member can take any number of courses without additional charge; only premium Some self-study courses use Macromedia Shockwave browse plug-ins for interactive exercises.
Wave Technologies	http://www.wavetech.com http://www.wavetech.com/trainingsolutions/	One of the world's premier sources for Web-based certification training in information technologies. First class, but not cheap. Good source for self-study CBT for Microsoft certification.
Learning Tree	http://learningtree.com	CBT materials for Windows NT administration, networking technologies, Intranet/Internet Web development. Each CBT product is 995 USD. Bundled sets of eight products cost less per product.
GlobalKnowledge	http://www.mindfire.com	CBT materials for Microsoft and Cisco technical training. Most Microsoft CBT products are 150 USD each.

10. Site Preparation

10.1. Summary

Computerization will take place in several phases, beginning with the installation of two personal computers (PCs) and one printer in each regional office. Minimum requirements for this first phase are simple. Most regional offices should meet these requirements with only minor changes. General requirements for Phase I include the following:

- A suitable room
- Physical security for the room
- A room air-conditioner (AC)
- Suitable electrical outlets and circuit
- A telephone line dedicated to the computer room
- Three tables or desks and two chairs

In comparison to regional offices of the Commission on Human Rights and Administrative Justice (CHRAJ), NEC regional offices are in much better shape. Some regional offices are ready for Phase I computer equipment now. Each NEC regional office was found to have a suitable room. A few will need additional tables and chairs. A few will need to shift an existing AC unit to the selected room, or install a new AC unit. Several will need to install new, strong, burglarproof window bars and stronger doors and locks. All NEC regional offices have at least two telephone lines. These are normally assigned to the Regional Director and Deputy Regional Director. Each regional office will need to dedicate one of their existing telephone lines to the computer room, or will need to install an additional line. The NEC should be able to use its position to get the necessary telephone lines installed by GT in time for testing, but should request those lines now.

The total cost for these changes should not be more than 3,000 USD (Ghø 12 million) per regional office. Most regional offices should be able to use existing AC units and furniture to come well below this figure.

Minimum requirements for Phase I are described in more detail below. Unless stated otherwise, these requirements are for two computers and one printer. Each regional office should consider selecting a larger room, sufficient for at least three computers and two printers, if such a room is available.

10.2. General Room Requirements

Each regional office should select one room for the first computers. This will simplify site preparation, since electrical, environmental, and security upgrades can be limited to one room only.

The room should be large enough for three standard-size desks and chairs. This should provide enough room for two PCs, a printer, and related electrical and communications equipment. As figure 3 shows, the minimum size for this room is about 10.5 square meters.

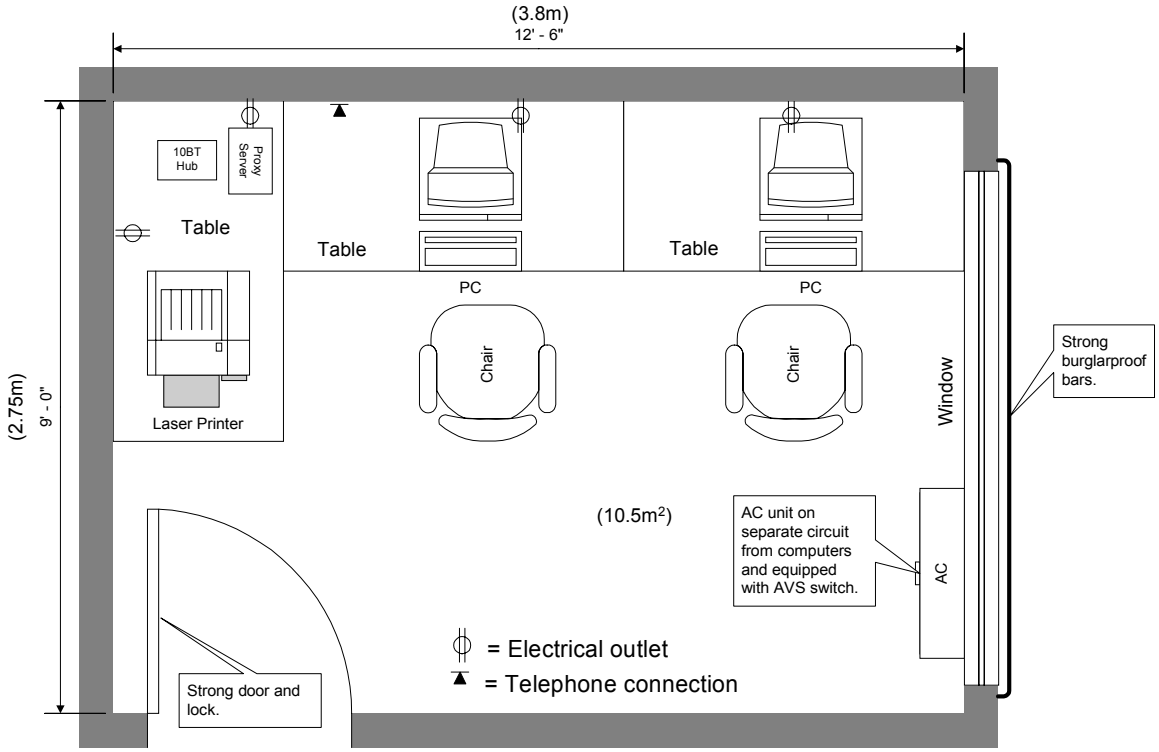

Figure 3 Example regional computer room layout for two PCs and one laser printer.

The example shown is the minimum size for this equipment. If the room is larger, it will be possible to install additional computer equipment in later phases. In further phases of development, each regional office may be equipped with six or seven computers an at least three laser printers. Most or all of this equipment will be networked. Some computers and printers will be located in other rooms within the regional office. If a larger room is prepared now, it will make it easier to add computers to the room later.

Figure 4 shows an example that can accommodate three computers and two laser printers with a floor area of about 15 square meters. The length and width of the room is not as important as the square meters of floor space. Any room of this general size that can accommodate this equipment is adequate.

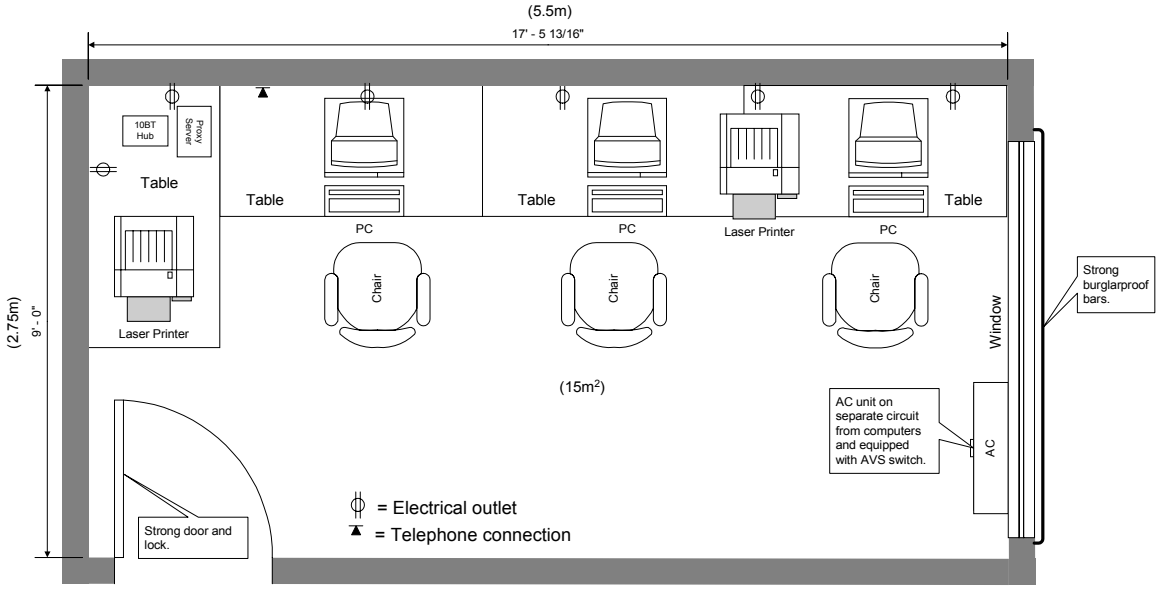

Figure 4 Example regional computer room layout for three PCs and two laser printers.

Table 5 lists the minimum requirements for computer rooms in regional offices.

Table 5 minimum requirements for computer rooms in regional offices.

Item	Description
Electrical	At least one electrical outlet for each computer, one for an Internet router/proxy server and 10BaseT network hub, and one for a laser printer. Total power draw of the computer equipment is estimated to be *1,328VA or 930 Watts*. The project will provide an *automatic voltage regulator (AVR)* and *uninterruptible power supply (UPS)* for each computer. The AVR will be connected to a wall power outlet. The UPS will be connected to the AVR. The computer and display monitor will be connected to the UPS, which has several electrical outlets. This will provide a high level of protection against current fluctuations. All *electrical outlets*, including any *electrical extensions*, should be *grounded*. An electrician should verify this. Ungrounded circuits are dangerous to people, increase the chance of lightening and static damage to equipment, and can disrupt network communications. Multiple outlet extension cords should be avoided if possible. If used, they should be the grounded type. The *router/proxy server*, *network hub*, and *laser printer* could be connected to a multiple outlet extension. Computer and communications equipment can be connected to ungrounded electrical outlets temporarily if necessary. The equipment will work. However, risk of damage to equipment, to network communications, and to people will be increased significantly. All equipment should be properly grounded as soon as possible, and

Item	Description
	computer and communications equipment should be protected from electrical disturbances by AVR and UPS units. It is important to have an electrician verify that the building electrical system has a proper ground to earth. Computer equipment should not be on the same circuit as air conditioning (AC) equipment, or any other equipment with periodic high-current demands.
Telephone connection	There should be at least *one telephone line* that permits trunk calling. This will be connected to the *modem,* which is connected to the *router/proxy server* for Internet access. If there is no router/proxy server, the modem can be connected directly to one of the PCs. This line could be used for voice calls, but only when not used by the computers. The project will provide a *telephone line surge suppressor* to protect the modem from high voltages that may be conducted through the telephone line.
Air conditioner	The room should have a working *air conditioner (AC)* to reduce and stabilize temperature and humidity. The air conditioner should not be on the same electrical circuit as the computers. If the air conditioner is on the same circuit as the computers and communications equipment, it may disrupt their operation. The project will provide an *automatic voltage switch* (AVS) to turn of power to the AC if the electrical current exceeds safe levels. This should extend the life of the AC unit.
Furniture	The room should have *three desks or tables and two chairs*. These may not look as nice as those in Figure 3, but as long as they are functional, that is enough.
Windows	Windows *should be closed* to protect the equipment against dust and rain. If necessary, seal broken and loose louvered windows with plastic. There should be a grid of *burglarproof bars* outside the window.
Door	There should be *strong door with a good lock*. The regional office should limit access to the keys to the room, and should make sure the room is locked with not in use.

