# DESIGN AND IMPLEMENTATION OF THE REGIONAL DATA COMMUNICATIONS NETWORK FOR THE MESOAMERCIAN BARRIER REEF SYSTEM PROJECT

Prepared for:

Marydelene Vasquez
Information Systems Specialist
Mesoamerican Barrier Reef Systems Project
Fisheries Compound, Princess Margaret Drive
P.O. Box 93
Belize City, Belize

Prepared by:

ESG International Inc.
361 Southgate Drive
Guelph, Ontario
N1G 3M5

C2301
December, 2002

# EXECUTIVE SUMMARY

This document comprises the network design and statement of requirements for the design of a regional data communications network for the Mesoamerican Barrier Reef System Project (MBRS). The purpose of this report is to provide recommendations to the MBRS for the development of an overall network design and procurement specifications for individual components which will make up the regional network.

The report outlines the types of equipment, network protocols, firewall and intrusion detection system elements which will be used at all layers of the network as well as the physical layout of the network in diagrammatical form. Additionally, the report contains a technical description of the network design and a description of each component which will make up the network. A Maintenance Plan and a Security Policy are also discussed.

In the section entitled Statement of Requirements, for procurement purposes, detailed specifications for all computer, networking and power hardware and software are outlined.

This page intentionally left blank.

# TABLE OF CONTENTS

## TABLES

## FIGURES

## APPENDICES

Appendix A      MBRS Node Site Visits
Appendix B      Equipment Specifications
Appendix C      Internet Charges for Selected Nodes

# 1  INTRODUCTION

The objective of the consultancy awarded to ESG International Inc. (ESG) is to design a regional data communications network comprised of sites (nodes) in Belize, Guatemala, Honduras and Mexico 'that will serve the Project's needs for data management, information dissemination, and public education'. The aim of the network is to support a Regional Environmental Information System (REIS) and a Synaptic Monitoring Program (SMP), presently under development by Research Panning Inc. (RPI), to aid in the preservation and conservation of the world's 'second largest barrier reef system'.

In attempting to design a regional data communications network, a number of issues served to add a level of complexity to the task.

1)  The design of the REIS and SMP is an ongoing process. Since the design of the regional data communications network is being attempted in parallel with the design of the REIS and SMP, a complete picture of the overall structure of the information system, necessary to provide an optimal system design, is unavailable at the present time;

2)  The guidelines for the development of the REIS and SMP suggest that these will be databases with GIS functionality. Since GIS functionality suggests certain parameters pertaining to the overall design of the network, it will play a significant role in the initial concept for the design;

3)  The network designers (ESG) and the software designers (RPI) are separate entities. Design elements of the information system and the network design will have to be agreed upon before an optimal network design can be achieved;

4)  Concurrent use, a major factor in determining the suitability of a centralized vs. distributed network design, is unable to be determined at the present time;

5)  As the MBRS has requested alternative solutions which would take into account Microsoft vs. Opensource operating system software, the design of the REIS, SMP and the regional data communications network has triggered a discussion as to the relative merits of utilizing either system software;

6)  The nodes chosen in each country present some challenges as the design of the system will have to take into account infrastructures already in place in these organizations. In addition, the perceived needs or recommendations made by the node agencies has to be taken into consideration;

7)  Due to the location of MBRS headquarters, there is a very real danger with respect to weather conditions and storm activity affecting the integrity of the network. Co-location is an option that should be given serious consideration; and,

8)  Budgetary constraints for the development of the REIS, SMP and the regional data communications network.

The design of the regional data communications network occurred subsequent to node selections completed by the MBRS and the Environmental Information Systems Technical Working Group (TWG). Site visits, which were recently conducted by representatives of the MBRS and ESG, were completed shortly following the node selection process. Site visits included meetings with node agencies as well as meetings with representatives from communications providers within each country to gather information on current infrastructure and the availability and cost of the bandwidth necessary to participate as a network node.

After reviewing background documentation and the information gathered from the MBRS, node agencies, and communications providers, ESG developed five options for the implementation of a regional data communications network.

Before listing the options and their respective advantages and disadvantages, a discussion of the aforementioned issues is necessary to fully appreciate the nature of the Project and the recommendations presented in this report.

# 2    BACKGROUND

ESG was involved in the Expert Meetings held by the MBRS in Cancun in May 2002. These meetings were designed to lay the groundwork for project information requirements and to gather information from Project consultancies, participants and other experts toward the design of an environmental information system (EIS). The design of the EIS can be broken down into two components: the REIS (as well as the SMP) and the regional data communications network.

It became clear very early on that, although the MBRS had a general idea as to what they envisioned to constitute the REIS and SMP, the process for the development of these systems was ongoing and so there was not a clear definition as to the precise nature of the systems and how they would be developed. The initial suggestion from RPI was that they would develop a system utilizing ArcView 3.x and Microsoft SQL server.

There did, however, appear to be a clear definition as to the requirements for developing a regional data communications network. The regional data communications network was envisioned as a fully distributed network with nodes in each of the four countries (Figure 1).
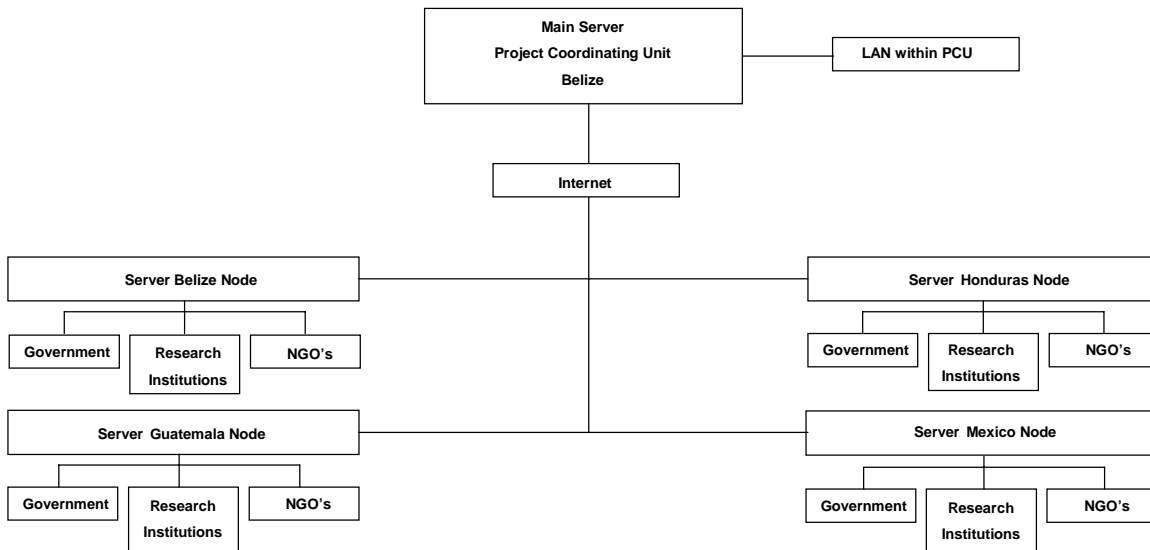


Figure 1.        Original network layout as proposed by MBRS.

# 3      THE REIS AND SMP

As the 'objective of the [ESG] consultancy is to design a regional data communications network that will serve the Project's need for data management, information dissemination and public education', the network had to be designed to support the REIS and SMP. Since ESG was not involved in the design of the REIS or SMP, it was critical that ESG understand the components that were under consideration by RPI.

The REIS was initially envisioned as a 'database with GIS functionality that will manage the environmental monitoring and other information collected through project activities. It will be a distributed database with nodes in each of the four participating countries' (Page 3, TOR for Regional Network). Recently, however, ESG has learned that the Project is not planning to implement GIS functionality at the server level at this time; the GIS component will be limited to workstations located at one or more of the nodes.

The information system now under consideration by the Project and RPI is a website with an SQL database or a series of SQL databases. The SQL database(s) RPI is planning to implement would be essentially a web-based data entry system and information repository. Input to the database(s) will occur via a web-browser graphical user interface (GUI) while maps and other 'canned' products generated by GIS workstation(s) would be provided for users and the public as web-based PDF files or some other downloadable file type.

# 4      CENTRALIZED VS. DISTRIBUTED NETWORK DESIGN

The network design team looked at several factors to determine whether a centralized or a distributed network solution would best suit the requirements of the Project. The factors are: number of concurrent users, redundancy and scalability.

The main factor determining whether one design would be recommended over another is the number of concurrent users. In general, the greater the number of users, the more likely a distributed design would be recommended.

Unfortunately, the MBRS has been unable to provide an approximation as to the number of concurrent users the proposed network can expect. As such, this has made it somewhat difficult for the designers to provide an informed decision based on this factor. Although the number of concurrent users cannot be determined at this point in time, a fully distributed network design would provide local connections to servers which would provide for quicker access for users, reduced load on the main server, and require less bandwidth to function efficiently.

Another factor is the issue of redundancy. With a distributed system design, redundancy is accomplished at each location thereby ensuring optimal up-state capability and the integrity of the network. A centralized design, on the other hand, would achieve redundancy by providing a duplicate server installation at the main installation site or a co-hosting facility at a remote location. Redundancy at the main installation site is a calculated proposition. Although redundancy is necessary to guarantee the up-sate of the network, central site redundancy would not provide adequate protection in the event of a disaster. Co-location, on the other hand, although providing a greater level of security for the integrity of the network in the event of a disaster, has associated costs and implications for network management.

Scalability is the final factor to be taken into consideration with respect to recommending a centralized or a distributed solution. To accommodate additional users and nodes, growth, in a centralized design, would require the purchase of additional bandwidth. Since bandwidth costs are at a premium, growth could very possibly be limited by the amount of dollars available for recurrent funding. A distributed network could accommodate many more users because the load is distributed across a number of servers in the network and the requirement for increased bandwidth does not come into the equation quite as early in the growth process. This issue will become critical should GIS functionality be required at any stage in the development of the information system.

A distributed network design would not only allow for any contingency with respect to concurrent use, it would address the limitations with respect to redundancy and scalability posed by a centralized solution.

# 5    WINDOWS VS. OPENSOURCE SOFTWARE

The operating systems under consideration for the implementation of the regional data communications network are Windows 2000 Professional Server and Linux. While it is beyond the scope of this document to outline all of the differences between Linux and Windows 2000 Professional Server, there have been a myriad of publications written as to the technical merits of each operating system such as Eric Hughes' 'Linux vs. Windows 2000: The Pros and Cons'

The debate between Windows and Opensource operating systems and programs is ongoing in the Information Technology industry. The preference between one and the other often comes down to cost. Windows operating systems and software programs are costly to purchase, license and maintain. Although the cost of obtaining Opensource operating systems and software programs is negligible, configuration and maintenance issues can make this choice costly to implement. In addition, there are also functionality issues which come to bear in the discussion.

Windows 2000 Professional Server has built in file replication capability between servers, group security profiles, authentication for working with client VPN connections at the router, user privilege replication between servers and an easy to use management environment. A Linux solution does not offer the same caliber of sharing, replication and distributed management capabilities.

The same reasoning applies to the SQL server options being considered for the REIS and SMP. Again, although it is also beyond the scope of this document to outline all the differences between the MS-SQL Server and other Opensource SQL software packages (e.g. mySQL, PostgreSQL), Opensource SQL databases clearly do not offer the same functionality and ease of use as MS-SQL in a Windows 2000 environment.

# 6  NODE AGENCIES

The design of the regional data communications network required that node agencies be found in each country 'that comply with certain criteria and must commit [themselves] to contributing certain in-kind resources' (MBRS Site Selection Document, Page 1) and therefore the network design for the project occurred subsequent to agency or node selections completed by the MBRS and the Environmental Information Systems Technical Working Group (TWG). The four agencies chosen to become Project nodes are The Universidad de Quintana Roo (Chetumal, Mexico), The Universidad del Valle de

Guatemala (Guatemala City, Guatemala), Red de Desarrollo Sostenible (Tegucigalpa, Honduras) and The Coastal Zone Management Authority (Belize City, Belize).

The compliance criteria outlined by the MBRS indicated, among other things, that these agencies must have access to the Internet and basic telecommunications services, a reliable and stable supply of electricity and a room with a controlled environment where the necessary network equipment could be safely housed. The possibility of taking advantage of the existing network infrastructures that were present in each node was also of interest to the Project.

Infrastructure inventories and the responses to a standard set of questions posed to each agency are detailed in Appendix A. In addition to a standard questions regarding network infrastructure, each agency was asked to make a recommendation as to the type of infrastructure upgrade they would most need to facilitate their participation in the Project.

The following is a summarized version of the responses obtained from each node:

**Uinversidad de Quintana Roo** (UQROO) has a complete network infrastructure in place to allow them to participate as an MBRS node. UQROO has volunteered a server, a GIS lab and student technicians for the implementation of the program. The server farm at UQROO is Sun based running the Solaris operating system. They also had a Windows 2000 Server that could be used for the project. UQROO recommended an increase in bandwidth or connectivity to the Internet to facilitate their participation in the project.

**Universidad del Valle de Guatemala** (UVG) has a complete network infrastructure in place to allow the institution to participate as a node agency. UVG has volunteered a server, a GIS lab, and student technicians for implementation of the Project . UVG runs both Windows 2000 and Linux server on Dell and Clone hardware. UVG recommended the purchase of a robust GIS workstation to facilitate their participation in the project.

**Red de Desarrollo Sostenible** (RDS) has a complete network infrastructure in place to allow them to participate as a node agency. RDS runs Red Hat Linux on Dell servers. Although they have the network infrastructure and bandwidth in place, they lack a GIS component. To facilitate their participation in the project, RDS recommended the purchase of a server.

**Coastal Zone Management Authority** (CZM) is located in the Fisheries Compound which is also occupied by MBRS headquarters. CZM presently has a networked printer. They have no network server but have the infrastructure (cabling and hub) to put a server in place. They have dial-up connectivity to email. CZM suggested the purchase of a server and/or access to a proxy server for email to facilitate their participation in the project. CZM also stated that they would need to hire a technician as their present staffing would not permit having an individual devoted to project duties.

The networking infrastructures at UVG, UQROO, and RDS clearly provide an opportunity for the Project to utilize components presently in place in order to facilitate the design and development of the network. Although the option to utilize existing infrastructures may appear to be beneficial to the Project in terms of the initial cost of implementation, the downside is loss of control of those devices not supplied by the Project and the complexity that will arise with the installation, configuration, maintenance and manageability of the network system.

# 7    CO-LOCATION

The potential in Belize City for natural disasters from hurricanes and other tropical storms suggests that co-location of the network is an option which should be seriously entertained.  As MBRS headquarters is located along the coast in an area which has been seriously affected by tropical storm activity and other weather factors in the recent past, co-location of the network and/or redundant server capacity would be highly recommended.

As was mentioned earlier, co-location of the network and/or redundant server capacity can be achieved with a fully distributed network design; MBRS headquarters need not necessarily house the central server.  UVG clearly has the infrastructure in place to become the central network node; RDS and UQROO to a lesser extent. In such a scenario, MBRS headquarters and CZM would have node servers which would feed into the central server and vice versa. The node servers would effectively become both local network servers as well as redundant servers in the larger WAN.  Should any one or multiple servers become disabled for any reason, the remaining servers would provide fail-over access.  This solution, however, will have implications for network management and network maintenance.

Another way to ensure the integrity of the network would be to place a server in a location other than at one of the Project nodes. There are many organizations around the world which provide co-location facilities and services. In addition to supplying everything from server rack space to complete application and website hosting, co-location facilities offer guaranteed up-time, timely backups and state-of-the-art security. Although this would definitely go a long way toward providing a robust solution and guaranteeing 99.5% up-time as suggested in the TOR, the costs associated with co-location can be substantial.

# 8    BUDGET

**Table 1.        MBRS hardware and software budget.**

| Detailed Items | | Budget (USD) |
|---|---|---|
| Central Database Equipment and Software | | |
|     Server hardware and software | | $24,010.00 |
|     2 user workstations | | $4,000.00 |
| | **Subtotal** | **$28,010.00** |
| Node Agencies Equipment and Software | **Subtotal** | **$78,000.00** |
| | **TOTAL** | **$106,010.00** |
| Node Agencies Training | **TOTAL** | **$10,000.00** |
| Recurrent Costs | | |
|     Dedicated line for metadatabase | **TOTAL** | **$15,000.00** |
|     Materials for node agencies | **TOTAL** | **$2,400.00** |

Table 1 outlines the budget for the implementation of the REIS and the regional data communications network. The dollar amounts refer only to the capital expenditures, training and recurrent costs allocated by the Project for the procurement of the hardware, software and services required to implement the network. As the nodes are responsible for maintaining and sustaining the systems after the initial outlay of capital by the Project, affordability and long-term sustainability have been keynote items underlying all discussions pertaining to the design of the regional data communications network.

Since the design team had to take into account the procurement constraints outlined in the budget and because specific amounts were allocated to specific items, a clarification statement was requested of the MBRS as to whether the amounts were fixed for each item or whether total allocation dollars could instead be used. It was determined that the total dollar amount could be used for calculation with respect to capital expenditures. It was also made clear that there was no requirement by the Project to provide each node with identical dollar amounts.

## 9 SUMMARY

The discussion in the preceding pages was deemed necessary to fully appreciate the nature of the issues around the design of the regional data communications network and the recommendations presented in this report. The following will serve to summarize the preceding discussion:

1) Even though the development of the REIS and SMP is an ongoing process, the network team was able to proceed with the design of the regional data communications network despite not have a complete understanding as to the overall structure of the proposed information system;

2) Since GIS functionality at the server level is no longer being considered an initial requirement for the implementation of the REIS hence the regional data communications network, the network design team has developed a solution which will address both present and future needs of the EIS ;

3) Discussions have occurred with RPI regarding the design elements of the information system; because the system being proposed is web based with SQL functionality, an efficient network design could be readily produced;

4) Although there is an inability to determine concurrent usage at this time, a distributed network would take into account attendant issues with respect to optimal design. Other issues such as redundancy and scalability are also appropriately dealt with in a distributed network design;

5) The design of the REIS and the regional data communications network triggered a discussion as to the relative merits of developing systems with Microsoft vs. Opensource software. While it the opinion of the network design team that a Microsoft platform would provide the optimal solution for the Project, an Opensource software platform will be supplied for each option;

6) Although the importance of providing each node with an infrastructure upgrade to facilitate their participation in the project should not be treated lightly, there may be a downside to utilizing existing infrastructures or components in the  design of the network;

7) With the potential for tropical storms and other weather related activity to affect the operation of the network given the location of MBRS headquarters, co-location is an option that should be given

serious consideration. It could be accomplished with a distributed network design or by locating a server at a co-location facility; and

8) Budgetary constraints outlined for the development of the REIS and the regional data communications network were taken into consideration. It was determined that total dollar amounts could be used for calculation with respect to capital expenditures and that there was no requirement by the Project to provide each node with identical dollar amounts.

# 10 DESIGN OF THE REGIONAL DATA COMMUNICATIONS NETWORK

Figure 2 outlines the intended network design and the expected connectivity for the regional data communication network.

The representative nodes making up the network are the MBRS (central node), CZM (Belize), UVG (Guatemala), UQROO (Mexico), and RDS (Honduras). As each node is designed to offer high capacity and powerful processing capability in a Local Area Network (LAN) setting, local researchers and users would connect to the node server in each country. Forming a wide area network (WAN), the node servers, in turn, would be permanently connected to a central server via a Virtual Private Network (VPN) established over the Internet to facilitate data sharing, collaboration and file replication. This design is intended to provide a high degree of data redundancy in case a disaster should occur at any node.

Remote users and specially designated organizations such as CONANP, IABIN and SIAM would have access to the information repository from the central server via the Internet, while government agencies, research institutions, NGO's and the public would connect to the Project website via the Internet.
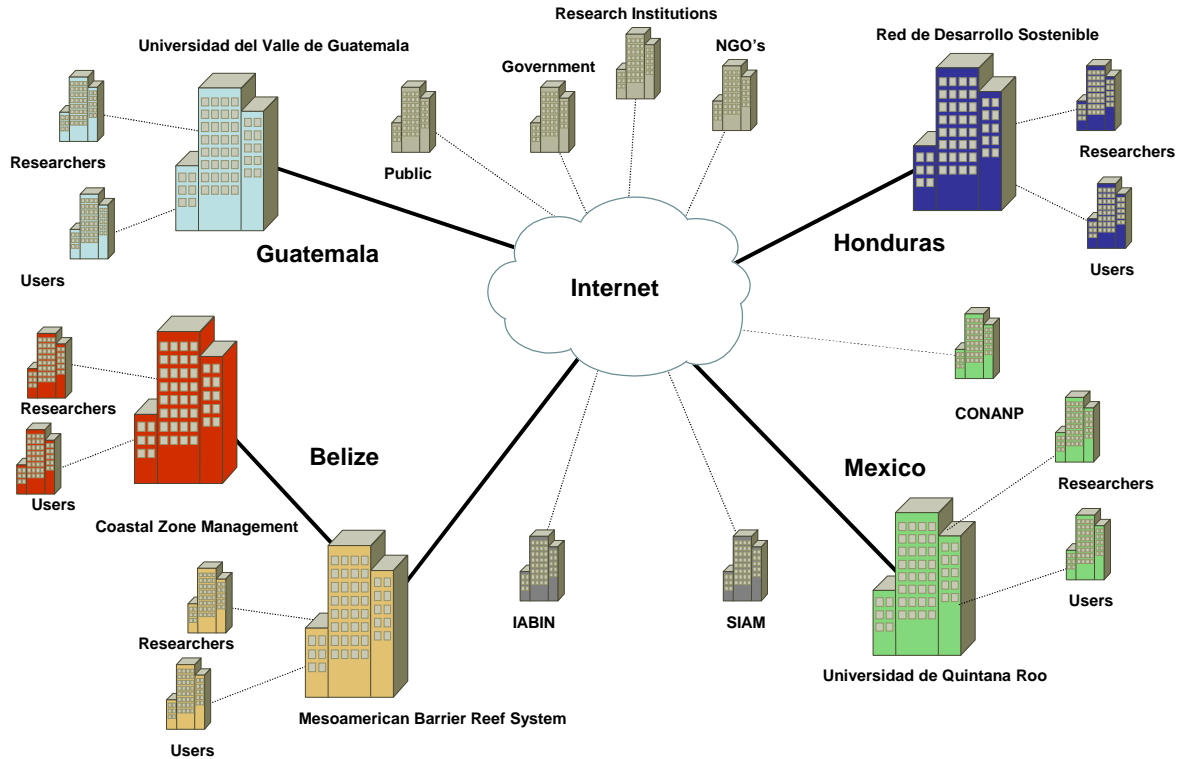
Figure 2.        MBRS overall network.

# 11    RECOMMENDATIONS

The primary recommendation for the design of the regional data communications network is a fully distributed system comprised of a completely self-contained package including server, switch, router, tape backup and UPS to be implemented at each node. With this implementation, extremely high security measures can be put into place to ensure complete control of access to the server and its information.

It is further recommended that Windows 2000 Professional Server be installed on all servers. A Windows 2000 solution has all of the tools necessary for implementing an international resource-sharing network and has been proven in thousands of installations around the world.

Although ESG has produced five options in total, the recommended or preferred options are Option 1 or Option 2 as they conform more closely to the design specified in the TOR. In addition, Linux server options have been included at the request of the MBRS.

## 11.1   Option 1

Option 1, outlined in Figure 3, provides for a fully distributed network with servers located in each of the four countries. A server is also located at a co-location facility hosted by BTL in Belmopan as there is a higher than acceptable risk of hurricane or other disaster at MBRS headquarters in Belize. The BTL server would become the central server in the design due to the extremely high bandwidth availability.
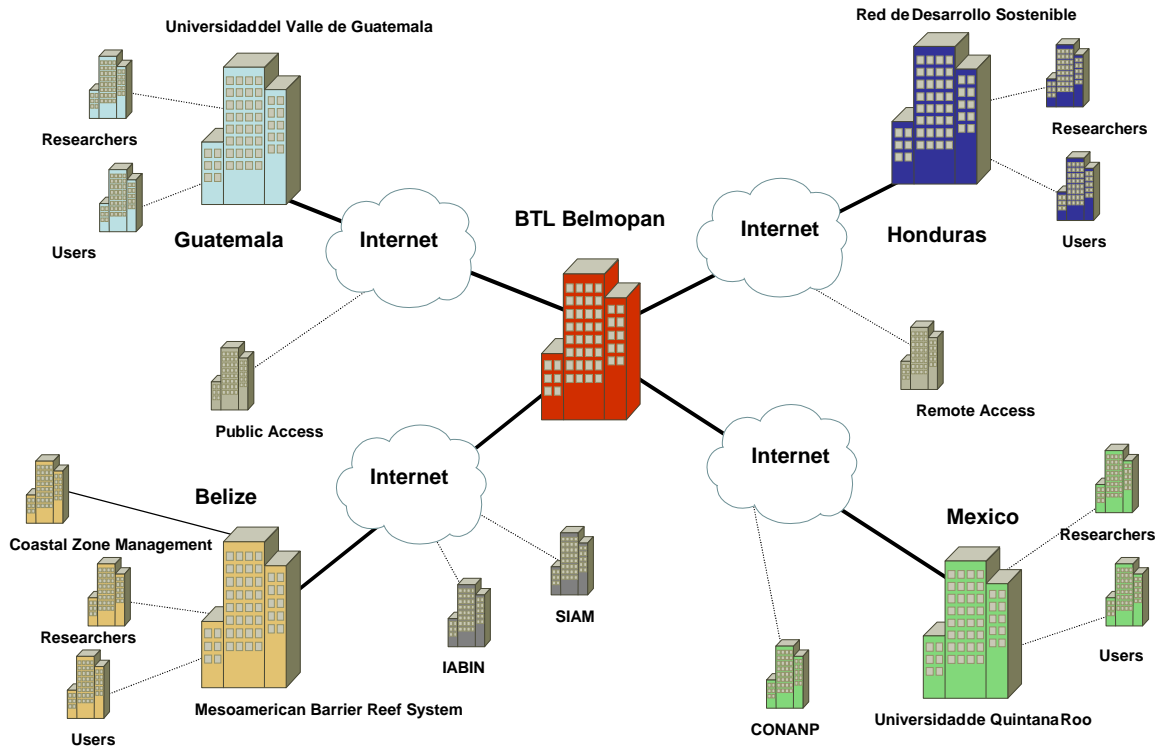
Figure 3.        MBRS overall network:  Option 1.

The node servers would be located at MBRS, UVG, UQROO and RDS. As they are located in the same building, CZM would share a node server which is to be located at MBRS headquarters.

Except for BTL (where a UPS is provided with co-location fees), the network equipment (Figure 4) provided for each node would be identical (all equipment specifications are detailed in Appendix B) and is outlined as follows:

- Cisco 1721-VPN/K9 router with firewall/hardware VPN capability
- Cisco WIC-1ENET second Ethernet port for 1721
- Cisco WS-C2950-24 24 port switch
- Dell 2650 Server
- APC UPS
- Microsoft Windows 2000 Professional Server
- MS SQL Server
- Backup Exec
- Powervault 110 LTO tape backup
- Workstation
- Bandwidth/Connectivity
- Windows 2000 CAL's

Additionally, the MBRS would be provided with a GIS workstation.

Connection to the Internet for the various nodes would be as follows:

- MBRS  - a proposed ADSL connection.
- UVG - existing 2mbps fiber connection
- UQROO – existing 256kbps fiber connection
- RDS  - existing 512kbps fiber connection
- CZM - would connect to the information via the MBRS server. It is anticipated that this will be done via switch-to-switch connectivity using CAT 5 ethernet cabling.

The cost for the proposed ADSL line for the MBRS is unable to be determined at the present time. However, the MBRS has indicated that the present cost of connectivity for the project ($350.00 USD/month) could be applied to recover some of the expense for this expenditure. In addition, the project has budgeted $1500.00 USD per month for connectivity.
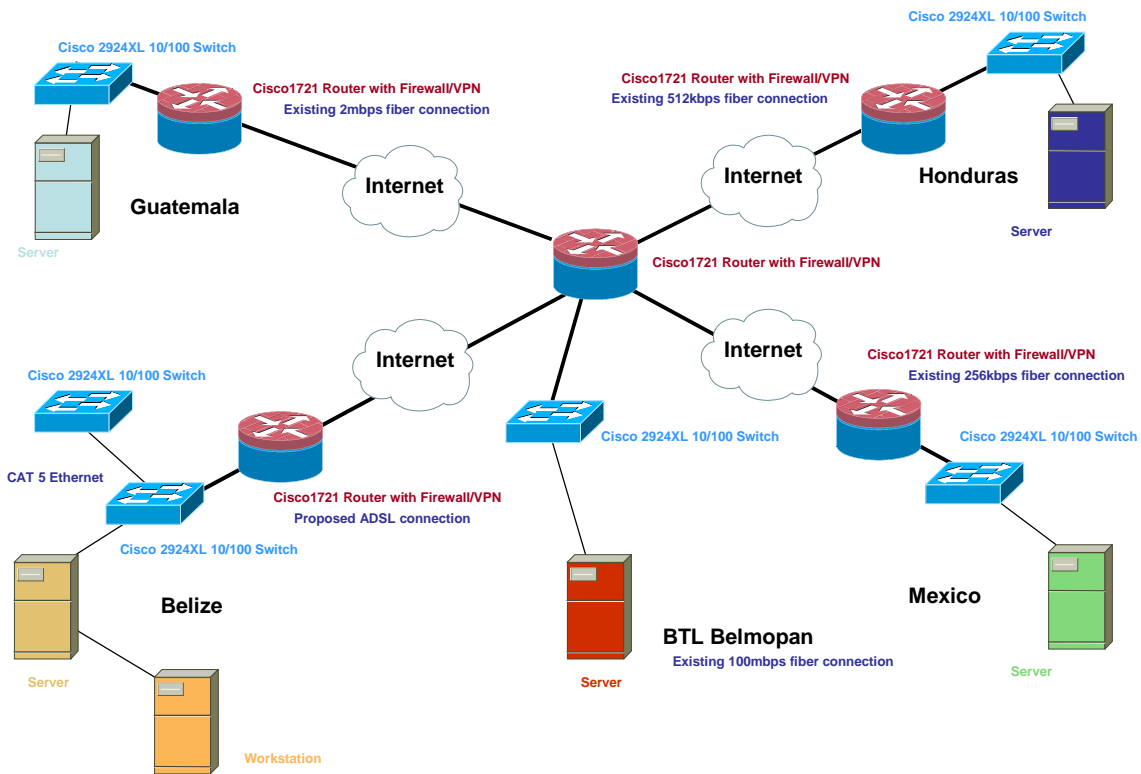


Figure 4.        Network equipment:  Option 1.