10.3. Specific Requirements

Table 6 lists specific recommendations for each regional office. These are based on the site assessments indicated in the table.

Table 6 Specific site preparation recommendations for each regional office.

Office	Date Assessed	Assessed by	Comments
Central Office	20-Dec-1999	Cressman Gyamfi	▪ Re-examine door and window security around perimeter of data center
Ashanti	7-Feb-2000 - 8-Feb-2000	Gyamfi	▪ Current location generally adequate. ▪ Install strong burglarproof iron bars outside windows ▪ Check electrical circuits for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment
Brong Ahafo	9-Feb-2000 - 10-Feb-2000	Gyamfi	▪ Current location generally adequate. ▪ Install strong burglarproof iron bars outside windows ▪ Provide additional tables and chairs for computer equipment
Central	16-Dec-1999	Cressman Gyamfi	▪ Current location generally adequate. ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary
Eastern	3-Feb-2000 - 4-Feb-2000	Gyamfi	▪ Current location generally adequate. ▪ Install stronger burglarproof iron bars outside windows ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment
Greater Accra			

Office	Date Assessed	Assessed by	Comments
Northern	25-Feb-2000 – 26-Feb-2000	Gyamfi	▪ Current location generally adequate. ▪ Install stronger burglarproof iron bars outside windows. ▪ Provide selected computer room with working AC unit. ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment
Upper East	29-Feb-2000	Gyamfi	▪ Current location generally adequate. ▪ Install stronger burglarproof iron bars outside windows. ▪ Make sure selected computer room has a working AC unit. ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment
Upper West	28-Feb-2000	Gyamfi	▪ Current location generally adequate ▪ Install strong burglarproof iron bars outside windows ▪ Make sure selected computer room has a working AC unit. ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment
Volta	23-Feb-2000 – 24-Feb-2000	Gyamfi	▪ Current location generally adequate ▪ Install strong burglarproof iron bars outside windows ▪ Make sure selected computer room has a working AC unit. ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment

Office	Date Assessed	Assessed by	Comments
Western	14-Feb-2000 – 15-Feb-2000	Gyamfi	▪ Current location generally adequate ▪ Install strong burglarproof iron bars outside windows ▪ Make sure selected computer room has a working AC unit – repair or replace the AC unit in the secretariat ▪ Check electrical circuit for current capacity and earth grounding; make sure AC circuit is separate ▪ Correct any problems found in check of electrical circuit; install new separate circuit for computing equipment if necessary ▪ Provide additional tables and chairs for computer equipment

11. Expertise and Level of Effort Required

11.1. Regional Offices

11.1.1. Configuration

The hardware and software configuration for each regional office should be assembled and tested at the central NEC data center. Data center support staff should work closely with vendors and any technical consultants to carefully assemble, configure, and test all components for the one regional office. *Technicians should take careful notes and use those notes to make detailed configuration checklists*. Completeness, accuracy, and clarity of those checklists will help ensure that all regional offices are configured the same way. Each set of regional office hardware and software should be completely assembled, configured, and tested in the NEC data center, then placed back in original boxes for delivery to regional offices. This will improve predictability, reduce support costs, and make it easier to restore configurations when necessary. It should also identify any out-of-box problems before materials are transported to the regions. Finally, it will allow more NEC data center support staff to become familiar with the configuration.

11.1.2. Installation

Regional offices must complete the tasks detailed in the section on site preparation before equipment is delivered. Electrical outlets, a telephone, furniture, and room security should be in place. Ideally regional offices should receive their new equipment in the order in which they complete their site preparation. However, equipment will need to be delivered and installed in several regional offices in the same trip to minimize travel. For example, equipment could be installed in Koforidua, Kumasi, Sekondi, and Cape Coast on the same trip.

At least one member of the NEC data center support staff should install or help install the equipment in each regional office. Each installation should take one day, including testing and orientation for regional staff members who received or will receive basic computer literacy training. In most cases the NEC data center staff member(s) and possibly a vendor technician, will need to stay overnight. The number of regional offices completed during a single visit will depend on distance, quality of roads, and capacity to transport equipment. Four is likely to be the maximum.

It should be possible to form two teams of two to three persons each to install equipment in regional offices. Each team will require a vehicle capable of transporting the computer equipment for two to three regions. This will allow both teams to be active at the same time, shorting the time required to complete these installations.

Table 7 lists tasks, expertise required, and estimated level of effort (LOE). Estimated LOE assumes experience and checklists from the first configuration, which should take considerably longer than subsequent installations. Installation and configuration of each regional office may therefore take ½ day. *Another ½ day should be used to introduce staff to the new system, review standard operating procedures, demonstrate Internet and Intranet access, and explain use of the printer*.

Table 7 Expertise and estimated level of effort required to install and configure equipment in regional offices

Task	Expertise Required	Estimated LOE (One Person)
▪ Assemble PC, UPS, and AVR ▪ Test PC hardware and software configuration ▪ Remove unnecessary software ▪ Install and configure anti-virus software ▪ Install and configure UPS software to monitor UPS status and initiate automatic PC shutdown ▪ Test PC/UPS configuration by disconnecting UPS from utility power while PC is running ▪ Install and configure Microsoft Office ▪ Install and test printer driver and printer sharing software	▪ Ability to read and follow instructions ▪ Experience configuring and supporting Windows 95/98/NT, and ideally 2000. ▪ Experience installing and configuring Microsoft Office 97 and ideally 2000.	1.5 hours
▪ Assemble, configure, and test printer	▪ Ability to read and follow instructions ▪ Some familiarity with laser printer setup	15 min.
▪ Assemble modem and network hub/proxy server ▪ Configure modem and network hub/proxy server (WebRamp) ▪ Connect printer and PCs to hub/proxy server ▪ Test dial-on-demand shared Internet connection from connected PCs ▪ Test ability to print from both PCs	▪ Ability to read and follow instructions ▪ Good understanding of TCP/IP and 10BaseT Ethernet networking ▪ Good understanding of PPTP VPN configuration for Windows NT Server ▪ Basic understanding of TCP/IP network security ▪ Good understanding of modem configuration and familiarity with Hayes extended AT modem commands ▪ Experience configuring dial-up ISP access	2 hours

11.2. Central Data Center

The selected ISP will install the dedicated Internet connection, and will register the NEC domain. *The appropriate domain is likely to be nec.gov.gh*. The ISP should install and configure the gateway router. The router specified in Annex E offers better performance and security than the model typically offered by ISPs in Ghana for dedicated connections. ISP technical staff should be able to configure this router. However, it is essential NEC data center staff to understand the configuration of this router and are able to assume full responsibility for its configuration with respect to security.

Data center personnel should be able to install and configure the network switch and network connections for the new server and PCs. Existing network hubs can be connected to the new switch.

Data center personnel should also be able to install and configure the new Intranet server. This requires some background in Windows NT Server, SQL Server, and Internet Information Server (ISS) configuration. The PPTP protocol must be installed and configured to support VPN connections from regional offices. It will also be necessary to configure and test tape backup.

Data center personnel should install and carefully configure McAfee Webshield, Netshield, and Groupshield anti-virus software on the server.

Data center personnel should conduct a careful audit of server security using the most recent information available from Microsoft. This will require downloading and carefully installing various service packs in the correct order, and verifying correct server operation. Intrusion detection software, specified in Annex E, should also be installed on the server and configured to install itself on each networked PC automatically.

The authors recommend a commercial Intranet foundation that can be expanded by adding custom-programmed modules. This software requires installation of Web application server software, and installation and configuration of the Intranet Web site. An experienced vendor should be able to do this better and faster than data center staff. However, data center staff should work closely with the vendor to make sure they understand the product and its configuration. The NEC must have a contingency plan in place to continue Intranet operation if the external vendor fails. Enabling data center staff to configure, manage, and extend the Intranet software is the most important step in this plan.

New PCs should arrive with Windows 2000 Professional installed. Data center personnel will need to remove unnecessary software from each PC, configure each PC for the network, then install and configure McAfee VirusScan and Office 2000 Professional. The intrusion detection software should be installed automatically from the network server. It may take two to three days to configure the first PC as a prototype. Data center personnel should take careful notes and construct checklists based on the prototype configuration. Using these checklists, it should take four hours or less to configure each additional PC. Data center personnel should be able to configure several new PCs at the same time. (Disk cloning software or new Windows 2000 Server Remote Installation Services can shorten this considerably, but take time to set up.)

Table 8 lists the expertise and estimated level of effort (LOE) required to install and configure the new equipment for the NEC central office.

Table 8 Expertise and estimated level of effort required to install and configure equipment in the NEC data center

Task	Expertise Required	Estimated LOE (One Person)
▪ Install and configure router and dedicated Internet connection	▪ Experience with Cisco router configuration, Cisco IOS, and the Cisco Firewall Feature Set ▪ Knowledge of ISP and PTT connection requirements	2 hours
▪ Install and configure network switch ▪ Connect switch to router ▪ Connect existing hubs to switch	▪ Experience with Cisco Catalyst switch configuration ▪ Good understanding of 10/100BaseTX Ethernet cabling standards and systems	1 hour
▪ Install and configure Intranet server, including: ▪ DLT tape autoloader ▪ UPS system ▪ Disk configuration ▪ Windows NT Server ▪ SQL Server 7 ▪ Internet Information Server (IIS) ▪ Exchange Server ▪ Veritas Backup Exec with SQL Server and Exchange Agents ▪ McAfee Netshield, and Groupshield ▪ NetworkICE ICEpac intrusion detection system	▪ Good understanding of Microsoft Windows NT server installation ▪ Understanding and experience installing and configuring the following BackOffice components: SQL Server 7, IIS, Exchange Server ▪ Good understanding of server backup systems and procedures	16 hours
▪ Install and configure Intranet Web site, including: ▪ ColdFusion Web application server ▪ Synergy Intranet framework	▪ Good understanding of the Web application server (ColdFusion)	8 hours
▪ Assemble and configure new PCs (PC, display monitor, UPS, diskette drive lock) ▪ Install and configure network access ▪ Install McAfee VirusScan ▪ Install MS Office 2000 ▪ Install BlackICE Pro intrusion detection (should be automatic from server)	▪ Experience configuring Windows 9.x/NT PCs in networked environments ▪ Good understanding of Microsoft Windows 2000 Professional installation and configuration options	4 hours per PC if not automated, much longer for the first PC

12. Implementation Plan

Figures 5 and 6 are an example Gantt chart illustrating the project timeline. Ideally all equipment should be in place and operating before the end of August, when NEC personnel will begin preparations in earnest for the December general election. *This means trying to trim at least 15 to 20 days off the schedules shown in Figures 5 and 6.*

As with many US Government information systems projects, equipment procurement is the critical path. There are several opportunities to reduce calendar time: reduce allowed Request for Quotations (RFQ) response time, and reduce time for evaluating responses and placing orders. Stated delivery time should be part of vendor evaluation, along with vendor technical support capability and track record.