### 11.1.1  Advantages
- Easy to implement, configure and maintain
- Within the budget outlined by the MBRS (Table 1)
- Full redundancy and safeguards for network integrity
- Identical hardware and software placed at each node for ease of management

- Users in each country connect to the country node for quicker access.
- Guaranteed up-time of 99.5%
- Co-location at BTL would provide a 100Mbps connection to the main server.

### 11.1.2 Disadvantages

- The MBRS and CZM would share a server which could pose limitation for concurrent user at both the MBRS and CZM

- Co-location would incur additional costs (approximately $1200.00 USD per month)

- Backing up the central server would incur additional costs from BTL

For the purpose determining of costing options for both the Windows and Linux platforms, Table 2 outlines the cost of implementing Option 1 utilizing a Microsoft software solution and Table 3 outlines the cost of implementing a Linux/Opensource solution. Although the italicized items in each table are not strictly part of the implementation of the regional data communications network, they have been included to reflect the overall cost of the option put forth.

### Table 2. Option 1A: Windows 2000 and Microsoft SQL

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; RDS; UQROO; UVG; BTL | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 5 | $2,000.00 | $10,000.00 |
| MBRS; RDS; UQROO; UVG; BTL | Cisco WIC-1ENET second Ethernet port for 1721 | 5 | $300.00 | $1,500.00 |
| MBRS; CZM; RDS; UQROO; UVG; BTL | Cisco WS-C2950-24 24 port switch | 6 | $750.00 | $4,500.00 |
| MBRS; RDS; UQROO; UVG; BTL | Dell 2650 Server | 5 | $7,300.00 | $36,500.00 |
| MBRS; RDS; UQROO; UVG | APC UPS | 4 | $1,100.00 | $4,400.00 |
| MBRS; CZM; RDS; UQROO; UVG; BTL | Microsoft Windows 2000 Professional Server | 5 | $600.00 | $3,000.00 |
| *MBRS; RDS; UQROO; UVG; BTL* | *MS SQL Server* | *5* | *$1,300.00* | *$6,500.00* |
| MBRS; RDS; UQROO; UVG; BTL | Backup Exec | 5 | $500.00 | $2,500.00 |
| MBRS; RDS; UQROO; UVG; BTL | Powervault 110 LTO tape backup | 5 | $3,000.00 | $15,000.00 |
| MBRS | Workstation | 1 | $2,000.00 | $2,000.00 |
| MBRS | SDSL – Bandwidth/Connectivity | 1 | $6,000.00 | $6,000.00 |
| BTL | Installation and co-location fees (5 years) | 1 | $17,100.00 | $17,100.00 |
| MBRS; RDS; UQROO; UVG; BTL | Windows 2000 CAL's | 60 | $40.00 | $2,400.00 |
| *MBRS* | *ArcView 3.3* | *1* | *$1000.00* | *$1,000.00* |
| | | | **TOTAL** | **$112,400.00** |

**Table 3.        Option 1B: Linux and Opensource**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; RDS; UQROO; UVG; BTL | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 5 | $2,000.00 | $10,000.00 |
| MBRS; RDS; UQROO; UVG; BTL | Cisco WIC-1ENET second Ethernet port for 1721 | 5 | $300.00 | $1,500.00 |
| MBRS; CZM; RDS; UQROO; UVG; BTL | Cisco WS-C2950-24 24 port switch | 6 | $750.00 | $4,500.00 |
| MBRS; RDS; UQROO; UVG; BTL | Dell 2650 Server | 5 | $7,300.00 | $36,500.00 |
| MBRS; RDS; UQROO; UVG; BTL | APC UPS | 4 | $1,100.00 | $4,400.00 |
| *MBRS; RDS; UQROO; UVG; BTL* | *Red Hat Linux and Apache* | *5* | *$150.00* | *$ 750.00* |
| *MBRS; RDS; UQROO; UVG; BTL* | *Opensource SQL Server* | *5* | *$0.00* | *$ 0.00* |
| MBRS; RDS; UQROO; UVG; BTL | Backup Exec | 5 | $500.00 | $2,500.00 |
| MBRS; RDS; UQROO; UVG; BTL | Powervault 110 LTO tape backup | 5 | $3,000.00 | $15,000.00 |
| MBRS | Workstation | 1 | $2,000.00 | $2,000.00 |
| MBRS | SDSL – Bandwidth/Connectivity | 1 | $6,000.00 | $6,000.00 |
| BTL | Installation and co-location fees (5 years) | 1 | $17,100.00 | $17,100.00 |
| *MBRS* | *GRASS* | *1* | *$0.00* | *$ 0.00* |
| | | **TOTAL** | | **$100,250.00** |

## 11.2 Option 2

Option 2, outlined in Figure 5, provides for a fully distributed network with servers located in each of the four countries.
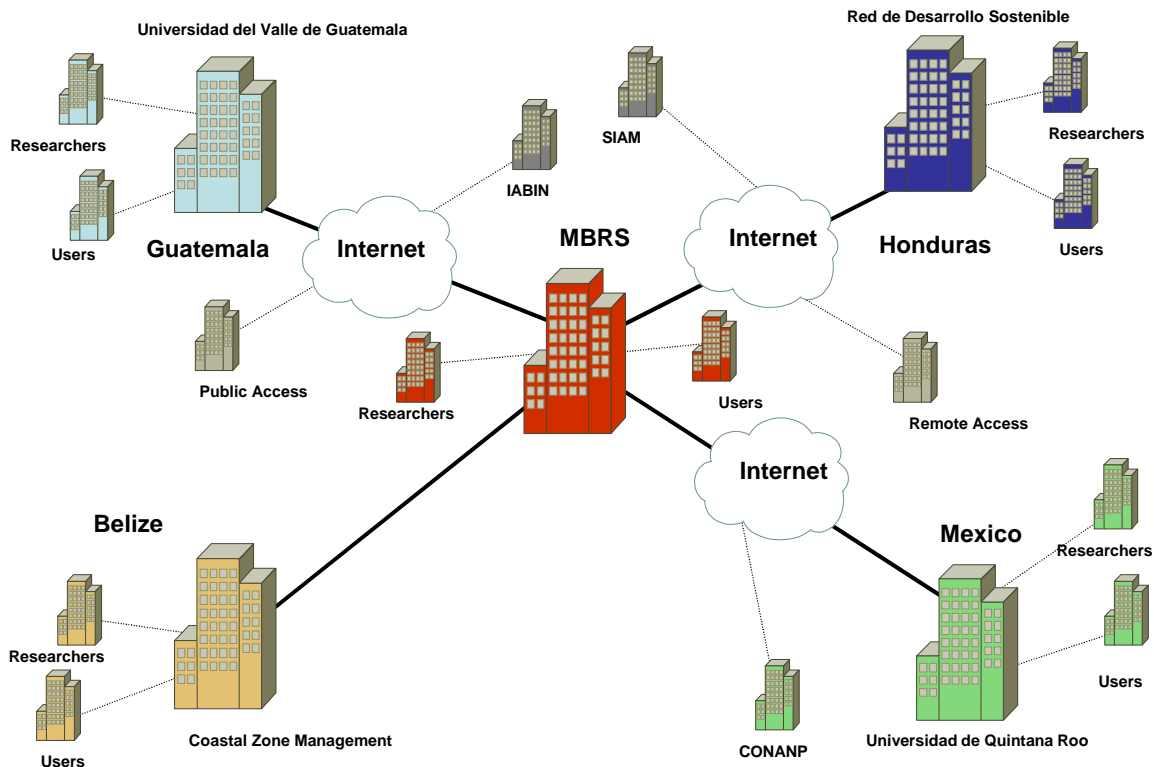


Figure 5.        MBRS Overall Network:  Option 2.

The node servers would be located at CZM, UVG, UQROO and RDS. MBRS headquarters would house the central server.

The network equipment (Figure 6) provided for each node would be identical (all equipment specifications are detailed in Appendix B) and is outlined as follows:

- Cisco 1721-VPN/K9 router with firewall/hardware VPN capability
- Cisco WIC-1ENET second Ethernet port for 1721
- Cisco WS-C2950-24 24 port switch
- Dell 2650 Server
- APC UPS
- Microsoft Windows 2000 Professional Server
- MS SQL Server
- Backup Exec
- Powervault 110 LTO tape backup
- Workstation

- Bandwidth/Connectivity
- Windows 2000 CAL's

Additionally, the MBRS would be provided with a GIS workstation.

Connection to the Internet for the various nodes would be as follows:

- MBRS  - proposed ADSL connection.
- UVG - existing 2mbps fiber connection
- UQROO – existing 256kbps fiber connection
- RDS  - existing 512kbps fiber connection

The cost for the proposed ADSL line for the MBRS is unable to be determined at the present time. However, the MBRS has indicated that the present cost of connectivity for the project ($350.00 USD/month) could be applied to recover some of the expense as well as a contribution from CZM. In addition, the project has budgeted $1500.00 USD per month for connectivity.

CZM would connect to the Internet via the MBRS router. It is anticipated that this will be done via switch to switch connectivity using CAT 5 ethernet cabling.

### 11.2.1  Advantages

- Easy to implement, configure and maintain
- Within the budget outlined by the MBRS (Table 1)
- Full redundancy and safeguards for network integrity
- Identical hardware and software placed at each node for ease of management
- Users in each country connect to the country node for quicker access.
- Guaranteed up-time of 99.5%

### 11.2.2  Disadvantages

- Connection to Internet for the central server would be significantly slower than BTL co-location.
- No contingency for the central server in the event of a disaster.

For the purpose of determining of costing options for both the Windows and Linux platforms, Table 4 outlines the cost of implementing Option 2 utilizing a Microsoft software solution and Table 5 outlines the cost of implementing a Linux/Opensource solution. Although the italicized items in each table are not strictly part of the implementation of the regional data communications network, they have been included to reflect the overall cost of the option put forth.
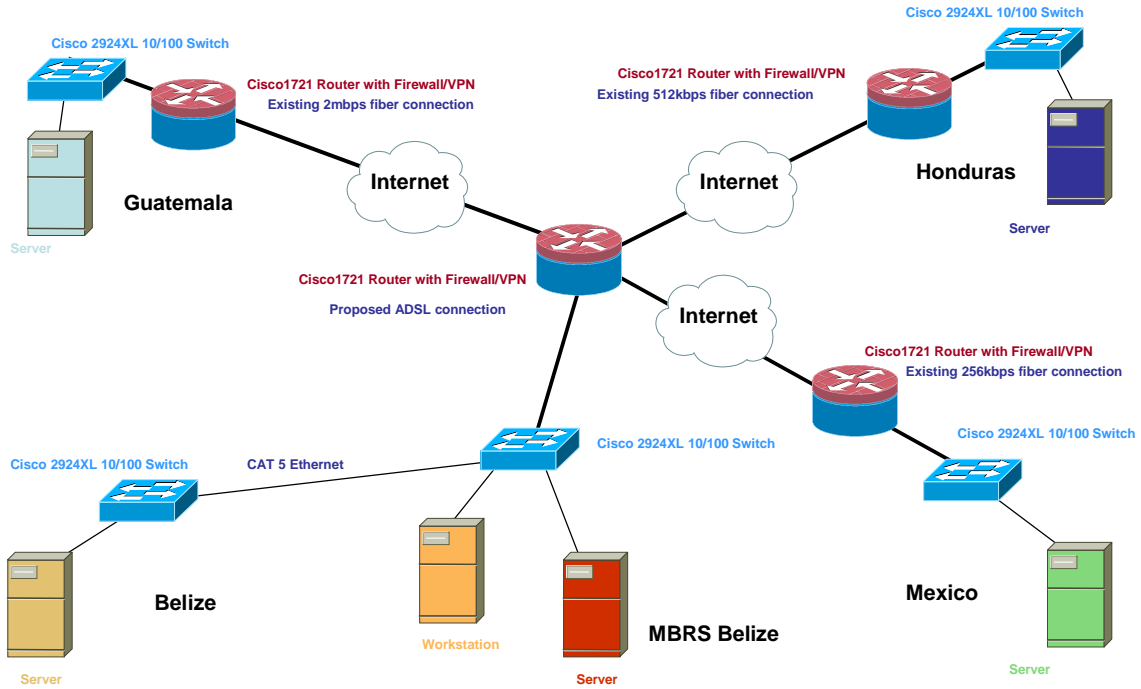
Figure 6.          Network equipment:  Option 2.

**Table 4.      Option 2A: Windows 2000 and Microsoft SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; CZM; RDS; UQROO; UVG | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 5 | $2,000.00 | $10,000.00 |
| MBRS; CZM; RDS; UQROO; UVG | Cisco WIC-1ENET second Ethernet port for 1721 | 5 | $300.00 | $1,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | Cisco WS-C2950-24 24 port switch | 5 | $750.00 | $3,750.00 |
| MBRS; CZM; RDS; UQROO; UVG | Dell 2650 Server | 5 | $7,300.00 | $36,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | APC UPS | 5 | $1,100.00 | $5,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | Microsoft Windows 2000 Professional Server | 5 | $600.00 | $3,000.00 |
| *MBRS; CZM; RDS; UQROO; UVG* | *MS SQL Server* | *5* | *$1,300.00* | *$6,500.00* |
| MBRS; CZM; RDS; UQROO; UVG | Backup Exec | 5 | $500.00 | $2,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | Dell Powervault 110 LTO tape backup | 5 | $3,000.00 | $15,000.00 |
| MBRS | Dell Precision 350 Workstation | 1 | $2,000.00 | $2,000.00 |
|  | Bandwidth/Connectivity | 0 | $0.00 | $ 0.00 |
| MBRS; CZM; RDS; UQROO; UVG | Windows 2000 CAL's | 60 | $40.00 | $2,400.00 |
| *MBRS* | *ArcView 3.3* | *1* | *$1000.00* | *$1,000.00* |
|  | **TOTAL** |  |  | **$89,650.00** |

**Table 5.      Option 2B: Linux and Opensource SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; CZM; RDS; UQROO; UVG | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 5 | $2,000.00 | $10,000.00 |
| MBRS; CZM; RDS; UQROO; UVG | Cisco WIC-1ENET second Ethernet port for 1721 | 5 | $300.00 | $1,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | Cisco WS-C2950-24 24 port switch | 5 | $750.00 | $3,750.00 |
| MBRS; CZM; RDS; UQROO; UVG | Dell 2650 Server | 5 | $7,300.00 | $36,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | APC UPS | 5 | $1,100.00 | $5,500.00 |
| *MBRS; CZM; RDS; UQROO; UVG* | *Red Hat Linux and Apache* | *5* | *$150.00* | *$ 750.00* |
| *MBRS; CZM; RDS; UQROO; UVG* | *Opensource SQL Server* | *5* | *$0.00* | *$ 0.00* |
| MBRS; CZM; RDS; UQROO; UVG | Veritas Backup Exec | 5 | $500.00 | $2,500.00 |
| MBRS; CZM; RDS; UQROO; UVG | Dell Powervault 110 LTO tape backup | 5 | $3,000.00 | $15,000.00 |
| MBRS | Dell Precision 350 Workstation | 1 | $2,000.00 | $2,000.00 |
| MBRS | Bandwidth/Connectivity | 1 | $0.00 | $ 0.00 |
| *MBRS* | *GRASS* | *1* | *$0.00* | *$ 0.00* |
|  | **TOTAL** |  |  | **$77,500.00** |

## 11.3   Option 3

Option 3, outlined in Figure 7, provides for a fully distributed network with servers located in each of the four countries. This option, however, proposes to utilize infrastructure components which currently exist at each node. Servers, routers and switches presently installed at UVG and UQROO would be configured for use with the REIS; routers and switches would be utilized at RDS. New servers would be implemented at RDS and MBRS. As in Option 1, a server is also located at a co-location facility hosted by BTL in Belmopan as there is a higher than acceptable risk of hurricane or other disaster at MBRS headquarters in Belize.   The BTL server would become the central server in the design due to the extremely high bandwidth availability.
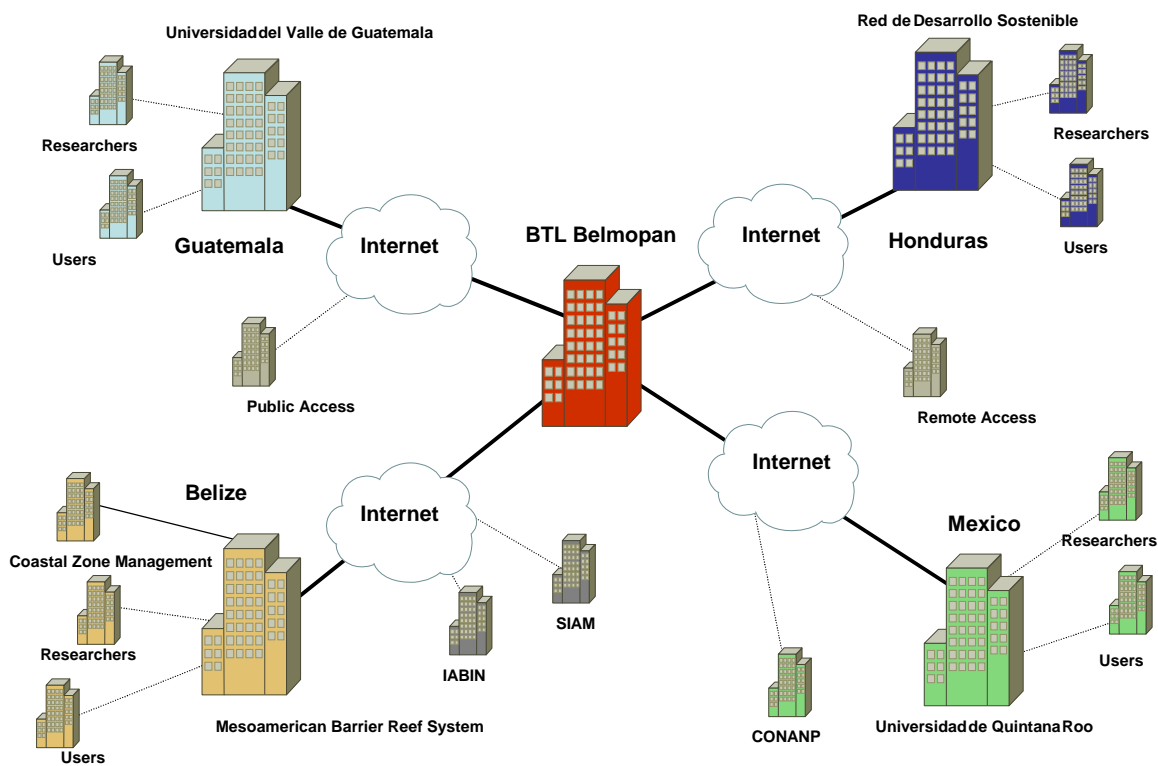


Figure 7.        MBRS overall network:  Option 3.

The network equipment (Figure 8) provided for the MBRS and BTL node would be identical (all equipment specifications are detailed in Appendix B) and is outlined as follows:

- Cisco 1721-VPN/K9 router with firewall/hardware VPN capability
- Cisco WIC-1ENET second Ethernet port for 1721
- Cisco WS-C2950-24 24 port switch
- Dell 2650 Server
- APC UPS
- Microsoft Windows 2000 Professional Server

- MS SQL Server
- Backup Exec
- Powervault 110 LTO tape backup
- Workstation
- Bandwidth/Connectivity
- Windows 2000 CAL's

Additionally, the MBRS would be provided with a GIS workstation.

Connection to the Internet for the various nodes would be as follows:

- MBRS  a proposed ADSL connection.
- UVG existing 2mbps fiber connection
- UQROO – existing 256kbps fiber connection plus additional connectivity (256kbps)
- RDS  - existing 512kbps fiber connection

The cost for the proposed ADSL line for the MBRS is unable to be determined at the present time. However, the MBRS has indicated that the present cost of connectivity for the project ($350.00 USD/month) could be applied to recover some of the expense as well as a contribution from CZM. In addition, the project has budgeted $1500.00 USD per month for connectivity.

CZM would connect to the Internet via the MBRS router and would share their information server. It is anticipated that this will be done via switch to switch connectivity using CAT 5 ethernet cabling.

### 11.3.1  Advantages
- Users in each country connect to the country node for quicker access
- Less costly as it takes advantage of existing installed capacity in each of the 4 nodes
- Addresses specific capacity building needs as stated by the node agencies.
- Within the budget outlined by the MBRS (Table 1)
- Full redundancy and safeguards for network integrity
- Users in each country connect to the country node for quicker access.
- Guaranteed up-time of 99.5%
- Co-location in case of disaster at one or more of the nodes .
- Co-location at BTL would provide a 100Mbps connection to the main server.

### 11.3.2  Disadvantages
- More difficult to install, maintain and manage
- The figure put into the budget for UQROO connectivity is for only 1 year
- Potential network administration issues at UVG, UQROO and RDS
- Beyond the scope of the TOR
- Loss of control over  servers and network components not purchased by the Project
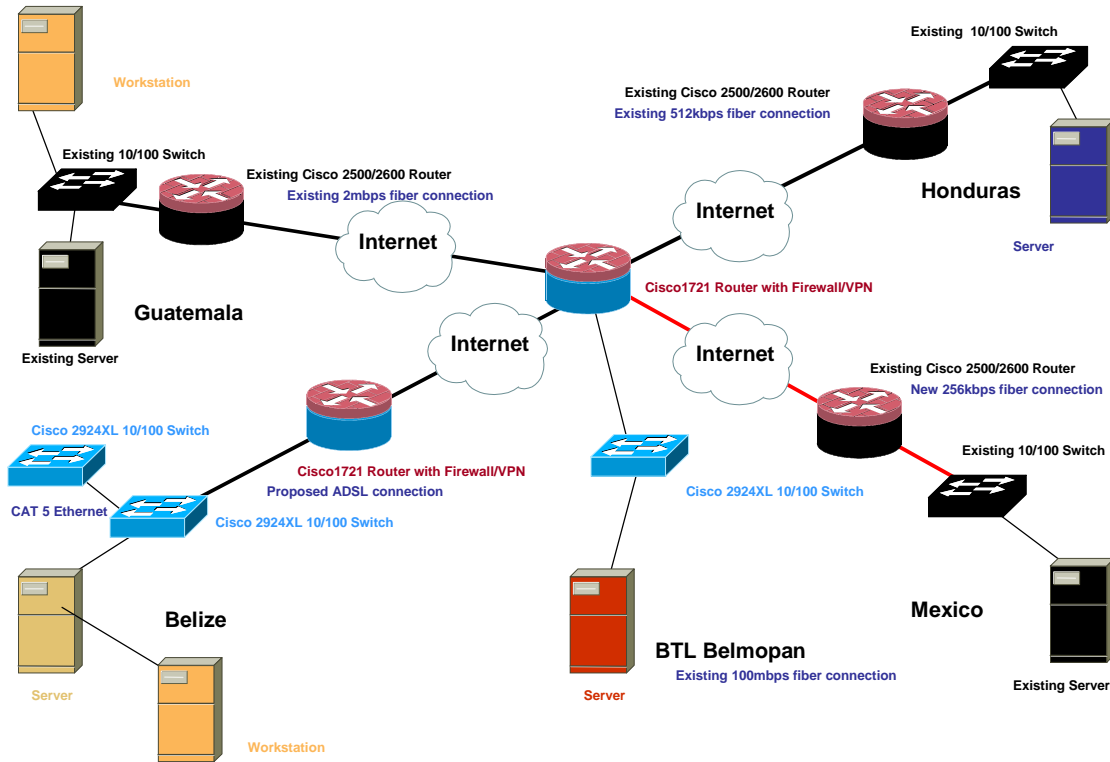
Figure 8. Network equipment: Option 3

For the purpose of determining of costing options for both the Windows and Linux platforms, Table 6 outlines the cost of implementing Option 2 utilizing a Microsoft software solution and Table 7 outlines the cost of implementing a Linux/Opensource solution. Although the italicized items in each table are not strictly part of the implementation of the regional data communications network, they have been included to reflect the overall cost of the option put forth.

### Table 6. Option 3A: Windows 2000 and Microsoft SQL

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; BTL | Cisco 1721-VPN/K9 router with firewall/hardware vpn capability | 2 | $2,000.00 | $4,000.00 |
| MBRS; BTL | Cisco WIC-1ENET second Ethernet port for 1721 | 2 | $300.00 | $ 600.00 |
| MBRS; CZM; BTL | Cisco WS-C2950-24 24 port switch | 3 | $750.00 | $2,250.00 |
| MBRS; RDS; BTL | Dell 2650 Server | 3 | $7,300.00 | $21,900.00 |
| MBRS | APC UPS | 1 | $1,100.00 | $1,100.00 |
| MBRS; RDS; BTL | Microsoft Windows 2000 Professional Server | 3 | $600.00 | $1,800.00 |
| *MBRS; RDS; BTL* | *MS SQL Server* | *3* | *$1,300.00* | *$3,900.00* |
| MBRS; RDS; BTL | Veritas Backup Exec | 3 | $500.00 | $1,500.00 |
| MBRS; RDS; BTL | Dell Powervault 110 LTO tape backup | 3 | $3,000.00 | $9,000.00 |
| MBRS; UVG | Dell Precision  350 Workstation | 2 | $2,000.00 | $4,000.00 |
| UQROO | Bandwidth/Connectivity | 1 | $13,000.00 | $13,000.00 |
| MBRS | SDSL – Bandwidth/Connectivity | 1 | $6,000.00 | $6,000.00 |

| | | | | |
|---|---|---|---|---|
| BTL | Installation and co-location fees (5 years) | 1 | $17,100.00 | $17,100.00 |
| MBRS; RDS; BTL | Windows 2000 CAL's | 60 | $40.00 | $2,400.00 |
| *MBRS; UVG* | *ArcView 3.3* | *2* | *$1000.00* | *$2,000.00* |
| | | **TOTAL** | | **$90,550.00** |

**Table 7.    Option 3B: Linux and Opensource SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; BTL | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 2 | $2,000.00 | $4,000.00 |
| MBRS; BTL | Cisco WIC-1ENET second Ethernet port for 1721 | 2 | $300.00 | $ 600.00 |
| MBRS; CZM; BTL | Cisco WS-C2950-24 24 port switch | 3 | $750.00 | $2,250.00 |
| MBRS; RDS; BTL | Dell 2650 Server | 3 | $7,300.00 | $21,900.00 |
| MBRS | APC UPS | 1 | $1,100.00 | $1,100.00 |
| *MBRS; RDS; BTL* | *Red Hat Linux and Apache* | *3* | *$150.00* | *$ 450.00* |
| *MBRS; RDS; BTL* | *Opensource SQL Server* | *3* | *$0.00* | *$  0.00* |
| MBRS; RDS; BTL | Veritas Backup Exec | 3 | $500.00 | $1,500.00 |
| MBRS; RDS; BTL | Dell Powervault 110 LTO tape backup | 3 | $3,000.00 | $9,000.00 |
| MBRS; UVG | Dell Precision 350 Workstation | 2 | $2,000.00 | $4,000.00 |
| UQROO | Bandwidth/Connectivity | 1 | $13,000.00 | $13,000.00 |
| MBRS | SDSL – Bandwidth/Connectivity | 1 | $6,000.00 | $6,000.00 |
| BTL | Installation and co-location fees (5 years) | 1 | $17,100.00 | $17,100.00 |
| *MBRS; UVG* | *GRASS* | *1* | *$0.00* | *$0.00* |
| | | **TOTAL** | | **$80,900.00** |

## 11.4   Option 4

Option 4, outlined in Figure 9, provides for a fully distributed network with servers located in each of the four countries. This option, however, proposes to utilize infrastructure components which currently exist at each node. Servers, routers and switches presently installed at UVG and UQROO would be configured for use with the REIS; routers and switches would be utilized at RDS. New servers would be implemented at CZM, RDS and MBRS. MBRS would become the central server.
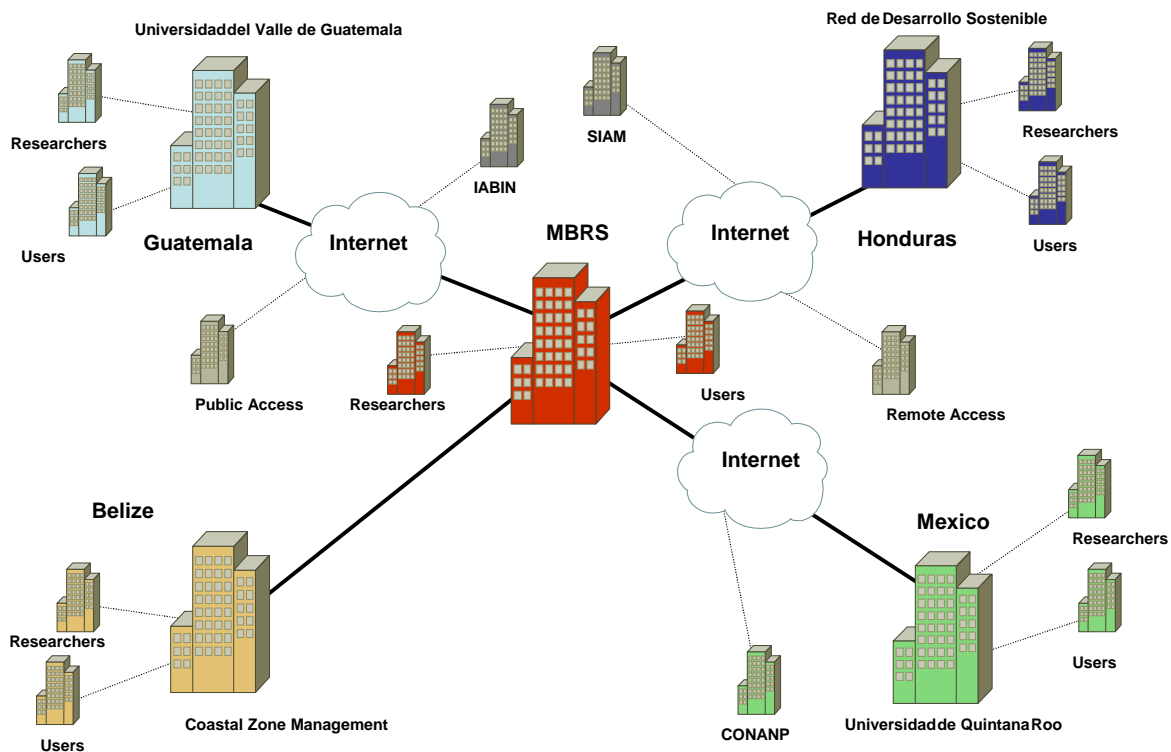


Figure 9.        MBRS overall network:  Option 4.