At least four separate RFQs could be prepared:

1. Computer equipment and software
2. Computer-based training (CBT) materials and development software for the NEC data center
3. ISP services, including a dedicated Internet connection for the NEC data center and dial-up access for each of the ten regional offices
4. Intranet Web site development services, including software licensing, installation, configuration, and related technical training for NEC data center personnel

Computer-based training materials (CBT), and perhaps some key software, for the NEC data center should be handled as a separate fast-track purchase. The objective is to allow data center personnel enough time to use the materials before new equipment and software arrives.

Site preparation in regional offices can begin immediately. Regional Directors or Deputy Directors may need to be in their offices to oversee this work. Training for a regional office should not begin until the Director and Deputy Director no longer need to oversee this work.

The training schedule assumes each regional office receives five days of "Priority A" basic computer literacy training, there are at least three training centers, and each training center can accommodate trainees from two regional offices. Note that some NEC data center support staff should monitor this training closely. *Whether this can be done depends primarily on the availability of three training centers, each capable of training up to twelve persons on at least six PCS.*

The schedule assumes NEC data center personnel are formed into the following teams:

NEC Data Center Team	Task
PC Team 1	Install, configure, and test equipment in Greater Accra, Easter, Volta, Northern, Upper West, and Upper East regional offices
PC Team 2	Install, configure, and test equipment in Central, Western, Ashanti, and Brong-Ahafo regional offices
PC Team 3	Install, configure, and test new PCs on NEC LAN
Network Tech. Team	Work with ISP to install dedicated Internet connection to NEC LAN; install, configure, and test new network router, switch, and wiring
Server Admin. Team	Install, configure, and test new network server; work with vendor to install, configure and test Intranet Web site

If possible, this kind of team arrangement will allow several major tasks to be done at the same time, particularly deployment of new equipment in regional offices, installation of new network and server capacity in the NEC data center, and installation of new PCs on the NEC local area network (LAN). *Whether this can be done depends on the number and skills of NEC data center personnel*.

ID	Task Name	Duration
1	**Equipment Procurement**	**72 days**
2	Prepare Equipment RFQ	5 days
3	RFQ Response Period	30 days
4	Evaluate RFQ Offers	4 days
5	Vendors Selected	0 days
6	Place Orders	3 days
7	Shipping & Delivery	6 wks
8	**Internet Services**	**43 days**
9	Prepare ISP RFQ	5 days
10	RFQ Response Period	30 days
11	Evaluate RFQ Offers	5 days
12	Vendor Selected	0 days
13	Conclude Service Contract	3 days
14	**Intranet Development Services**	**41 days**
15	Prepare Intranet RFQ	5 days
16	RFQ Response Period	30 days
17	Evaluate RFQ Offers	3 days
18	Vendors Selected	0 days
19	Conclude Purchase & Service Contract	3 days
20	**CBT Procurement**	**27 days**
21	Prepare CBT RFQ	1 day
22	RFQ Response Period	14 days
23	Evaluate RFQ Offers	1 day
24	Vendors Selected	0 days
25	Place Orders	1 day
26	Shipping & Delivery	2 wks
27	**Train NEC Data Center**	**30 days**
28	Use of CBT Materials	6 wks

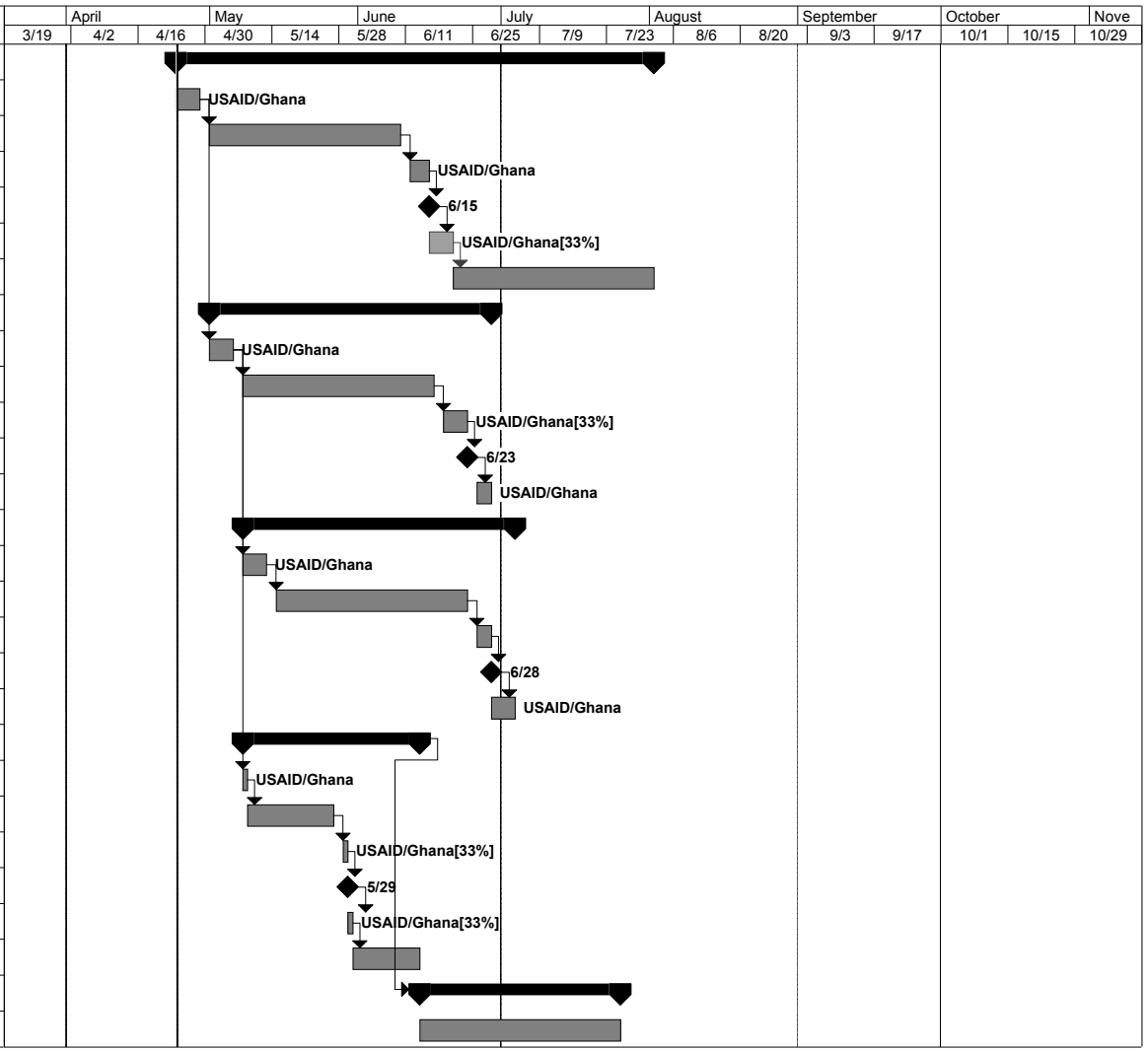

Figure 5 Example project implementation plan Gantt chart

ID	Task Name	Duration
29	**Site Prepare Regional Offices**	**13 days**
30	Check & Correct Electrical Problems	2 wks
31	Stengthen Building & Room Security	1 wk
32	Provide Tables and Chairs	1 wk
33	Move AC if Necessary	3 days
34	Regional Sites Prepared	0 days
35	**Train Regional Offices**	**15 days**
36	Train Upper West, Upper East	5 days
37	Train Northern, Brong-Ahafo	5 days
38	Train Ashanti	5 days
39	Train Central, Western	5 days
40	Train Greater Accra, Eastern	5 days
41	Train Volta	5 days
42	Regional Offices Trained	0 days
43	**Deploy Regional Offices**	**26 days**
44	Configure & Test	12 days
45	Deploy Greater Accra, Eastern, Volta	6 days
46	Deploy Central, Eastern	4 days
47	Deploy Ashanti, Brong-Ahafo	6 days
48	Deploy Northern, Upper West, Upper East	8 days
49	Regional Offices Deployed	0 days
50	**Upgrade NEC Data Center**	**9 days**
51	Install & Configure Internet Connection	1 day
52	Install Ethernet Switch & Wiring	5 days
53	Install & Configure Server	2 days
54	Install & Configure Intranet Web Site	1 day
55	Install & Configure New PCs	9 days
56	NEC Data Center Upgraded	0 days

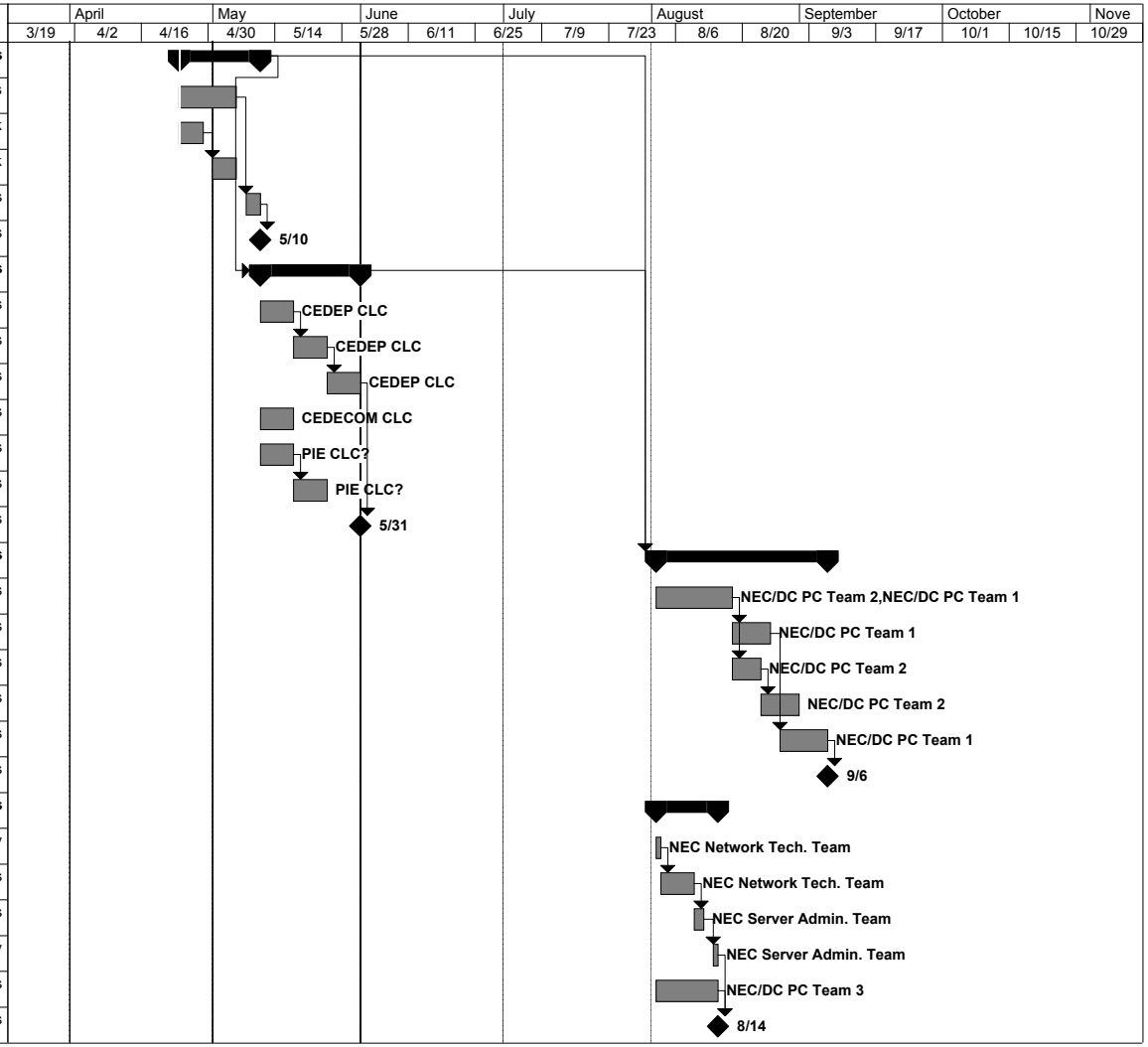

Figure 6 Example project implementation plan Gantt chart (cont.)

Annex A: Scope of Work

EDUCATION FOR DEVELOPMENT AND DEMOCRACY (EDDI)

SCOPE OF WORK

Assessment of Requirements for the Regional Offices of the
The National Electoral Commission (EC) and
Commission of Human Rights and sow.rtiAdministrative Justice (CHRAJ)
To be networked and have Full Internet Connectivity

I Background:
The Education for Development and Democracy Initiative (EDDI) is designed to improve the quality of and technology for African education to assist with Africa's integration into the world community of free-market democracies. This Intergovernmental initiative is a result of President William Clinton's March 1998 visit to Africa and reflects his commitment to strengthen educational systems and democratic principles in Africa.

The Internet and other new technologies are observing unprecedented rapid advancement in information science and play an important role in the development process. There are seven distinct Internet activities currently supported by the USAID Mission to Ghana. In order to maximize the benefits of each of these activities the ***Ghana Education and Democracy Network*** is being established under the Education for Development Initiative (EDDI) to link the existing connectivity projects as well as serve as a catalyst for initiating new activities.
USAID/Ghana's Strategic Objective #4, *Public Policy Decisions Better Reflect Civic Input,* will implement activities targeted at two key *independent governmental institutions*, the Electoral Commission (EC) and the Commission on Human Rights and Administrative Justice (CHRAJ). ***Ghana Education and Democracy Network*** support will assist these institutions in their capacity to communicate internally and among other institutions, and to facilitate outreach and civic education to the rural and urban citizens.

Long-term sustainability of Ghana's electoral process will be facilitated by several technological innovations. Information technology used to speed the distribution of voter education material that will further enhance public and political party confidence in the electoral process. Specifically the EC's 10 regional offices require computers and internet connectivity to facilitate communications with civil society in Ghana, to facilitate data transfer from field to headquarters central data bank, for enhanced internal communications resulting in better managerial practices, and better flow of information from headquarters to regional offices. The EC will also establish a web-page that will create links between it and other election authorities in Ghana and around the world such as the International Foundation for Elections Systems and Sweden's International IDEA. Currently Ghana's EC is the secretariat for the African Association of Election Authorities (AAEA), a web-site for AAEA can also be established with appropriate links. The benefits of such links are enormous in sharing best practices in sustainable, credible election administration and on-line training.

Ghana's EC would not only benefit from better data flow, planning and secure vote tabulation transfer, but better access to information would enable the EC to provide more information to its staff through on-line training and community outreach for voter education. Ghana's electoral process would be universally strengthened from voter education to registration and voting day. Enhanced confidence brought about by information technology will augment the legitimacy of Ghana's electoral process thereby assisting the process of democratic consolidation. They key result from increased usage of information technology is to contribute to the building of an elections authority on Ghana with advanced administrative techniques for long-term sustainability of Ghana's multi-party democracy.

The second target institution, the Commission on Human Rights and Administrative Justice, is Ghana's front-line constitutionally established institution dedicated to monitoring, reporting and acting on human rights and corruption abuses. CHRAJ currently has offices in Accra and all of Ghana's 10 regions, however their efforts are stymied by lack of resources that enables them to carry out their functions as completely as possible.

CHRAJ will be supplied with computer and Internet communications equipment from its headquarters to all 10 regional offices. Better data management will enable CHRAJ to effectively monitor, report, catalogue and track human rights abuses, especially those perpetrated against society's more vulnerable women and children, and instances of official corruption throughout the country. This will enable important trend analysis in human rights abuses and corruption in Ghana. Through their enhanced access to information and communications, CHRAJ regional offices will also serve as resource centers on human rights and anti-corruption education and provide a valuable link to the numerous civil society organizations involved with human rights education at the local level. CHRAJ will have facilitated means of information access to keep their regional and district level investigators informed about international trends, training and investigative techniques and conferences. Enhanced internal commission communications will facilitate improved management and coordination. Regional offices will also be able to compare cases from region to region and offer expertise to colleagues without expensive in-country travel. CHRAJ will also establish a web site that would be dedicated to informing the community on human rights and corruption in Ghana.

II Objective:
The objective of this assessment it to obtain a report on the technological and institutional factors and requirements that must be addressed in order to establish a network and full Internet connectivity at EC and CHRAJ.

The Report will be developed from and expert assessment of the following:

- The current state of the telecommunications network of the organizations
- Ways and means of improving the existing telecommunications infrastructure and of introducing fully functional Internet connectivity the meets the needs of the organizations.

The Report arising for the assessment will be structured in such as way as to serve as an implementation plan by which the organizations can achieve the above objective. The report will also provide a series of recommendations to USAID/Ghana as to the best approach to establishing the regional networks and introducing full Internet connectivity to the two organizations.

III Tasks:

The contractor will conduct an assessment of the current capabilities of the telecommunications system of EC and CHRAJ at the headoffices in Accra and the regional offices throughout Ghana. The equipment and capabilities of their current system will be assessed as will its potential for expansion/improvement to meet current and future telematics needs of the organizations. The contractor will also assess the computer training required to equip the staff of both organizations to use this new system and the estimated cost of each of the networks.

III Deliverables:

Assessment Report/Strategy Document

The Contractor will submit an Assessment/Strategy Document to USAID/Ghana. The report will include the following elements:

- Executive summary - including a concise statement of conclusions and recommendations.
- Equipment needs with detailed specifications
- Computer training required for Staff to use the system
- The best type and available internet technology to be used
- Estimated Cost of Networking and provision of full connectivity for each organization
- Kind of expertise needed to execute the projects and level of effort
- An implementation Plan

Appendices - including this SOW, a description of the methodology, a bibliography and a list of persons/agencies contacted.

Annex B: Principal Persons Contacted

Africa Online

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Fax: 021-226849
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Kwadwo Owusu, Sales and Marketing Manager
Mobile: 024-353505
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NEC Central Office

National Electoral Commission
P.O.Box M214
Accra, Ghana
Telephone: 228-421, 228-432, and 228-452
Fax: 223-328
E-mail: NEC@ighmail.com

Mr. Hubert Akumiah, Data Processing Manager.

NEC Ashanti Regional Office

Box 1589
Kumasi
Tel: 051-28466 (Director)
Tel: 051-28165(Dep. Director)
Tel: 051-26061 (Main Office)

Mr. K. Isaac Boateng, Regional Director
Mr. Sam A. Ntow, Deputy Director

NEC Brong-Ahafo Region Office

Box 1349
Sunyani
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Tel: 061-23695

Mr. Amadu Sulley, Regional Director
Mr. Yahya Mahama, Deputy Director

NEC Central Region Office

Box 548

Cape Coast
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Fax: 042-322269

Mr. Mark Anyinadu, Regional Director
District Officer, Mfantsiman (Saltpond)

NEC Eastern Region Office

Box 193
Koforidua
Tel/Fax: 081-22749 (Director)
Tel: 081-23202 (Dep. Director)
Mr. C. O. Addei, Regional Director
Mr. Paul Boateng, Deputy Director

NEC Northern Region Office

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Mr. Isaac Asomaning, Regional Director
Iddrisu Adam, Deputy Regional Director

NEC Upper East Region Office

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Bolgatanga
Phone: 072-22474 / 23188
Tel/Fax: 072-23074

Mr. J. Carl-Rhule, Regional Director

NEC Upper West Region Office

Box 220
Wa
Phone: 0756-22137
Tel/Fax: 0756-22357

Mr. Kwame Boateng, Regional Director

NEC Volta Region Office

Box 138
Ho
Phone: 091-26669 / 26601
Tel/Fax: 091-26486

Mr. Mohamed K. Adoquaye, Regional Director
Innocent Akoto, Deputy Regional Director

NEC Western Region Office

Box 283
Sekondi
Phone: 031-46905 / 46176 / 46129
Tel/Fax: 031-46996

Mr. J.W.K. Kwaw, Electoral Officer, Sekondi

(The Regional Director, Mr. Sammy Aidoo, was out of the country and the Deputy Regional Director had not yet arrived at post.)

natel

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Internet: http://www.ghana.com, http://www.ncs.com.gh

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William Tevie, Chief Technical Officer
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USAID Mission to Ghana

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Annex C: Site Assessment Guidelines

USAID/Ghana Strategic Objective #4: ***Public Policy Decisions Better Reflect Civic Input***

Meet with the Director and Deputy Director of the office. Introduce yourself. Explain the background and purposes of the visit.