The network equipment (Figure 10) provided for the CZM, RDS and the MBRS would be identical (all equipment specifications are detailed in Appendix B) and is outlined as follows:

- Cisco 1721-VPN/K9 router with firewall/hardware VPN capability
- Cisco WIC-1ENET second Ethernet port for 1721
- Cisco WS-C2950-24 24 port switch
- Dell 2650 Server
- APC UPS
- Microsoft Windows 2000 Professional Server
- MS SQL Server
- Backup Exec
- Powervault 110 LTO tape backup

- Workstation
- Bandwidth/Connectivity
- Windows 2000 CAL's

Additionally, the MBRS would be provided with a GIS workstation.

Connection to the Internet for the various nodes would be as follows:

- MBRS  a proposed ADSL connection.
- UVG existing 2mbps fiber connection
- UQROO – existing 256kbps fiber connection plus additional connectivity (256kbps)
- RDS  - existing 512kbps fiber connection

The cost for the proposed ADSL line for the MBRS is unable to be determined at the present time. However, the MBRS has indicated that the present cost of connectivity for the project ($350.00 USD/month) could be applied to recover some of the expense as well as a contribution from CZM. In addition, the project has budgeted $1500.00 USD per month for connectivity.

CZM would connect to the Internet via the MBRS router. It is anticipated that this will be done via switch to switch connectivity using CAT 5 ethernet cabling.

### 11.4.1  Advantages
- Users in each country connect to the country node for quicker access
- Less costly as it takes advantage of existing installed capacity in each of the 4 nodes
- Addresses specific capacity building needs as stated by the node agencies.
- Within the budget outlined by the MBRS (Table 1)
- Full redundancy and safeguards for network integrity
- Users in each country connect to the country node for quicker access.
- Guaranteed up-time of 99.5%

### 11.4.2  Disadvantages
- The figure entered into the budget for UQROO connectivity is for only 1 year
- Potential network administration issues at UVG , UQROO and RDS
- Beyond the scope of the TOR
- Loss of control over servers and network components not purchased by the project
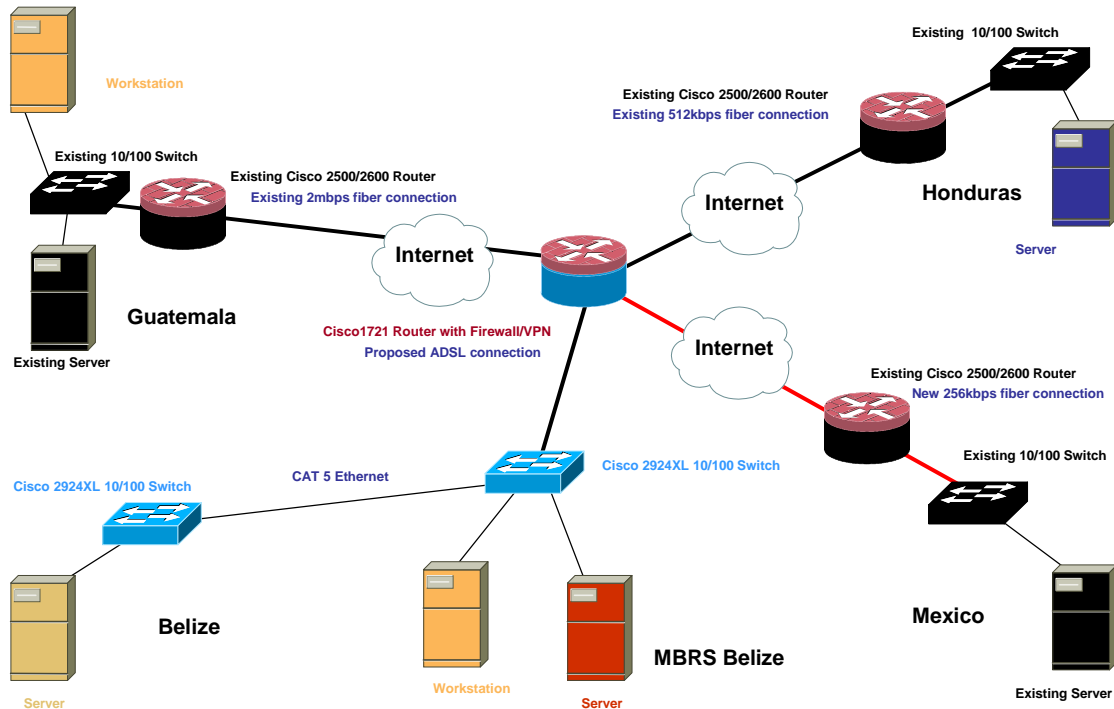
Figure 10.    Network equipment: Option 4.

For the purpose of determining of costing options for both the Windows and Linux platforms, Table 8 outlines the cost of implementing Option 2 utilizing a Microsoft software solution and Table 9 outlines the cost of implementing a Linux/Opensource solution. Although the italicized items in each table are not strictly part of the implementation of the regional data communications network, they have been included to reflect the overall cost of the option put forth.

**Table 8.    Option 4A: Windows 2000 and Microsoft SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 1 | $2,000.00 | $2,000.00 |
| MBRS | Cisco WIC-1ENET second Ethernet port for 1721 | 1 | $300.00 | $ 300.00 |
| MBRS; CZM | Cisco WS-C2950-24 24 port switch | 2 | $750.00 | $1,500.00 |
| MBRS; CZM; RDS | Dell 2650 Server | 3 | $7,300.00 | $21,900.00 |
| MBRS; CZM | APC UPS | 2 | $1,100.00 | $2,200.00 |
| MBRS; CZM; RDS | Microsoft Windows 2000 Professional Server | 3 | $600.00 | $1,800.00 |
| *MBRS; CZM; RDS* | *MS SQL Server* | *3* | *$1,300.00* | *$3,900.00* |
| MBRS; CZM; RDS | Veritas Backup Exec | 3 | $500.00 | $1,500.00 |
| MBRS; CZM; RDS | Dell Powervault 110 LTO tape backup | 3 | $3,000.00 | $9,000.00 |
| MBRS; UVG | Dell Precision 350 Workstation | 2 | $2,000.00 | $4,000.00 |
| UQROO | Bandwidth/Connectivity | 1 | $13,000.00 | $13,000.00 |
| MBRS; CZM; RDS | Windows 2000 CAL's | 60 | $40.00 | $2,400.00 |
| *MBRS; UVG* | *ArcView 3.3* | *2* | *$1000.00* | *$2,000.00* |
| | | | **TOTAL** | **$65,500.00** |

**Table 9.        Option 4B: Linux and Opensource SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 1 | $2,000.00 | $2,000.00 |
| MBRS | Cisco WIC-1ENET second Ethernet port for 1721 | 1 | $300.00 | $ 300.00 |
| MBRS; CZM | Cisco WS-C2950-24 24 port switch | 2 | $750.00 | $1,500.00 |
| MBRS; CZM; RDS | Dell 2650 Server | 3 | $7,300.00 | $21,900.00 |
| MBRS; CZM | APC UPS | 2 | $1,100.00 | $2,200.00 |
| *MBRS; CZM; RDS* | *Red Hat Linux and Apache* | *3* | *$150.00* | *$ 450.00* |
| *MBRS; CZM; RDS* | *Opensource SQL Server* | *3* | *$0.00* | *$ 0.00* |
| MBRS; CZM; RDS | Veritas Backup Exec | 3 | $500.00 | $1,500.00 |
| MBRS; CZM; RDS | Dell Powervault 110 LTO tape backup | 3 | $3,000.00 | $9,000.00 |
| MBRS; UVG | Dell Precision 350 Workstation | 2 | $2,000.00 | $4,000.00 |
| UQROO | Bandwidth/Connectivity | 1 | $13,000.00 | $13,000.00 |
| *MBRS; UVG* | *GRASS* | *2* | *$0.00* | *$0.00* |
| | | **TOTAL** | | **$55,850.00** |

## 11.5 Option 5
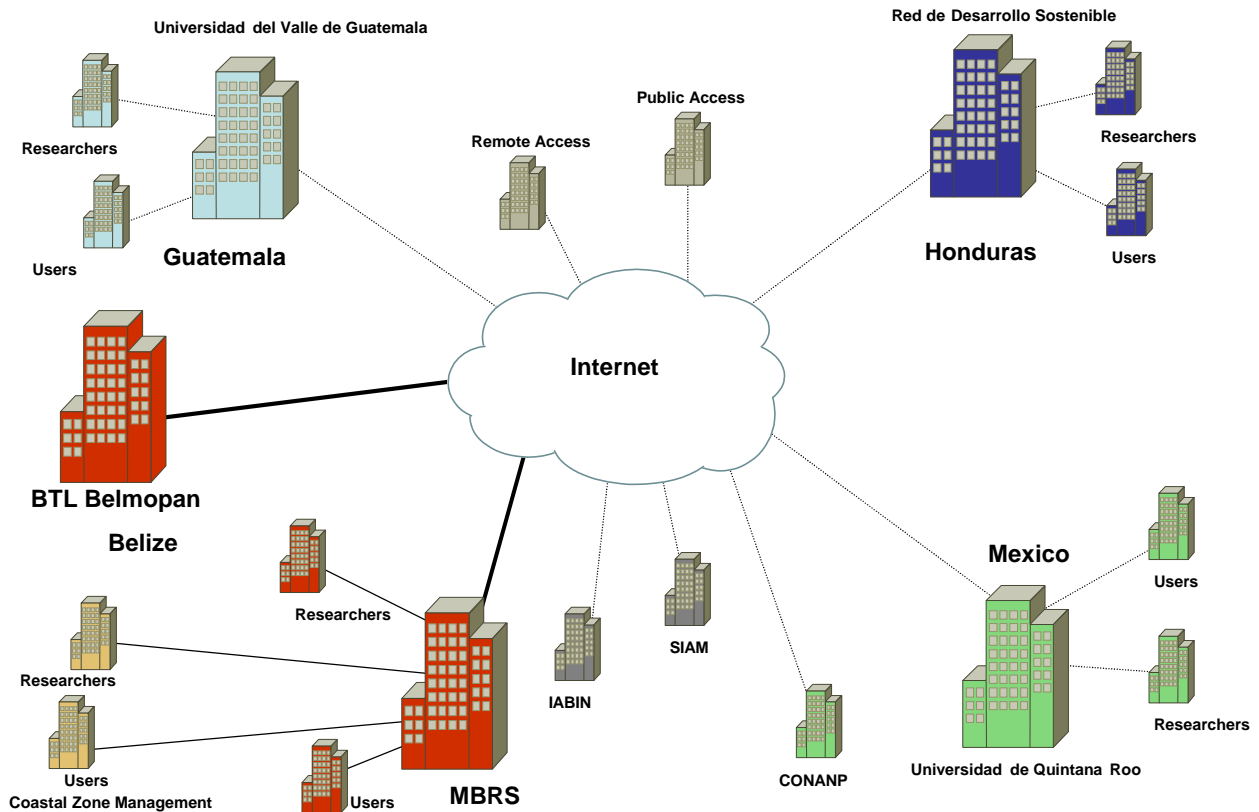


Figure 11.        MBRS overall network:  Option 5.

Option 5, outlined in Figure 11, provides for a distributed network with servers located in one country. New servers would be implemented at the MBRS and BTL. As in Option 1, a server is located at a co-location facility hosted by BTL in Belmopan as there is a higher than acceptable risk of hurricane or other disaster at MBRS headquarters in Belize.  The BTL server would become the central server in the design due to the extremely high bandwidth availability.

The node server would be located at MBRS.

The network equipment (Figure 12) provided for the MBRS and BTL is outlined as follows (all equipment specifications are detailed in Appendix B):

- Cisco 1721-VPN/K9 router with firewall/hardware VPN capability
- Cisco WIC-1ENET second Ethernet port for 1721
- Cisco WS-C2950-24 24 port switch
- Dell 2650 Server
- APC UPS
- Microsoft Windows 2000 Professional Server
- MS SQL Server
- Backup Exec

- Powervault 110 LTO tape backup
- Dell 350 Workstation
- Bandwidth/Connectivity
- Windows 2000 CAL's

Additionally, the MBRS, UVG and RDS would be provided with a GIS workstations.

Connection to the Internet for the various nodes would be as follows:

- MBRS  a proposed ADSL connection.
- UVG existing 2mbps fiber connection
- UQROO – existing 256kbps fiber connection plus additional 256kbps connectivity
- RDS  - existing 512kbps fiber connection

The cost for the proposed ADSL line for the MBRS is unable to be determined at the present time. However, the MBRS has indicated that the present cost of connectivity for the project ($350.00 USD/month) could be applied to recover some of the expense as well as a contribution from CZM. In addition, the project has budgeted $1500.00 USD per month for connectivity.

CZM would connect to the Internet via the MBRS router and would share the MBRS server. It is anticipated that this will be done via switch to switch connectivity using CAT 5 ethernet cabling.

### 11.5.1  Advantages
- Easy to implement, configure and maintain
- Within the budget outlined by the MBRS (Table 1)
- Redundant site provides safeguards for network integrity
- Identical hardware and software placed at two locations for ease of management
- Guaranteed up-time of 99.5%
- Co-location in case of disaster at one or more of the nodes .
- Co-location at BTL would provide a 100Mbps connection to the main server.

### 11.5.2  Disadvantages
- Would not constitute a full distributed implementation
- The figure put in the budget for UQROO connectivity is only for only 1 year
- All users would access the information via the web which could potentially cause slow access
- Falls outside the scope of the TOR.