Address

Office mailing address, telephone, fax, and e-mail

Principal Persons Contacted

List the names and titles of key persons interviewed during the assessment.

Location

Provide a general description of the location of the facility.

Description of Region

Collect statistics to estimate local data processing and communications requirements

- Number of constituencies
- Estimated number of registered voters
- Number of districts
- Method of communicating with districts
- Distance by road to the farthest district from the regional office

Description of Site

Describe the building(s) and facilities.

- Do they have a suitable place for the equipment?
- What would need to be done to provide a suitable location?
- How is the building arranged?
- How many rooms?
- What are the assigned purposes of major rooms?
- Is the building secure? Can the doors be locked? Are the windows secure?
- What is the condition of the electrical wiring?
- Does the electrical service appear adequate?
- Have they experienced electrical problems? Outages? Equipment failures?
- Which rooms have working air conditioners?

Staff

- How many staff members are in the regional office?
- How many staff members are in each district office?
- What are their positions?
- How many would be using the computers?
- What is their current level of computer literacy?
- Have they had any training to date?
- Where did they get it? When? How often do they use computers? What for?
- What are their main tasks and processes now?

Telecommunications

- How do they communicate with the main office in Accra?
- How many telephone lines are in the office?
- Where are they located and who uses them?
- How reliable is the telephone service?
- How do they communicate with district offices? Is this method reliable?

If possible, test the telephone circuits by dialing the nearest POP, and by dialing a POP in Accra. What speed did you get? Try several times to see what the range of connection speeds is. Stay on for a while to see whether the connection is reliable.

- Do they use the Internet now? If so, who has access? What do they use it for?
- What are the nearest ISP POPs?
- What are the plans of each ISP to provide service to the area?
- Are their other organizations that might provide service?

Computer Equipment

Obtain a complete and accurate list of existing computer equipment, including make, model, and general condition

- Computers?
- Printers?
- Modems?
- Other peripherals?
- Operating system and version?
- Software applications and versions?
- UPS?
- Voltage regulator?
- Surge suppressor?

Other Equipment

- Photocopiers?
- Other major electronic equipment?

Equipment Maintenance and Repair

- When the computer, printer, photocopier, or other electronic equipment breaks, how do they get it repaired?
- Where do they have to take the equipment?
- How do they pay for it?
- Is any of the equipment covered by a maintenance contract?

Consumable Supplies

- Where do they get paper for printers and photocopiers?
- Where do they get ribbons for dot-matrix printers?
- Where do they get toner cartridges for photocopiers?
- Where do they get diskettes for computers?
- Are any of these items difficult to get?
- Who pays for supplies?

Recommendations

- What changes are needed in the building structure?
- Air conditioning?
- Door and window security?

- Electrical wiring and service?
- Existing computer equipment?
- How many computers could they use productively?
- Will they need additional tables/desks and chairs?
- How many staff members require training or re-training? In what subjects? To what level?
- What sources of appropriate training are there in the area?

Annex D: Site Assessments

Central Office Data Center

Address

National Electoral Commission
P.O.Box M214
Accra, Ghana
Telephone: 228-421, 228-432, and 228-452
Fax: 223-328
E-mail: NEC@ighmail.com

Principal Persons Contacted

Mr. Hubert Akumiah, Data Processing Manager.

Location

Processing

During elections, regional offices fax election results to the central office. There are 120 electoral districts (sub-metro areas are included). There are 110 administrative districts. There are 200 constituencies in the country, and 50 to 250 polling stations per constituency. Each constituency has an election return form that consists of about two pages. There are normally only ten or so names on the ballot for each constituency. Polling stations count results manually. Districts tally results manually. Regional offices may use calculators.

Roughly 400 sheets of paper are faxed to the central office to submit returns from all constituencies.

Description of Site

General Layout

The compound includes several interconnected buildings. The computing facility is divided into a mid-size server room and larger data entry room, both with raised floors.

Security

Physical security appears adequate. The NEC should examine window and door locks on the perimeter of the data center to make sure it is not easy to break in and remove critical equipment.

Electrical

Electrical wiring appears relatively new and in good condition. It may have been upgraded when the computing facility was installed. It has sufficient capacity for existing equipment and should have enough capacity for the additional equipment envisioned.

Environmental

Most rooms have air conditioners that appear to be in good working order. The computer room in particular appears to have adequate environmental controls.

Staffing

Computer Literacy

Data center personnel are proficient with existing equipment and software. They have developed considerable skills extending the life of existing equipment, and building on what they have incrementally. They may require training in network security and Intranet design and development methods and technologies.

Telecommunications

There is one fax machine and three telephones in Electoral Commissioner's office. There are several other telephone lines in the facility. Ghana Telecom provides about ten dedicated lines during elections. These are used for voice calls to coordinate vote processing and to communicate and crosscheck vote tallies.

They currently use a dial-up ISP account with InternetGhana for e-mail and Web access from modem-equipped PCs. There is no shared Internet connection, dial-up or dedicated.

Computer Equipment

The data center includes a Bull Unix minicomputer with 20 terminals. The Bull minicomputer is a DPX2/2 with 5GB of fixed disk storage. This system was used for the 1992 election and has essentially been phased out in favor of Microsoft Windows NT 4.0 servers and PCs on a local area network (LAN).

There are two Windows NT servers, and a third utility server with the only tape backup. Two of the Windows NT servers are Pentium II 300Mhz models with 10GB of fixed disk storage and CD-ROM drives. The Windows NT servers and LAN were used for the 1996 election.

They reported having 50 PCs on an Ethernet LAN. I saw one small wall-mounted rack and a wall-mounted hub. All PCs are 486 and are non-Y2K compliant. They are beginning to replace them now.

They have two Genicom 4490xt high-speed printers with parallel interfaces. These they have connected to PCs or Windows NT servers. They also have two Bull PR54 line printers, which they can interface to the PCs, and one HP LaserJet 4 laser printer.

They have a Gerin EPS 2000 20KVA uninterruptible power supply (UPS).

Other Equipment

There is one room reserved for collating voter registration forms for each region. There is no computer equipment in this area.

They have been using optical mark recognition (OMR) scanning for voter registration. The scanners are made in the US and were provided by the British government. The manufacturer has no representative in Ghana. A qualified technician must be flown in from the UK occasionally to service these machines. They have been cannibalizing broken machines to repair others.

When they work, they work well. They currently have six working scanners. A Microsoft Access application is used as a front-end to the scanning software. Results are placed in a text file then imported into the central Voter registration database.

About 0.5 million voter registrations are reviewed each year.

One OMR scanner can scan about 40,000 forms per day.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

All consumable supplies are obtained locally. There does not appear to be any serious difficulty getting these items.

Recommendations

This data center does not appear badly run. Most of the equipment is still functional, but is non-Y2K compliant and would be considered somewhat obsolete. They have plenty of printing capacity. PCs need to be replaced with Y2K compliant models. All servers need to be equipped with tape backup drives. They may need some additional peripherals, such as a CDR (CD read/write) drive for archival storage.

In general the center appears capable of supporting an Intranet Web server for continuous on-line voter registration, as well as a public Web server. However, none of the existing servers are suitable for mission critical Intranet and database applications. They are not fault-tolerant systems, and do not have the necessary disk capacity. In addition, tape backup is entirely insufficient.

A dedicated connection to the Internet is necessary for the center to provide the following Intranet services:

- Continuous online voter registration
- Electronic check of voter registration
- Electronic submission of vote tallies
- Online access to internal policies and procedures documents
- Electronic mail

In addition, the center could then host a Web site to provide information to the general public.

The center will need a leased or dedicated line and unlimited Internet access. Associated connecting equipment, domain registration, DNS, and other services should be purchased through competitive bidding of local ISPs.

Security should be a significant concern. The NEC network should have a reasonably high level of protection against electronic intrusions at all connecting points. Installing a dedicated firewall appliance, and eliminating all unsecured modems, would meet this need. A good firewall appliance can cost 18,000 USD. Software firewalls are available for as little as 2,000 USD. A border router with network address translation and packet filtering capability is less expensive and is certainly better than no protection. Inexpensive intrusion detection software can help alert system administrators and stop intruders.

Regional offices need similar protection. Assuming communications between regional offices and the central data center travel over the public Internet, they need to be encrypted. In addition, both parties in the communication need to be authenticated. Virtual Private Networking (VPN) technologies, including the IPSec protocol, can be used to provide this protection. Finally, physical security should not be neglected. Diskette drives can be locked to prevent unauthorized removable/insertion of sensitive data on diskettes. Doors and windows can be secured when facilities are not in use to prevent intruders from tampering with the system, or removing computers containing sensitive data.

Site Preparation

No site preparation should be necessary to add the equipment necessary to meet NEC objectives. The space, electrical service, and environmental controls, should be sufficient. It should not be difficult to install additional network cable in the building.

Computing Equipment

The center will require telecommunications equipment for a dedicated Internet connection. An ISP may provide this equipment. In addition, the center needs a firewall or a gateway router with some firewall features.

The center will require at least one new mission-critical server for Intranet applications. Ideally, the center will need new Intranet Web, database, and electronic mail servers. One server can also function as a Primary Domain Controller (PDC). A second server can double as a Backup Domain Controller (BDC). Existing servers can be used to provide some file and print services, or can be used for development.

The center needs to replace or upgrade all existing PCs with Y2K-compliant models capable of running current software releases.

The center may need additional networking equipment to connect new servers and PCs. This may include one or more additional hubs, and a floor-standing rack system.

Training

Data center staff should receive qualified training in network security policies and technologies. Selected staff will require training in Intranet application design and development.

Ashanti Region Office

Address

Box 1589
Kumasi
Tel: 051-28466 (Director)
Tel: 051-28165(Dep. Director)
Tel: 051-26061 (Main Office)

Principal Persons Contacted

Mr. K. Isaac Boateng, Regional Director
Mr. Sam A. Ntow, Deputy Director

Location

The Ashanti Regional Administration Office compound- Nhyiaeso, Kumasi

Description of Region

The region has twenty-one districts covering thirty-three constituencies and about 1.6 million registered voters. Most districts (except three) have telephones. Radio Communications Equipment has been installed in all the districts except the four districts within the Kumasi metropolitan area. Travel to district capitals is usually not difficult and they are all within 65 miles from Kumasi.

Description of Site

General Layout

The regional office currently has rooms designated for the Director, Deputy Director, Secretariat, Main Office, Accounts Office and Stores. A new two-story building (ground floor + 2 extra floors) is near completion. According to schedule it should be completed by the end of May 2000. It is located behind the current office block on the same compound.

Security

The entrance to the buildings and doors to individual rooms can be locked and windows are of the glass louver type. The windows for the new building are of the glass panel type but no burglarproof protection yet.

Electrical

The electrical service in the building currently seems adequate. The contractor for the new building will have to ensure adequate electrical supply and separate the circuits for the air conditioners and the computers.

Staffing

The regional office has twenty (20) staff members and the minimum staff positions at each of the 21 districts are:

- District Officer
- Assistant District Officer/Electoral Officer

- Secretary/Typist
- Driver

Computer Literacy

Two Secretaries in the regional office received training in Accra and three employees in the districts have had some training privately. The Regional Director and his Deputy also took Word and Excel courses but do not have microcomputers to work with. Most staff members will need basic training or refresher courses to cope with operating system and application software changes.

Telecommunications

The Regional Director has a telephone/fax line connected to a Canon fax machine and the Deputy Regional Director has a regular telephone. Another telephone line is in the Main Office. There is Barrett Radio Communications equipment in the Secretariat.

Computer Equipment

There is one ICL M75/33 microcomputer running Windows 3.1 and Word 6.0 software in the Secretariat/Computer room. An Epson LQ 2550 dot matrix printer is connected to the computer.

Other Equipment

There is a Xerox 5026 photocopier in the Secretariat.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major supplies are requested from Accra.

Recommendations

Site Preparation

Physically the site is secure and there is already air conditioning in all the rooms except the Main Office.

An external grid of reinforced bars should be installed behind the windows of the rooms containing the computers.

Separate circuits for air conditioners and the computers should be provided. Earth grounding should also be taken into account as well as automatic voltage regulators in addition to uninterruptible power supply (UPS).

Additional tables and chairs will be needed to accommodate new computer equipment. The project needs to resolve who will provide the furniture.

Computing Equipment

The existing computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

One computer and one printer should be allocated to the Regional Director for confidential communications with the central office in Accra. The other computers and printers should be located in a single room for shared use by the rest of the staff. All equipment should be networked to allow the printers to be shared. At least two printers are necessary to provide backup if one fails.

Training

All the members of staff would need basic computer literacy and skills training. Training should include an introduction to Microsoft Windows, Microsoft Word and Excel to the intermediate level.

Training facilities in Kumasi include the following centres:

- Community Learning Centre(CLC), Kumasi
- GoldLink Institute
- Computer Processing Centre (CPC)
- "J" BAE-COM Computer Services Ltd.
- APS Computer Training Schools
- Klassy Computer Training School

Brong-Ahafo Region Office

Address

Box 1349
Sunyani
Tel/Fax: 061-27053 / 27297 (Director)
Tel: 061-23695

Principal Persons Contacted

Mr. Amadu Sulley, Regional Director
Mr. Yahya Mahama, Deputy Director

Location

Opposite Food Distribution (GFDC), off Main Kumasi Road

Description of Region

The regional office has about 25 employees. There are thirteen districts with twenty-one constituencies with a total of about 1 million registered voters. Atebubu, the farthest district capital, is about 80 miles from Sunyani. District offices generally communicate with the regional office by telephone and radio communications.

Description of Site

General Layout

The regional office has rooms designated for the Director, Deputy Director, Accounts. Secretariat/Typing, Stores, Registry and Conference Room. The rooms are well kept.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are the glass louver type with an external grid of wire mesh, which is not very strong.

Electrical

The electrical service in the building currently seems adequate but should be rechecked with the new equipment demands in mind. There is air conditioning in the Director's and Deputy Director's offices as well as the Typing Pool/Secretariat.

Staffing

There are about 25 staff members in the regional office. Each district office has at least the following positions:

- District Officer
- Clerk
- Typist
- Driver

Computer Literacy

Two secretaries have had some training but they do not believe it was adequate. There is no functioning microcomputer in the office for them to improve their skills.

Telecommunications

The Regional Director has a telephone/fax machine and the Deputy Regional Director has a regular telephone. There is Barrett radio communications equipment in the Radio operations section in the Secretariat/Typing room.

Computer Equipment

The two microcomputers in the office have been sent to Accra for repairs and/or replacement.
The office therefore has no functioning microcomputer.

Other Equipment

There is a Xerox 5026 photocopier in the Regional Director's office.

Equipment Maintenance and Repair

Equipment maintenance contracts are through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major consumable supplies are obtained from Accra.

Recommendations

Site Preparation

Physically the site is secure and has air conditioning in the offices occupied by the Director, Deputy Director and the Secretariat. The wire mesh protection against break-ins will have to be replaced by reinforced bars (burglar proof).

New electrical circuits should be installed to support new computer equipment.

Additional tables and chairs will be needed for the computers to be provided. The project needs to resolve who will provide the furniture.

Computing Equipment

There is no microcomputer in use. One computer and one printer should be allocated to the Regional Director for confidential communications with the central office in Accra. The other computers and printers should be located in a single room for shared use by the rest of the staff. All equipment should be networked to allow the printers to be shared. At least two printers are necessary to provide backup if one fails.

Training

Training for employees should start from scratch with the basics and should include Microsoft Windows as well as Microsoft Word and Excel to the intermediate level.

Training facilities in Sunyani include the following centers:

- Ghana Business Research Computer Training Centre (Sunyani Branch)
- MICLINK Computer Science Institute
- S & M Computer and Business Services Limited
- School of Computers & Information Technology

Central Region Office

Address

Box 548
Cape Coast
Tel:: 042-33338
Fax: 042-322269

Principal Persons Contacted

Mr. Mark Anyinadu, Regional Director
District Officer, Mfantsiman (Saltpond)

Location

The compound is between the junction of the Junkwas road into Cape Coast and the Cape Coast bypass, and the State Insurance Corporation (SIC) building.

Description of Region

There are twelve districts in the region. Each district office is staffed with at least four persons. On average there are 60,000 voters registered in each district, and a total of nearly 800,000 registered voters in the region. District offices communicate with the regional office in Cape Coast by telephone or by driving to Cape Coast. Straight-line distances to district capitals range from 12km to 110km. All but one is within an 80km radius.

Description of Site

General Layout

The regional office is in a small, well-built building with six rooms, not including a lavatory. Separate rooms are designated for the Registry, Regional Director, Deputy Regional Director, Operations Room, and Accountant. There are two storage rooms in a separate building. The rooms are generally clean and well kept. There is some evidence of water damage at the top of the walls in the Registry and below the windowsills in some rooms.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are closed by Venetian blinds that are protected against break-ins by an external grid of reinforcing bars.

Electrical

The main electrical and telephone connections to the building are to the left of the entrance. The electrical service in the building is probably adequate, but should be checked against estimated equipment demands before installing new circuits for the computers. There are only three electrical outlets in the operations room. Air conditioners are on separate circuits.

Environmental

Most rooms have air conditioners that appear in working order.

Staffing

There are 15 staff members in the regional office. There are about 90 staff members distributed in district offices, an average of 4 per district office. At a minimum, each district has the following staff positions:

- District Officer
- Electoral Officer
- Secretary
- Driver

Computer Literacy

One staff member (a secretary) knew how to use the computer. This secretary has now gone to the polytechnic. The Regional Director hopes to replace her with a national service staff member. None of the other existing staff members have personal computer experience. Some secretaries in district offices have used personal computers, but do not have access to them in the districts. The Regional Director suggested that these persons could be transferred to the regional office to take better advantage of new computers.

Telecommunications

The Regional Director has a fax machine and two telephones. There are three typewriters in the Registry and one in the Operations Room. There is a single computer in this building in the Operations Room.

Computer Equipment

There is one 80486DX/66 computer (ICL M75-33) with 8MB RAM. This computer dates from 1995. It is located in the Operations room. An Epson LQ 2550 dot matrix printer is connected to the computer. They use A4 cut-sheet paper in this printer. They use approximately one printer ribbon every three months. An APC BackUPS 800 UPS unit protects the computer system when power fails and provides some surge protection. There is no automatic voltage regulator. The computer is used primarily for word processing.

Other Equipment

There is a Xerox 5026 photocopier in the same room as the computer.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Some consumable supplies, such as A4 paper, is obtained locally. Other supplies, such as toner cartridges for the photocopier and ribbons for the dot-matrix printer, are obtained from Accra. There does not appear to be any serious difficulty getting these items.

Recommendations

Site Preparation

Physically the site is secure and already equipped with air conditioning. Water damage below windowsills indicates possible problems in the rainy season. This should be

discussed with the Regional Director during site preparation. Computer equipment may need to be located away from these areas.

We did not establish the capacity of the current electrical service. This should be verified after the computer equipment has been specified. The site will need new electrical circuits installed to support additional computers. The current wiring should be checked carefully to verify a proper earth ground.

The electrical current should be measured to determine the range of voltage fluctuations. The Cape Coast area has experienced unusually high voltages, and periodic high-voltage transients caused by lightening strikes on the grid. Special care should be take with sites in Cape Coast to verify earth grounding, and to install automatic voltage regulators in addition to uninterruptible power supplies.

Additional tables and chairs will be needed if more than two or three computers are provided. The project needs to resolve who will provide this furniture.

The Regional Director offered to move his office to the Operations room, allowing his current much larger office to be used for computer equipment. This is practical and commendable. Electrical improvements should not be made until the final location of the equipment is designated and made available. This should be clarified through a memorandum of understanding with the NEC.