For the purpose of determining of costing options for both the Windows and Linux platforms, Table 10 outlines the cost of implementing Option 2 utilizing a Microsoft software solution and Table 11 outlines the cost of implementing a Linux/Opensource solution. Although the italicized items in each table are not strictly part of the implementation of the regional data communications network, they have been included to reflect the overall cost of the option put forth.
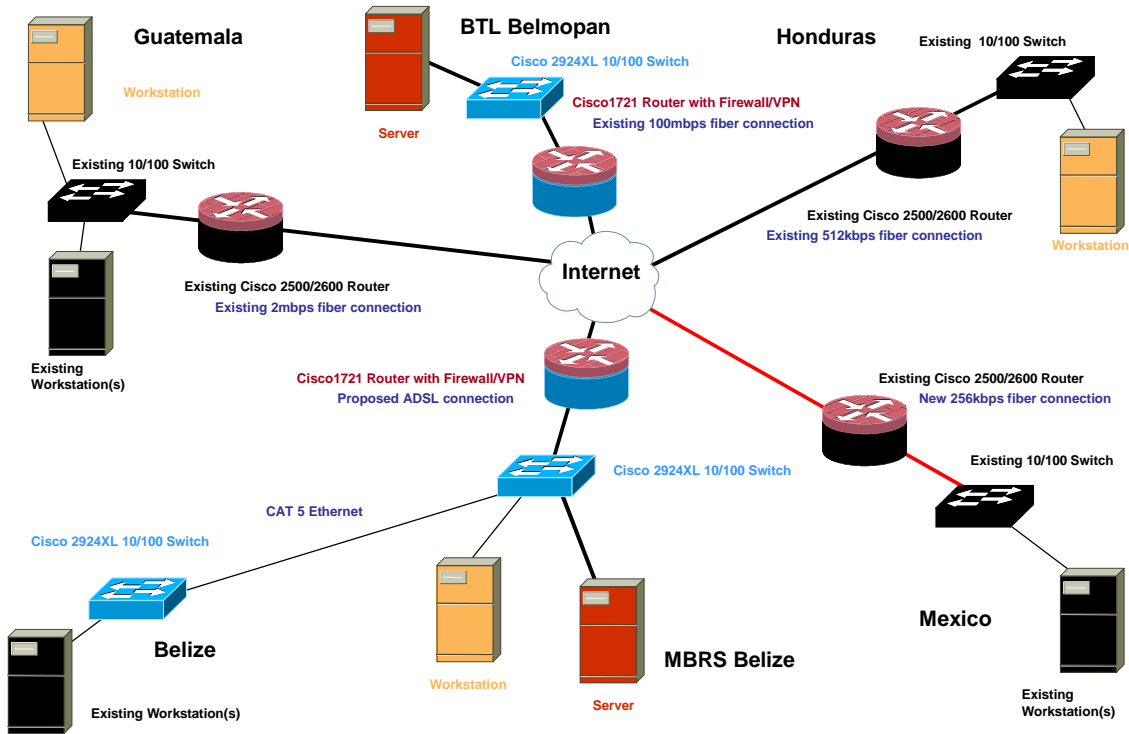
Figure 12.        Network equipment:  Option 5.

**Table 10.        Option 5A: Windows 2000 and Microsoft SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; BTL | Cisco 1721-VPN/K9 router with firewall/hardware vpn capability | 2 | $2,000.00 | $4,000.00 |
| MBRS; BTL | Cisco WIC-1ENET second Ethernet port for 1721 | 2 | $300.00 | $ 600.00 |
| MBRS; CZM; BTL | Cisco WS-C2950-24 24 port switch | 3 | $750.00 | $2,250.00 |
| MBRS; BTL | Dell 2650 Server | 2 | $7,300.00 | $14,600.00 |
| MBRS | APC UPS | 1 | $1,100.00 | $1,100.00 |
| MBRS; BTL | Microsoft Windows 2000 Professional Server | 2 | $600.00 | $1,200.00 |
| *MBRS; BTL* | *MS SQL Server* | *2* | *$1,300.00* | *$2,600.00* |
| MBRS; BTL | Veritas Backup Exec | 2 | $500.00 | $1,000.00 |
| MBRS; BTL | Dell Powervault 110 LTO tape backup | 2 | $3,000.00 | $6,000.00 |
| MBRS; RDS; UVG | Dell Precision 350 Workstation | 3 | $2,000.00 | $6,000.00 |
| UQROO | Bandwidth/Connectivity | 1 | $13,000.00 | $13,000.00 |
| MBRS | SDSL – Bandwidth/Connectivity | 1 | $6,000.00 | $6,000.00 |
| BTL | Installation and co-location fees (5 years) | 1 | $17,100.00 | $17,100.00 |
| MBRS; BTL | Windows 2000 CAL's | 60 | $40.00 | $2,400.00 |
| *MBRS; RDS; UVG* | *ArcView 3.3* | *3* | *$1000.00* | *$3,000.00* |
| | | | **TOTAL** | **$80,850.00** |

**Table 11.    Option 5B: Linux and Opensource SQL**

| Installation Agency | Product Description | # of Units | Unit Cost | Total Cost (US) |
|---|---|---|---|---|
| MBRS; BTL | Cisco 1721-VPN/K9 router with firewall/hardware VPN capability | 2 | $2,000.00 | $4,000.00 |
| MBRS; BTL | Cisco WIC-1ENET second Ethernet port for 1721 | 2 | $300.00 | $ 600.00 |
| MBRS; CZM; BTL | Cisco WS-C2950-24 24 port switch | 3 | $750.00 | $2,250.00 |
| MBRS; BTL | Dell 2650 Server | 2 | $7,300.00 | $14,600.00 |
| MBRS | APC UPS | 1 | $1,100 | $1,100.00 |
| *MBRS; BTL* | *Red Hat Linux and Apache* | *2* | *$150.00* | *$ 300.00* |
| *MBRS; BTL* | *Opensource SQL Server* | *2* | *$0.00* | *$ 0.00* |
| MBRS; BTL | Veritas Backup Exec | 2 | $500.00 | $1,000.00 |
| MBRS; BTL | Dell Powervault 110 LTO tape backup | 2 | $3,000.00 | $6,000.00 |
| MBRS; RDS; UVG | Dell Precision 350 Workstation | 3 | $2,000.00 | $6,000.00 |
| UQROO | Bandwidth/Connectivity | 1 | $13,000.00 | $13,000.00 |
| MBRS | SDSL – Bandwidth/Connectivity | 1 | $6,000.00 | $6,000.00 |
| BTL | Installation and co-location fees (5 years) | 1 | $17,100.00 | $17,100.00 |
| *MBRS; RDS; UVG* | *GRASS* | *3* | *$0.00* | *$ 0.00* |
| | **TOTAL** | | | **$71,950.00** |

# 12  PROTOCOLS

The proposed network is based upon the universal network transport standard called TCP/IP. The public Internet is based upon this standard. In the OSI seven layer model of network communications, IP is layer 3 and TCP is layer 4. TCP/IP is a connection-oriented protocol for ensuring the timely, reliable and guaranteed delivery of byte streams.

The network design is based upon providing maximum network security while extending privileged access to project information. The server is meant to be connected to a public communications medium such as the Internet through a dedicated firewall. The firewall also provides intrusion detection capabilities (IDS). Each node is designed to be a self-sufficient and highly protected data repository based upon a concept of layered security.

The nodes replicate and share information. To ensure data security and privacy, the firewalls provide a private, encrypted, full meshed Virtual Private Network (VPN). This allows data between servers to be replicated without fear of data interception, manipulation, or discovery outside of the nodes.

The firewall also allows client based VPN's to be connected.  This means that authorized personnel can connect to the nodes through the public Internet, but yet maintain security and privacy of data manipulation.

The network switch and router work in conjunction with each other.  For example, specific ports on the switch can be dedicated to the server and related accessories.  Other ports on the switch can be used for workstations and connectivity to other LAN's and workstations on the hosting node's network.  The router is used to segregate the two sections of the switch to ensure privacy and controlled access to all information elements.

## 12.1  Intrusion Detection

The Cisco IOS Firewall IDS feature identifies 59 of the most common attacks using "signatures" to detect patterns of misuse in network traffic. The intrusion-detection signatures included in the Cisco IOS Firewall were chosen from a broad cross-section of intrusion-detection signatures. The signatures represent severe breaches of security and the most common network attacks and information-gathering scans. For a description of Cisco IOS Firewall IDS signatures, refer to the "Cisco IOS Firewall IDS Signature List" section.

The Cisco IOS Firewall IDS acts as an in-line intrusion detection sensor, watching packets and sessions as they flow through the router, scanning each to match any of the IDS signatures. When it detects suspicious activity, it responds before network security can be compromised and logs the event through Cisco IOS syslog. The network administrator can configure the IDS system to choose the appropriate response to various threats. When packets in a session match a signature, the IDS system can be configured to take these actions:

- Send an alarm to a syslog server or a Cisco Secure IDS Director (centralized management interface)
- Drop the packet
- Reset the TCP connection

## 12.2    Firewall i.e. Context Based Access Control (CBAC)

CBAC intelligently filters TCP and UDP packets based on application-layer protocol session information. Without CBAC, traffic filtering is limited to access list implementations that examine packets at the network layer, or at most, the transport layer. However, CBAC examines not only network layer and transport layer information but also examines the application-layer protocol information (such as FTP connection information) to learn about the state of the session. This allows support of protocols that involve multiple channels created as a result of negotiations in the control channel.

CBAC inspects traffic that travels through the firewall to discover and manage state information for TCP and UDP sessions. This state information is used to create temporary openings in the firewall's access lists to allow return traffic and additional data connections for permissible sessions.

Inspecting packets at the application layer, and maintaining TCP and UDP session information, provides CBAC with the ability to detect and prevent certain types of network attacks such as SYN-flooding. A SYN-flood attack occurs when a network attacker floods a server with a barrage of requests for connection and does not complete the connection. The resulting volume of half-open connections can overwhelm the server, causing it to deny service to valid requests. Network attacks that deny access to a network device are called denial-of-service (DoS) attacks.

## 12.3    Alerts and Audit Trails

CBAC also generates real-time alerts and audit trails. Enhanced audit trail features use SYSLOG to track all network transactions; recording time stamps, source host, destination host, ports used, and the total number of transmitted bytes, for advanced, session-based reporting. Real-time alerts send SYSLOG error messages to central management consoles upon detecting suspicious activity. Using CBAC inspection rules, you can configure alerts and audit trail information on a per-application protocol basis. For example, if an audit trail information for HTTP traffic is required, it can specified in the CBAC rule covering HTTP inspection.

# 13    DESIGN CONSIDERATIONS

The design considerations outlined by the MBRS are addressed as follows:

## 13.1    Shared Resources

A Virtual Private Network (VPN) will server to connect the Local Area Networks (nodes) to form a Wide Area Network (WAN) via the internet.

Access at the LAN level will allow Project participants to input files and data to the local server. Through the automated features of the operating system, deltas on the individual LANs will be replicated to a central server on a nightly basis. (Depending on which Option is chosen, the replication may be a reciprocal process and would effectively create a complete information repository on each LAN server. If an Option was chosen which includes co-location, the replication would be limited between the MBRS node and the server placed at a co-location facility. )

The central server on the WAN will contain the complete repository and related information for the Project. The central server will also house the Project website which will be the main vehicle for disseminating information to scientists and researchers as well as the general public. (Again, depending

on the option chosen, the central server may also be used by one or two nodes for the inputting of files and data. This would certainly be the case if the MBRS housed the central server).

Additionally, remote users accessing the SMP will have access to the central server via the internet to upload data and update information.

## 13.2 Scalability

The network, regardless of the option chosen by the MBRS, is designed and configured in such a way as to allow for future growth requirements.

In the larger WAN, servers can be added to the system at any time. The addition of servers could either be in the form of adding additional agencies or nodes (LANs) to the network or increasing the computing and data handling capabilities of the central server by adding servers for specific functions such as SQL

processing (i.e. creating a server farm).

For each LAN (node), the servers outlined in the specifications are equipped with significant storage capacity. Should it be required, however, drive capacity can be increased by the addition of extra drives or with the addition of an external storage capacity device. High capacity 24 port switches have also been selected for each LAN which provide the opportunity for increasing the number of workstations accessing the network.

Remote users, or those requiring access such as the individuals or groups involved with the SMP, may be added at any time.

## 13.3 Reliability

Reliability involves all aspects of the network design as well as internet connectivity.

By employing a fully distributed network design, reliability is enhanced via the placement of servers at each node; the system does not rely only one server or one internet connection. In the event of catastrophic failure of one site or server, the remaining nodes can maintain the functionality and integrity of the network.

With respect to hardware, system components were selected which have excellent reliability statistics.

Specifically, each server has two network ports, two power supplies, a RAID 1 log file system and a RAID 5 data file drive system. A high capacity UPS is specified for providing filtered and backup power to the server. A tape storage backup unit for data recovery has also been specified in the case of catastrophic server failure or other data or file damage.

In conjunction with RPI's software design, data will be automatically replicated to all nodes for fast and timely access and reliability.

## 13.4 Maintainability

From a component point of view, the regional data communications network can be easily maintained; system components are identical at all nodes for ease of management, spare parts inventory, and replacement. Manufacturers' warranties vary from 1 year to lifetime with servers being supported through the initial three years of operation.

In addition, each server has monitoring tools in place for drive space utilization, component temperatures, drive reliability and other critical components. Pro-active system maintenance alerts can be generated before failure occurs. The primary server will contain a network management package for the collection and distribution of network statistics. Daily system backups are perhaps the only labor-intensive aspect of network management.

The servers are Microsoft Windows 2000 Professional or Linux based and technical support is readily available for managing and maintaining either platform.

## 13.5   Modularity

Components are common at all nodes. Configurations are similar between all units and can be used as templates for adding agency nodes. As a result, each node can work independently when communication facilities are unavailable but will re-establish connectivity when communications are restored.

## 13.6   Security

User security is maintained at several levels. Primary user management is maintained on the server and is replicated between all servers. Each user can be assigned specific privileges with respect to, for example, VPN access, file areas, web area, server management etc. Similar security is carried over for ensuring protection with database access. The Cisco 1721 has firewall and intrusion detection capability. The VPN keeps data updates localized to the network. The network management program will communicate with the firewalls in the router to detect intrusions.

## 13.7   Web Hosting

Web hosting is built into the Windows platform and will be accomplished by Apache Software with a Linux operating system. If required, each server can share web-hosting responsibilities.

## 13.8   Affordability and Long-term Sustainability

Five options for a network design have been outlined in Section 11 of the report. All of the proposed options fall within the budget outlined by the MBRS  (Table 1).  With respect to the long term, each node will be supplied with high-quality networking components that are warranted. This will help to provide sustainability over the long-term.

## 13.9   Back-end and Front-end Application and Systems Software

Consultation with RPI with respect to the design of the REIS and SMP has occurred and will continue to occur throughout the development and implementation of the network to ensure the network will perform the required services.

## 13.10  Interoperability between IABIN and SIAM

As the IABIN and SIAM databases have not been developed to the point where interoperability issues can be addressed, the MBRS has supplied information to the interested parties as well as an assurance of conformity with international standards. The MBRS will provide further information on interoperability at the appropriate time. Additionally, the MBRS has requested that CONANP (Cancun) be given access to

the REIS system. Access requirements for CONANP will be provided by the MBRS and will be implemented at the system level.

# 14 STATEMENT OF REQUIREMENTS

Regardless of the option chosen, the requirements for the implementation of the regional data communications network includes servers, workstations, routers, switches, uninterrupted power supplies and backup tape drives. The following section outlines the recommended specifications for each system component.

## 14.1 Servers

**System Processor:** Intel® Xeon 2.2GHz with NetBurst Micro-architecture with Hyper-Threading technology

**Front Side Bus:** 400MHz front side bus that allows for faster data throughput than 133MHz front side bus speeds

**Cache:** 512KB L2 Advanced Transfer Cache

**Chipset:** ServerWorks GC-LE chipset supports 5 PCI buses: 3 PCI-X (1 X 64bit/133MHz, 2 X 64bit/100MHz), 1 x 64bit/66MHz, 1 legacy bus (32bit/33MHz)

**Memory:** 2GB 200MHz DDR SDRAM; 6 DIMM sockets on system board configurable for Spare Bank

**Expansion Slots:** 3 full length PCI-X slots (1 X 64bit/133MHz, 2 X 64bit/100MHz)

**Drive Controller:** (RAID 3) PERC 3/Di with battery-backed cache (internal channels only with 128MB battery-backed cache

**Drive Bays:**
- Hard Drive bays for 5 X 1" hot-plug SCSI drives
- 24X EIDE CD-ROM or 8X IDE DVD ROM
- 3.5" 1.44MB diskette drive
- Backplane split for a 2 + 3 configuration

**Hard Drives:** 5 - 73GB (10,000 rpm) SCSI

**Cluster Support:** 2-node SCSI; 2-node Fibre Channel

**Communications:** Intel Pro/100+ Dual Port Server Adapter

**Input Devices**; Windows keyboard; Mouse

**Ports:** 2 9-pin serial, 2 Universal Serial Bus, video, PS/2 mouse, PS/2 keyboard, 3 RJ45

**Power:** Hot plug, redundant 500 watts power supplies; Voltage: 100-240 VAC

**Extras Features**
- Spare Bank configurable ECC memory;
- Chipkill supported with 512KB and 1GB ECC memory DIMMs;
- Dual embedded NICs with failover and load balancing support;
- Hot-pluggable x 2 redundant power supplies and hot-plug fans;

- Hot-pluggable hard drives;
- Front mounted keyboard, video and monitor ports.

**Chassis Features**

- Rack-Mountable Chassis: 3.375" (8.5725cm) H x 19.00" (48.26cm) W x 27.50" (69.85cm) D
- 2U rack height
- Active ID includes an illuminated indicator that provides basic system status information
- Front mounted keyboard, video and monitor ports provide easy access for crash cart
- Front mounted LCD alphanumeric display shows error messages and codes and illuminates different colors to indicate system status
- Cable-less motherboard design routes all internal connections through the printed wire assemblies to improve ease of serviceability (one cable in the system to connect backplane to control panel)

**Weight:** Up to 55 lb.

**Graphics:** Integrated ATI-Rage XL controller w/8MB of SDRAM

**Management Features**

- Embedded Remote Access (ERA) allowing remote management of servers;
- Pre Executable Environment (PXE) support of embedded NICs;
- Fault monitoring of voltage, fan, and thermal conditions to help ensure notification in case of potential problems;
- Management of drive array under optional Expandable RAID Controller;
- Track memory errors that have been corrected by the ECC memory;
- Automatic Server Recovery will reboot and restart the server if the OS hangs without user intervention;
- Setting for user-definable OS thresholds
- Email or paging capability to informed of potential server problems before they become critical
- Asset management features enable customers to inventory server configuration, CPU, memory and disk information, helping keep track of systems and keep them up-to-date

**Environmental Features**

**Operating Temperature:** 10º C to 35º C (50º F to 95º F)
**Storage Temperature:** -40º C to 65º C (-40º F to 149º F)
**Operating Relative Humidity:** 8% to 80% (non-condensing)
**Storage Relative Humidity:** 5% to 95% (non-condensing)
**Operating Vibration:** 0.25G at 3Hz to 200Hz for 15 minutes
**Storage Vibration:** 0.5G at 3Hz to 200Hz for 15 minutes
**Operating Shock:** 1 shock pulse in the negative Z axis of 41G for up to 2ms
**Storage Shock:** 6 shock pulses of 71G for up to 2ms
**Operating Altitude:** -16m to 3,048m (-50 ft to 10,000 ft)
**Storage Altitude:** -16m to 10,600m (-50 ft to 35,000 ft)

**Hardware Support (Warranty):** One year warranty

## 14.2   Workstations

**Processors and Chipset:** Intel® XeonTM  1 processors at 1.8 Ghz; 512KB Advanced Transfer L2 Cache Intel 860 Chipset with 400MHz system bus

**Memory**; 384MB  dual-channel RDRAM®  PC800

**Storage and Ports;** Hard Drives: 20GB2 ATA/100 7,200RPM hard drive

**Optical Devices:** EIDE CD-ROM

**Removable Media:** 3.5" Floppy Drive

**I/O Ports**

- Two 9-pin serial connectors; 16550-compatible;
- 25-pin parallel connector (bi-directional;
- 6-pin mini-DIN PS/2 keyboard connector;
- 6-pin mini-DIN PS/2 mouse connector;
- RJ45 NIC connector;
- Four USB-compliant 4-pin connectors;
- Two IEEE 1394 ports.

**Graphics Cards and Monitors:** Mainstream Graphics: nVIDIA®  GeForce2 GTS®  (32MB DDR)

17" (16.0" viewable) Monitor

**Additional Features**

- I/O Slots
- One 4XAGP Pro110;
- Five PCI slots;
- Three 32 bit/33 MHz;
- Two 64 bit/66 MHz.

**Communications:** Integrated Network Interface - 3Com®  3C920v3 Fast EtherLink XL 10/100 PCI with Wakeup on LAN

**Input Devices**

- Enhanced keyboard with 3 programmable hotkeys;
- 2-button PS/2 mouse.

**Software:** Microsoft: Windows XP®  Professional,

**Chassis:** Dimensions (WxHxD) - 8.89" x 19.87" x 19.8"

**Power:** 460 watt power supply

**Hardware Support Services (Warranty):** One year warranty.

## 14.3   Routers

**Processor:** a RISC processor

**Stateful inspection firewall:**   to include context-based access control for dynamic firewall filtering, denial-of-service detection and prevention, Java blocking, and real-time alerts

**High-performance VPN encryption:** IPSec DES and 3DES VPN module for high-speed, hardware-based encryption

**Device authentication and key management:** IKE, X.509v3 digital certification, support for Certificate Enrollment Protocol (CEP) with certificate authorities (CAs)

**VPN tunneling with IPSec, GRE, L2TP, L2F:** Choice of standards-based tunneling methods to create VPNs for IP and non-IP traffic

**VPN Remote:** To allows the router to act as remote VPN client and have VPN policies pushed down from the VPN concentrator

**VPN Server:** Must allow termination of remote access VPNs initiated by mobile and remote workers and termination of site-site VPNs

**Other Features:** must have CAR, policy routing, LLQ, WFQ, PQ/CBWFQ, GTS, FRTS, RSVP, DiffServ

**Device integration:** Integrated advanced routing, firewall, encryption, VPN tunnel server in a single device.

**Enhanced Management Features**

IEEE 802.1Q VLAN; Dynamic Host Configuration Protocol (DHCP) Server; Dynamic Host Configuration Protocol (DHCP) Client; Network Address Translation (NAT)/Port Address Translation (PAT); Auxiliary (AUX) port; and manageable via SNMP, Telnet, and console port

**Flexibility Features**

Must support for multiprotocol routing (IP, IPX, AppleTalk, IBM/SNA) and bridging

**Physical Interfaces/Ports**

- One 10/100BASE-TX Fast Ethernet port (RJ-45) which has Automatic speed detection; Automatic duplex negotiation and IEEE 802.1Q VLAN routing
- Two WAN interface card slots
- One auxiliary (AUX) port which supports; RJ-45 jack with EIA/TIA-232 interface; Asynchronous serial data terminal equipment (DTE) with full modem controls Carrier Detect, data set ready (DSR), Request To Send (RTS), Clear To Send (CTS) and Asynchronous serial data rates up to 115.2 kbps
- One console port which has RJ-45 jack with EIA/TIA-232 interface; Asynchronous serial DTE; Transmit/receive rates up to 115.2 kbps (default 9600 bps, not a network data port); No hardware handshaking such as RTS/CTS
- One internal expansion slot for support of hardware-assisted services such as VPN encryption
- (up to T1/E1 performance)

**Dimensions and Weight**

Width: 11.2 in.(28.4 cm); Height: 3.1 in. (7.85 cm); Depth: 8.7 in. (22.1 cm); Weight (maximum): 2.9 lb (1.32 kg)

**Power**

Locking connector on power socket; AC input voltage: 100 to 240 VAC; Frequency: 47 to 64 Hz; AC input current: 0.5 amps; Power dissipation: 20W (maximum)

**Environmental**

Operating temperature: 32 to 104 F (0 to 40 C); Non-operating temperature: -4 to 149 F (-20 to 65 C); Relative humidity: 10 to 85% non-condensing operating; 5 to 95% non-condensing, non-operating

**Safety**

UL 1950;CSA 22.2—No. 950;EN60950; EN41003;AUSTEL TS001;AS/NZS 3260;ETSI 300-047;BS 6301 (power supply)

**EMI**

AS/NRZ 3548 Class A;Class B;FCC Part 15 Class B;EN60555-2 Class B;EN55022 Class B;VCCI Class II;CISPR-22 Class B

**Immunity**

55082-1 Generic Immunity Specification Part 1: Residential and Light Industry;IEC 1000-4-2 (EN61000-4-2);IEC 1000-4-3 (ENV50140);IEC 1000-4-4 (EN61000-4-4);IEC 1000-4-5 (EN61000-4-5);IEC 1000-4-6 (ENV50141);IEC 1000-4-11;IEC 1000-3-2

**Hardware Support Services (Warranty):** Limited lifetime

## 14.4   Switches

1 rack-unit (RU) standalone, fixed-configuration, managed 10/100 switch; 24 10/100 ports

The product should have the following features and provide support for:
- Standard Image (SI) Software
- IEEE 802.1D Spanning-Tree Protocol
- UplinkFast, BackboneFast and PortFast technologies;
- Support for Cisco's optional, 300-watt redundant AC power system provides a backup power source for up to four units for improved fault tolerance and network uptime.
- unidirectional link detection (UDLD);
- Bandwidth aggregation through EtherChannel® technology; Port Aggregation Protocol (PAgP);
- Per-port broadcast, multicast, and unicast storm;
- Per virtual LAN (VLAN) Spanning-Tree Plus (PVST+) ;
- VLAN Trunking Protocol (VTP);
- Dynamic Trunking Protocol (DTP); and,
- Internet Group Management Protocol (IGMP).

**Security Features**
- A private VLAN edge
- Support for the 802.1x standard
- Port Security which secures the access to a port based on the MAC address of a users device.
- MAC Address Notification
- Multilevel security on console access
- TACACS+ and RADIUS authentication
- Cisco CMS Software Security Wizards ease the deployment of security features for restricting user access to a server, a portion of the network or access to the network.

## Quality of Service Features

- Support for reclassifying frames based either on 802.1p class of service value or default per port assigned by network manager;
- Four queues per egress port supported in hardware;
- The Weighted Round Robin (WRR) scheduling algorithm;
- Strict priority queue configuration via Strict Priority Scheduling

## Management Features

- Simple Network Management Protocol (SNMP) and Telnet interface support;
- An embedded Remote Monitoring (RMON) software agent supporting four Remote Monitoring groups (history, statistics, alarms, and events);
- A SPAN port can mirror traffic from one or many ports to another port for monitoring all nine RMON groups with an Remote Monitoring probe or network analyzer;
- Trivial File Transfer Protocol (TFTP);
- Network Timing Protocol (NTP);
- Multifunction LEDs per port for port status, half-duplex/full-duplex, 10BASE-T/100BASE-TX /1000BASE-T indication, as well as switch-level status LEDs for system, redundant power supply, and bandwidth utilization

## Deployment Features

- Auto-configuration; Auto-sensing; Auto-negotiating on all ports;
- Cisco Discovery Protocol (CDP) Versions 1 and 2 enable a CiscoWorks network management station to automatically discover the switch in a network topology;
- support dynamic VLANs and dynamic trunk configuration across all switches;
- Support for dynamic VLAN assignment through implementation of VLAN Membership Policy Server (VMPS);
- Voice VLAN;
- default configuration stored in Flash

## Performance Features

- 8.8-Gbps switching fabric
- 4.8-Gbps maximum forwarding bandwidth
- 3.6-Mpps wire-speed forwarding rate
- 8-MB packet buffer memory architecture shared by all ports
- 16-MB DRAM and 8-MB Flash memory
- Configurable up to 8,000 MAC addresses

## Standard Features

- IEEE 802.1x support
- IEEE 802.3x full duplex on 10BASE-T and 100BASE-TX ports
- IEEE 802.1D Spanning-Tree Protocol
- IEEE 802.1p class-of-service (CoS) prioritization
- IEEE 802.1Q VLAN
- IEEE 802.3 10BASE-T specification
- IEEE 802.3u 100BASE-TX specification
- Y2K compliant

**Connectors and Cabling Features**

- 10BASE-T ports: RJ-45 connectors, two-pair Category 3, 4, or 5 unshielded twisted-pair (UTP) cabling 100BASE-TX ports: RJ-45 connectors; two-pair Category 5 UTP cabling
- Management console port: 8-pin RJ-45 connector, RJ-45-to-DB9 adapter cable for PC connections; for terminal connections, use RJ-45-to-DB25 female data-terminal-equipment (DTE) adapter (can be ordered separately from Cisco, part number ACS-DSBUASYN=)

**Power Connector Features**

- Internal Power Supply Connector
- The internal power supply is an auto-ranging unit.
- The internal power supply supports input voltages between 100 and 240 VAC.
- Use the supplied AC power cord to connect the AC power connector to an AC power outlet.