Computing Equipment

The existing computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

This site could currently use at least six computers and three printers for preparing documents and communicating with the central office and other regional offices. This would provide roughly one computer for every three staff members.

One computer and one printer should be allocated to the Regional Director for confidential communications with the central office in Accra. The other five computers and two printers should be located in a single room for shared use by the rest of the staff. All equipment should be networked to allow the printers to be shared. At least two printers are necessary to provide backup if one fails.

Training

Everyone in this office needs basic computer literacy and skills training. Even if some secretaries with computer experience are transferred from district offices, their skills are likely to be rusty. Training should include an introduction to Microsoft Windows and training in Microsoft Word and Excel to the intermediate level.

Training could be arranged locally through the CEDECOM CLC. The CLC has the capacity to train up to twelve students at a time, is well equipped, and has experienced trainers. It could also benefit from the income. There are at least two other sources of training in Cape Coast: the University of Cape Coast Computer Center and Project Search Consultancy. The Author assessed these sources more than a year ago and believes the CLC is able to provide better quality training.

Eastern Regional Office

Address

Box 193
Koforidua
Tel/Fax: 081-22749 (Director)
Tel: 081-23202 (Dep. Director)

Principal Persons Contacted

Mr. C. O. Addei, Regional Director
Mr. Paul Boateng, Deputy Director

Location

Old Estates near the Ministries/Regional Administration Area

Description of Region

There are fifteen districts in the region with each district staffed with at least four persons. The regional office has about twenty-four employees. There are twenty-six constituencies with about 950,000 registered voters in the region. Some districts do not have telephone and/or radio communications equipment. Access to a district like the Afram plains is difficult and its capital is over 150 miles from the Eastern regional capital Koforidua.

Description of Site

General Layout

The regional office has rooms designated for the Director, Deputy Director, Chief Admin Assistant, Computer/Secretariat, Security, Operations, Accounts, Stores, Conference Room, and lavatories.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are the glass louver type with an external grid of wire mesh, which is not very strong.

Electrical

The electrical service in the building currently seems adequate.

Staffing

There are 24 staff members in the regional office. At a minimum, each of the 15 districts has the following staff positions:

- District Officer
- Assistant District Officer/Electoral Officer
- Secretary/Typist
- Driver

Computer Literacy

Three Secretaries have had some training, which they do no believe has been adequate. Furthermore the microcomputer in the office is an old Dell PC running old software. The

Regional Director and the Deputy Director also received some training but do not have any microcomputers to practice their skills on.

Telecommunications

The Regional Director has a telephone/fax machine and the Deputy Regional Director has a regular telephone. There is Barrett Radio Communications equipment in the Operations room.

Computer Equipment

There is one Dell OptiPlex 466/LE microcomputer running Windows 3.1 and WordPerfect 5.1 software in the Computer room/Secretariat. An Epson LQ 2550 dot matrix printer is connected to the computer. They use A4 cut-sheet paper in this printer. A UPS unit that protects the computer system when power fails and provides some surge protection has been sent to Accra for repairs. The computer is used primarily for word processing.

Other Equipment

There is a Xerox 5026 photocopier in the Regional Director's office.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Some consumable supplies, such as A4 paper, are obtained locally. Other supplies, such as toner cartridges for the photocopier and ribbons for the dot-matrix printer, are obtained from Accra. There does not appear to be any serious difficulty getting these items.

Recommendations

Site Preparation

Physically the site is secure and there is already air conditioning in some rooms including the computer room and the Regional Director's office. The wire mesh protection against break-ins is not strong and should be replaced by an external grid of reinforced bars (burglar proof).

The capacity of the electrical service should be verified after the computer equipment has been specified. The site will need new electrical circuits installed to support additional computers. Earth grounding should be taken into account and automatic voltage regulators should be provided in addition to uninterruptible power supply (UPS).

Additional tables and chairs will be needed for new computers. The project needs to resolve who will provide this furniture.

Computing Equipment

The existing computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

One computer and one printer could be allocated to the Regional Director for confidential communications with the central office in Accra. The other computers and printers should be located in a single room for shared use by the rest of the staff. All equipment should be networked to allow the printers to be shared. At least two printers are necessary to provide backup if one fails.

Training

Everyone in this office needs basic computer literacy and skills training. Training should include an introduction to Microsoft Windows and training in Microsoft Word and Excel to the intermediate level.

- Training facilities in Koforidua include the following centres:
- ICL Computer Training Institute
- VBS Information Technology Centre
- Erimak Computer Institute

Northern Region Office

Address

Box 169
Tamale
Phone: 071-22784
Tel/Fax: 071-22804

Principal Persons Contacted

Mr. Isaac Asomaning, Regional Director
Iddrisu Adam, Deputy Regional Director

Location

Located behind the TOHAZIE Hotel (Ex-Catering Rest House)

Description of Region

There are 13 districts and 23 constituencies in the region. Total number of registered voters is around 800,000. District offices communicate with the regional office in Tamale by telephone and / or radio communications equipment. Seven district capitals can only communicate by radio. The farthest district capital from Tamale by road is Bole, which is 200 kilometers.

Description of Site

General Layout

The regional office has a well-built round house with rooms designated for the Regional Director, Deputy Regional Director, Secretariat, Accounts and Conference Hall. Behind the round house are two big storerooms, a storekeeper's room, a drivers' room and a guest room.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are of louver glass blade type with an external grid of wire mesh. The wire mesh is not very strong.

Electrical

The electrical service in the building seems adequate, but should be checked against estimated equipment demands before installing new circuits for the computers.

Environmental

There are functioning air conditioners in the offices of the Director, the Deputy Director and the Secretariat.

Staffing

There are 28 staff members in the regional office in Tamale. The districts have at least 4 employees each comprising:

- Electoral Officer

- Typist
- Driver
- Watchman

Computer Literacy

Two typists have attended some private computer classes. The Director and the Deputy Director also had some training about a year ago in Windows 95, Word and Excel. The PC in the office is technically obsolete and therefore has not helped employees to improve computer literacy and skills. Re-training will be needed.

Telecommunications

The Regional Director has a Canon Fax-8320 and a regular telephone line. There are Barrett radio communications equipment and OKI Microline turbo printer in the Secretariat.

Computer Equipment

There is one old 80486DX/66 computer (ICL M75-33) running Windows 3.0 operating system and WordPerfect and Lotus applications. It is located in the Secretariat. An Epson LQ 2550 dot matrix printer is attached to the PC.

Other Equipment

There is a Xerox 5026 photocopier in the Deputy Director's office.
A Gestetner 4130 duplicating machine and two Olivetti LINEA 98 manual typewriters are located in the Secretariat.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major supplies are obtained from Accra whilst minor items are purchased locally if available.

Recommendations

Site Preparation

Physically the site is secure and has air conditioning in some rooms. The electrical service seems adequate but should be verified after additional computer equipment has been specified. Circuit breakers for the computer equipment should be separated from those for the air conditioners. The wiring should be checked carefully to verify a proper earth ground. Additional tables and chairs will be needed. The project needs to resolve who will provide this furniture.

Computing Equipment

The old ICL M75/33 computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

If two computers are to be provided for this site, then they should be located in a single room for shared use by the rest of the staff, and should be networked to allow sharing of printer(s).

Training

Staff should be given basic computer literacy and skills training and should include an introduction to Microsoft Windows as well as training in Microsoft Word and Excel to the intermediate level.

Training facilities the Tamale area include:

- Ayacoss Computer Training Centre
- Grich Computer Studies & Secretarial School
- GAP System Co. Ltd. Computer Training
- Sawaba Secretariat School

Upper East Region Office

Address

Box 182
Bolgatanga
Phone: 072-22474 / 23188
Tel/Fax: 072-23074

Principal Persons Contacted

Mr. J. Carl-Rhule, Regional Director

Location

Located near Bolgatanga Catering Rest House

Description of Region

There are 6 districts and 12 constituencies in the region. Total number of registered voters is around 340,000. District offices generally communicate with the regional office in Bolgatanga by telephone and / or radio communications equipment. There is electricity in all the district capitals. There is telephone access to three of the six district capitals - Bolga, Bawku East and Navrongo.

Bolgatanga is centrally located and is about 50 miles from the farthest district capital of Bawku East

Description of Site

General Layout

The regional office is a very well built multi-story building. It has rooms designated as offices for the Regional Director, Deputy Regional Director, Computer room, Secretariat, Accounts, Conference room, Admin Assistant, Storekeeper's room, Stores, Library and Drivers room.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are of louver glass blade type with an external grid of wire mesh. The wire mesh is not very strong.

Electrical

The electrical service in the building seems adequate, but should be checked against estimated equipment demands before installing new circuits for the computers.

Environmental

There are air conditioners in most offices.

Staffing

There are 21 staff members in the regional office in Bolgatanga. The districts have at least 4 employees each comprising:

- District Officer
- Field Officer
- Typist
- Driver

Computer Literacy

A few members of staff have had some training but it is inadequate. The PC in the office is an old ICL machine. Need to re-train employees on new operating systems and applications.

Telecommunications

The Regional Director has a Canon Fax-B320 and a regular telephone line. There is Barrett radio communications equipment in the Secretariat.

Computer Equipment

There is one old 80486DX/66 computer (ICL M75-33) running Windows 3.1 operating system and WordPerfect and Lotus applications. It is located in the computer room. An Epson LQ 2550 dot matrix printer is attached to the PC.

Other Equipment

There is a Xerox 5026 photocopier in the Deputy Director's office. A broken Gestetner 4130 duplicating machine is located in the Library.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major supplies are obtained from Accra whilst minor items are purchased locally if available.

Recommendations

Site Preparation

Physically the site is secure and has air conditioning in most of the rooms. The electrical service seems adequate but should be verified after additional computer equipment has been specified. Circuit breakers for the computer equipment should be separated from those for the air conditioners. The wiring should be checked carefully to verify a proper earth ground.

Additional tables and chairs will be needed. The project needs to resolve who will provide the furniture.

Computing Equipment

The old ICL M75/33 computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

At least two computers should be provided for this site. They should be located in a single room for shared use by the rest of the staff, and should be networked to allow sharing of printer(s).

Training

Staff should be given basic computer literacy and skills training and should include an introduction to Microsoft Windows as well as training in Microsoft Word and Excel to the intermediate level.

Training facilities the Bolgatanga area include:

- Sapsco Systems - Computer Training Unit
- WinCom Computer Training Centre
- Bolgatanga Girls Technical School

Upper West Region Office

Address

Box 220
Wa
Phone: 0756-22137
Tel/Fax: 0756-22357

Principal Persons Contacted

Mr. Kwame Boateng, Regional Director

Location

Wa Ministries Block "'C", First Floor

Plans to move to New Site when finished. The Nsew Site is a multi-story building under construction and is nearing completion.

Description of Region

There are 5 districts and 8 constituencies in the region. Total number of registered voters is about 280,000. District offices communicate with the regional office in Wa by telephone and / or radio communications equipment. All the district capitals have electricity and reliable telephone lines. The farthest district capital from Wa by road is Tumu, which is about 84 miles.

Description of Site

General Layout

The regional office is located in the Ministries Block "C" on the first floor. It has a room designated as the Director's office, and two other rooms which have been divided up and converted into Accounts, Registry and Typing pool areas.

Security

The entrance door to the office and the doors to individual rooms can be locked. Windows are of louver glass blade type with an external grid of wire mesh. The wire mesh is not very strong.

Electrical

The electrical service to the block seems adequate, but electric power to the Electoral Commission section should be checked against estimated equipment demands before installing new circuits for the computers.

Environmental

There is air conditioning in the Director's office and the Typing pool. The other offices have been provided with electric fans. Air conditioning should be considered for any room that would be provided with a computer.

Staffing

There are about 10 staff members in the regional office in Wa. The districts have at least 3 employees each comprising:

- District Officer
- Typist
- Driver

Computer Literacy

The regional typist/secretary received some training organized by the Head Office in Accra in 1992. Another typist in the Lawra office had six months computer training in Wa with the KUSMOS Computer Training School. Two typists have attended some private computer classes. With no functioning computer in the office to practice their skills on, they most probably have become rusty and would need fresh training.

Telecommunications

The Regional Director has a Canon Fax-B320 and a regular telephone line as well as Barrett radio communications equipment.

Computer Equipment

The only computer in the office has been sent to Accra for repairs and so the office has no functioning computer.

Other Equipment

There is a Xerox 5026 photocopier in the Director's office. A Gestetner 4130 duplicating machine and two Olivetti LINEA 98 manual typewriter s are located in the Typing pool.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major supplies are obtained from Accra whilst minor items are purchased locally if available.

Recommendations

Site Preparation

Physically the site is secure and has air conditioning in some rooms. The electrical service seems adequate but should be verified after additional computer equipment has been specified. Circuit breakers for the computer equipment should be separated from those for the air conditioners. The wiring should be checked with the Government electrical engineers and advisers. Advice should also be sought from them on the electrical system at the New Site.

Additional tables and chairs will be needed. The project needs to resolve who will provide this furniture.

Computing Equipment

There is no functioning computer in the office. At least two computers should be provided for this site and they should be located in a single room for shared use by the rest of the staff. It should also be configured to allow printers to be shared.

12.1.1. Training

Staff should be given basic computer literacy and skills training and should include an introduction to Microsoft Windows as well as training in Microsoft Word and Excel to the intermediate level.

Training facilities the Wa area include:

- Musko Information Technology Center
- Workers College - Institute of Adult Education
- Computek Ghana Ltd.

Volta Region Office

Address

Box 138
Ho
Phone: 091-26669 / 26601
Tel/Fax: 091-26486

Principal Persons Contacted

Mr. Mohamed K. Adoquaye, Regional Director
Innocent Akoto, Deputy Regional Director

Location

Located at Bankoe, Tarso Junction

Description of Region

There are twelve districts and nineteen constituencies in the region. Total number of registered voters is around 1,000,000. District offices generally communicate with the regional office in Ho by telephone and / or radio communications equipment. The farthest district capitals from Ho by road are Krachi and Nkwanta which are 387 and 245 kilometers respectively.

Description of Site

General Layout

The regional office is a well-built two-story building (ground floor + 2 other floors). The ground floor contains the Telephone room, Reception, Ho District office, and Stores. The first floor has separate rooms designated for the Deputy Director, General Administration, Principal Clerk, Principal Security, and Accounts. The second floor contains separate rooms designated for the Regional Director, Secretary, Director's Conference room, Operations and Conference Hall.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are of louver glass blade type with an external grid of wire mesh. The wire mesh is not very strong.

Electrical

The electrical service in the building seems adequate, but should be checked against estimated equipment demands before installing new circuits for the computers.

Environmental

There are functioning air conditioners in most of the offices..

Staffing

There are 20 staff members in the regional office in Ho and an average of 4 in each of the 12 district offices comprising:

- District Officer
- Field Officer
- Secretary/Typist
- Driver

Computer Literacy

Two secretaries received three weeks training organized by the Head Office in 1992 on WordPerfect, Lotus, and Windows 3.1. They are using an old PC and would need to be re-trained. Director received some training in Word, Excel and Publisher in Accra. He is using a PC with Windows 98 operating system and Office 97 applications. He would need some brush-up.

Telecommunications

The Regional Director has a fax machine, a fax line and a regular telephone line. The Deputy Director has a regular phone line. There are Barrett radio communications equipment and an Okidata Microline turbo printer in the Operations room.

Computer Equipment

There is one old 80486DX/66 computer (ICL M75-33) running Windows 3.0 operating system and WordPerfect and Lotus applications. It is located in the Secretariat. An Epson LQ 2550 dot matrix printer is attached to the PC. There is also one Fujitsu PC on loan from the Head Office to the Director running Windows 98 operating system and Microsoft Office 97 applications.

Other Equipment

There is a faulty Xerox 5026 photocopier in the Director's Conference room and a faulty Xerox Piano 3 electric typewriter in the secretariat.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major supplies are obtained from Accra whilst minor items are purchased locally if available.

Recommendations

Site Preparation

Physically the site is secure and has air conditioning in many rooms. The electrical service seems adequate but should be verified after additional computer equipment has been specified. Circuit breakers for the computer equipment should be separated from those for the air conditioners. The wiring should be checked carefully to verify a proper earth ground.

Additional tables and chairs will be needed. The project needs to resolve who will provide this furniture.

Computing Equipment

The old ICL M75/33 computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

The Fujitsu PC is good and can still be used.

If two additional computers are to be provided for this site, then they should be located in a single room for shared use by the rest of the staff, and should be networked to allow sharing of printer(s).

Training

Staff should be given basic computer literacy and skills training and should include an introduction to Microsoft Windows as well as training in Microsoft Word and Excel to the intermediate level.

Training Facilities in the Ho area include:

- New Age Secretarial and Computer Training Institute
- Anointed Computer Training School
- Mawuli School

Western Region Office

Address

Box 283
Sekondi
Phone: 031-46905 / 46176 / 46129
Tel/Fax: 031-46996

Principal Persons Contacted

Mr. J.W.K. Kwaw, Electoral Officer, Sekondi

(The Regional Director, Mr. Sammy Aidoo, was out of the country and the Deputy Regional Director had not yet arrived at post.)

Location

Located on the Cliff Road at the Western Regional Offices Area in Sekondi

Description of Region

There are 13 districts in the region. Total number of registered voters is around 700,000. District offices communicate with the regional office in Sekondi by telephone and / or radio communications equipment. A few districts do not have radio equipment because they have been stolen or have been sent for repairs. Some district capitals are very far from the regional capital. Juabeso and Bibiani are about 215 and 184 miles respectively from Sekondi.

Description of Site

General Layout

The regional office is well-built and has separate rooms designated for the Regional Director, Deputy Regional Director, Secretariat, Storekeeper, Preventive Office, Operations Room, General Office, Chief Clerk Office, Sekondi Office and Stores.

Security

The entrance to the building and doors to individual rooms can be locked. Windows are of louver glass blade type with an external grid of wire mesh that is not very strong.

Electrical

The electrical service in the building seems adequate, but should be checked against estimated equipment demands before installing new circuits for the computers.

Environmental

There are functioning air conditioners in the Regional Director's and the deputy Regional Director's offices but the air conditioner at the secretariat is faulty.

Staffing

There are about 72 staff members in the region including 24 located in the regional office in Sekondi. At a minimum, each district has the following staff positions:

- District Officer
- Electoral Officer
- Secretary/Typist
- Driver

Computer Literacy

Two secretaries received three weeks training organized by the Head Office in 1992 in WordPerfect, Lotus, and Windows 3.1. Three other staff members have taken some computer courses privately. With one old PC running Windows 3.1 operating system, staff members have not gained much experience and would have to be re-trained.

Telecommunications

The Regional Director has a fax machine, a fax line and a regular telephone line. There are two other phone lines in the offices of the electoral officer and the accountant. There are Barrett radio communications equipment and an Okidata Microline turbo printer in the Secretariat.

Computer Equipment

There is one old 80486DX/66 computer (ICL M75-33). It is located in the Secretariat. Also located in the room are an Epson LQ 2550 dot matrix printer, which is faulty, and a Solatek SVS 3500 stabilizer.

Other Equipment

There is a Xerox 5026 photocopier in the Deputy Director's office and there is a manual typewriter Olivetti LINEA 98 in the Secretariat.

Equipment Maintenance and Repair

The current computer equipment and the photocopier are included in maintenance contracts through the central NEC office in Accra. The regional office contacts the central office in Accra when equipment needs repair.

Consumable Supplies

Major supplies are obtained from Accra whilst minor items are purchased locally if available.

Recommendations

Site Preparation

Physically the site is secure and has air conditioning in some rooms. The electrical service seems adequate but should be verified after additional computer equipment has been specified. Circuit breakers for the computer equipment should be separated from those for the air conditioners. The wiring should be checked carefully to verify a proper earth ground.

Additional tables and chairs will be needed and the project needs to resolve who will provide this furniture.

Computing Equipment

The existing computer system is not Y2K compliant and is obsolete. It does not have the capacity to run current software. The dot-matrix printer and the UPS can continue to be used.

If only two computers are to be provided for this site, then they should be located in a single room for shared use by the rest of the staff, and should be networked to allow sharing of printer(s).

Training

Staff should be given basic computer literacy and skills training and should include an introduction to Microsoft Windows as well as training in Microsoft Word and Excel to the intermediate level.

Training facilities the Sekondi/Takoradi area include:

- Wang Computer Training Institute
- Star Computer Training Institute
- Centre for Computer Studies Ltd.
- Dita-Ding Micro Systems Ltd.

Annex E: Material Specifications and Cost Estimates