**Indicators Features**

- Per-port status LEDs: link integrity, disabled, activity, speed, and full-duplex indications
- System status LEDs: system, RPS, and bandwidth utilization indications

**Dimensions and Weight (H x W x D) Features**

- 1.72 x 17.5 x 9.52 in. (4.36 x 44.45 x 24.18 cm)
- One rack-unit high (1.72 in./4.36 cm)
- One rack-unit high (1.72 in./4.36 cm)
- 6.5 lb (3.0 kg)

**Environmental Ranges Features**

- Operating temperature: 32 to 113 F (0º C to 45 C)
- Storage temperature: -13 to 158 F (-25 to 70 C)
- Operating relative humidity: 10 to 85% (non-condensing)
- Operating altitude: Up to 10,000 ft (3,000 m)
- Storage Altitude: Up to 15,000 ft (4,500 m)

**Power Requirement Features**

- Power consumption: 30W (maximum), 102 BTUs per hour
- AC input voltage/frequency: 100 to 127 or 200 to 240 VAC (auto-ranging), 50 to 60 Hz
- DC Input Voltages for Cisco RPS 300 Redundant Power System (RPS): +12V @ 4.5A

**Mean Time Between Failure (MTBF)**—Predicted 268,292 hours

**Safety Certifications**

- UL 60950/CSA 22.2 No. 950; IEC 60950/EN 60950; AS/NZS 3260, TS001; CE Marking

**Hardware Support Services (Warranty):** Lifetime limited

## 14.5 Uninterrupted Power Supply (UPS)

**General Features**

- 3000VA/2250W, Input 120V/ Output 120V, Interface Port DB-9 RS-232, SmartSlot, Rack Height 3 U
- Automatic Voltage Regulation (AVR) Hot Swap Batteries
- Intelligent Battery Management

- Load Meter
- Network-grade line conditioning
- Overload Indicator
- Rack Mount
- Replace Battery indicator
- Self-testing
- Sine-wave output
- Site wiring fault indicator
- SmartSlot
- Software
- User Replaceable batteries

**Included Items**

- CD with software, Rack Mounting support rails, Smart UPS signalling RS-232 cable, User Manual
- Management software included

**Communications & Management  Features**

- Interface port    DB-9 RS-232 , SmartSlot
- Available Smart Slot Interface Quantity  1
- Control panel    LED status display with load and battery bar-graphs and On Line : On Battery : Replace Battery : and Overload Indicators
- Audible alarm   Alarm when on battery : distinctive low battery alarm : configurable delays
- Emergency Power Off (EPO)     Optional

**Output Features**

- Output power capacity  3,000 VA
- Output power capacity  2,250 Watts
- Nominal output voltage          120 V
- Waveform type Sinewave

**Output Connections Features**

- (8)NEMA 5-15R

**Input Features**

- Nominal input voltage   120 V
- Input frequency          50/60 Hz +/- 3 Hz (auto sensing)

**Input Connection Type Features**

- NEMA L5-30P
- Cord Length     8 feet
- Input voltage range for main operations 92 - 147 V
- Input voltage adjustable range for main operations       86 - 154 V

**Surge Protection and Filtering Features**

- Surge energy rating       880 joules
- Filtering Full time multi-pole noise filtering : 0.3% IEEE surge let-through : zero clamping response time : meets UL 1449

**Runtime Features**

- Typical backup time at half load        13.1 minutes (1125 Watts)
- Typical backup time at full load  5.6 minutes (2250 Watts)

**Battery Features**

- Battery type       Maintenance-free sealed Lead-Acid battery with suspended electrolyte : leakproof
- Typical recharge time 3 hour(s)
- Replacement battery cartridge    (1) RBC12

**Physical Features**

- Maximum height dimensions 5.25 inches (13.34 cm)
- Maximum width dimensions 19.00 inches (48.26 cm)
- Maximum depth dimensions 25.00 inches (63.50 cm)
- Rack Height       3 U
- Net weight       114.00 lbs (51.82 kg)
- Shipping Weight        132.00 lbs (60.00 kg)
- Shipping Height        10.00 inches (25.40 cm)
- Shipping Width        24.50 inches (62.23 cm)
- Shipping Depth        37.50 inches (95.25 cm)
- Color    Beige

**Environmental Features**

- Operating Environment         0 - 40  C (32 - 104  F)
- Operating Relative Humidity 0 - 95%
- Operating Elevation       0-10000 feet (0-3000 m)
- Storage Temperature     -15 - 45  C (5 - 113  F)
- Storage Relative Humidity 0 - 95% Non-condensing
- Storage Elevation        0-50000 feet (0-15000 m)
- Audible noise at 1 meter from surface of unit 47 dBA
- Online thermal dissipation   375 BTU/hr

**Conformance Approvals:** CSA, FCC A, UL 1449, UL 1778

**Hardware Support Services (Warranty):** 2 years repair or replace

**Equipment protection policy Lifetime:** $150000.00

**Network Management Card for UPS**

**General Features**

- 10/100 BaseT Connection
- Boot-P support
- Data Logging
- Email/Pager Notification
- Event logging
- Flash Upgradeable
- MD5 Authentication Security

- Modular/Expandable
- Multiple System Shutdown
- Network Time Protocol
- Scheduling
- Standards-based management
- CD with software
- RS-232 configuration cable

**Physical Features**

Net weight   0.30 lbs  ( 0.14 kg)
Net Height  .50  inches  ( 3.81 cm)
Net Width   4.75  inches  ( 12.07 cm)
Net Depth  4.25  inches  ( 10.80 cm)
Shipping Weight          2.00 lbs  ( 0.91 kg)
Shipping Height          2.86  inches  ( 7.26 cm)
Shipping Width           9.00  inches  ( 22.86 cm)
Shipping Depth           6.50  inches  ( 16.51 cm)
Color    Black
Units per Pallet 672.0

**Environmental Features**

- Operating Temperature 0 - 45   C (32 - 113   F)
- Storage Temperature -15 - 65   C (5 - 149   F)
- Operating Relative Humidity 0 - 95 %
- Storage Relative Humidity 0 - 95 %
- Operating Elevation      0-10000  feet (0-3000 m)
- Storage Elevation          0-50000  feet (0-15000 m)

**Conformance Approvals** - BSMI, C-tick, CE, EN 55022 Class A, EN 55024, FCC Part 15 Class A, VCCI

**Hardware Support Services (Warranty):** 2 years repair or replace

## 14.6   Backup Tape Drive (LTO)

**General Features**

**Form Factor:**  Internal

**Capacity:**  100 GB native, 200 GB compressed

**Media Type:**  LTO Ultrium

**Recording Format:**  LTO Ultrium Generation 1

**Depth:** 8"; **Height:**  3.25" ;**Weight:**  4.2 lbs ; **Width:**  5.75"

**Average Seek / Access Time:**  71s

**Compliant Standards:**  CSA Certification to C22.2, No. 950 Amd 4, UL Listed to UL 1950 Amd 4, CE Declaration of Conformity CE 73/23/EEC Amended by (93/68/EEC)

**Controller Interface Type:**  Ultra wide SCSI-2

**Data Transfer Rate:** 15 MBps native, 30 MBps compressed

**Device Type:** Internal Tape Drive

**Dimensions (WxDxH):** 5.75" x 8" x 3.25"

**Dimensions (WxDxH) / Weight:** 5.75" x 8" x 3.25" / 4.2 lbs

**Environmental Parameters:** Operating temperature 50 F to 95 F; 20% to 80% humidity

**Interface Type:** Ultra wide SCSI-2

**Max Operating Temperature:** 95 F

**Min Operating Temperature:** 50 F

**Power Consumption Operational:** +5V @ 5.2A typical, +12V @ 0.7A typical, +5V @ 6.3A (max), +12V @2.75A (max)

**Humidity Range Operating:** 20% to 80%

**Max Altitude Operating:** 15,000 ft

**Native / Compressed Capacity:** 100 GB / 200 GB

**Vibration Tolerance Operating:** 0.3G pk 5-250 Hz (sine), 0.3G rms 5-250 Hz (random)

**Shock Tolerance Operating:** 5G 3ms (no performance change), 2G 11ms (no performance change), 8G 11ms (no data loss)

**Hardware Support Services (Warranty):** One year warranty


# 15  MAINTENANCE PLAN

The Maintenance Plan for the regional data communications network will provide a structured and manageable means of maintaining the network and information system.  However, since some critical information required to develop a comprehensive maintenance plan is not available at this time, the MBRS has suggested that the Maintenance Plan development be an ongoing process through to the implementation of the network and information system.

In general, given the regional data communications network is implemented across four countries (making it  logistically impossible for a single individual to perform all required maintenance functions in a timely and cost effective fashion), it is recommended that the MBRS be responsible for the overall management and maintenance of the network while the node agencies be responsible for the day to day maintenance of the networked components located in their respective countries.  The MBRS would perform maintenance on the network and central system while each node agency would perform maintenance on network components in conjunction with or directed by the MBRS.

The MBRS, in taking the lead role for overall system management and maintenance, will be responsible for:

- The development of a Memorandum of Understanding (MOU) with respect to system maintenance for the node agencies ;

- The development of a database for the categorization and identification of the components which will make up the network;
- The development of a reporting regimen for networking issues and problems;
- The development of a catalogue computer documentation;
- The development of a Disaster Management Plan;
- Monitoring the day to day function of the network components;
- Troubleshooting network problems;
- Scheduling repairs and maintenance;
- Performing daily system, database and website backups; and
- Installing software products and/or upgrades as necessary.

The node agencies will be responsible for:

- Implementation of a periodic schedule for cleaning all computers;
- Maintaining a current inventory of all computer equipment;
- Performing routine backups of systems and data as outlined by the MBRS;
- Cataloguing computer documentation;
- Troubleshooting computer problems and repair or fix whenever possible as coordinated with the MBRS;
- Scheduling repairs and maintenance that cannot be done on site in conjunction with the MBRS;
- Installing software products and/or upgrades as necessary as directed by the MBRS.

# 16   SECURITY POLICY

Since some critical information required to develop a comprehensive security policy is not available at this time, the MBRS has suggested that security policy development be an ongoing process throughout the design and implementation of the EIS.

From a network design point of view, it is recommended that system security include, but not necessarily be limited to, the following:

- Maintenance of user security at several levels;

- Primary user management maintained on the server and replicated between all servers;

- Specific privileges assigned to each user; for example, VPN access, file areas, web area, server management etc;

- Security privileges carried over to ensure protection at the database level;

- Firewall and intrusion detection capability; and,

- Secure VPN connectivity.

As the development of the information system progresses to the point of implementation, ESG and the MBRS will decide if the security policy goals of the organization are adequately met with the aforementioned security measures or whether additional considerations are necessary.  A Security Policy will then be developed from the resulting discussions.

_____

Project Manager

_____

Project Director

# APPENDIX A

# MBRS NODE SITE VISITS

# UNIVERSIDAD DE QUINTANA ROO, MEXICO

September 26th

**Hardware:**

- Sun Server Farm (220; 750; 880)
- Cisco Routers
- Fiber-optic Ring with 1gb backbone

**Software:**

- Solaris 2.6 – 5.8

**Connectivity:**

- 256kbps fiber connections via UNINET (Telmex); UNAM
- 1 connection they label a redundant one.
- There are some connectivity problems with UNAM – does not recognize address range 200.15.28.0. UNINET does recognize the address range. They are not sure why this is being blocked.
- There is a possibility to procure 128kbps ISDN links for increasing bandwidth.
- The cost to purchase 256kbps fiber would be $130,000 pesos or approximately $13,000 USD yearly. So $1,100 USD per month for a 256kbps fiber connection.
- It would be the same cost with either UNAM or UNINET.

**Network:**

- There are 550 workstations connected to the network. Fiber ring with 1gb backbone connected to smart switches (10/100). Approximately 500 concurrent users on average.
- Cozumel Campus is connected via 512kbps fiber.

**Security:**

- Spectrum Monitoring System.
- Firewall scheme.
- Netscape Proxy Server.

**Uses:**

- 1000 email user system with no quota for accounts
- LDAP mail news web
- Netscape Messenger Server/ mail – 1 dedicated server
- Netscape Enterprise / web – 1 dedicated server
- Web Server for distance learning – 1 dedicated server
- Research Center for Maya Language in Telum

**Videoconferencing facilities:**

- IP
- ISDN

**Hardware Standards:**

- Compaq - PC workstations

- HP - peripherals
- SUN - servers
- Cisco - routers
- 3COM – hubs and switches
- ENTERASYS – wireless connectivity

**Power:**

- There are currently problems with the electrical supply but they are investing $80,000 to update the electrical system. There are plans to build another computer center over the next fiscal year.
- UPS system in place allow for 20 minutes. They will have a new system in place which will provide 1 hour.
- Normally no blackouts and they have been able to maintain 99.9% up-time over the past year.

**Space:**

- The IT department is located in a secure building.
- There is a separate server room with space to locate a server; rackmount or standard unit.
- The server room is air-conditioned and kept at a constant 17 degrees celcius.

**Personnel:**

- Highly trained personnel to monitor and maintain the system. Highly trained GIS personnel. Students to provide data entry.

**GIS:**

- A state of the art GIS lab exists with sufficient hardware and software to accommodate the project.

**What could we leverage/use for the project:**

- Compaq Proliant – 2ghz dual processors – 1gb RAM – 6 hard drives (36.4gb)
- Network infrastructure
- Routers

**What would they like from the project:**

- Increased bandwidth.

# UNIVERSIDAD DEL VALLE DE GUATEMALA, GUATEMALA CITY

September 23, 2002

**Hardware:**

- Linux; Windows 2000
- Rack mount and stand alone.
- Have own web server.

**Software:**

- Windows 2000; Linux

**Connectivity:**

- 1gb backbone
- Fiber 2mbps. Thinking of increasing to 4mbps to accommodate remote campuses.

**Network:**

- University completely wired. 2700 users + 500 teaching; administration. Cisco external; HP internal routing.

**Security:**

- Firewall. Building is secured. Kapersky Anti-virus.

**Uses:**

- Internet connectivity; file sharing; 2 GIS labs. They are the GT domain administration.

**Hardware Standards:**

- Dell; HP.

**Power:**

- Reported to be generally good.
- UPS capability on individual machines and throughout the IT area (power transformer).

**Space:**

- The cable patch panel rack is located in a small room which is also used for GIS machines.

**Personnel:**

- Highly trained personnel to monitor and maintain the system. Trained GIS personnel for 2 labs. Students to provide data entry.

**GIS:**

- GIS lab exists with sufficient hardware and software to accommodate the project. All the software is licensed. ArcView 8 (20 licenses); ERDAS;IDRISI

**What could we leverage/use for the project:**

- All network infrastructure.

**What would they like from the project:**

- Server capacity; increased drive space.
- Workstation; $2000.00 USD

# RED DE DESARROLLO SOSTENIBLE, TEGUCIGALPA, HONDURAS

September 24, 2002

**Hardware:**

- 3 Servers. 1 new Dell Poweredge 4600 (1.8ghz; 108mb drive space – 3x36)

**Software:**

- RedHat Linux 7.2

**Connectivity:**

- 512kbps dedicated. Cisco 2500 and 2600 series routers.

**Network:**

- 300 users; approximately 50 on-site.

**Security:**

- Firewall on each server; 24hr surveillance.

**Uses:**

- Run an Internet café. They are an ISP for NGO's and some government. They are the administration for .HN

**Hardware Standards:**

- Dell; Apache.

**Power:**

- Reported to be generally good.
- UPS capability at the present time is 8hrs for server; battery; inverter backup power supply

**Space:**

- The cable patch panel rack is located in a small room with other servers. There is space for a new server if required.

**Personnel:**

- Highly trained personnel to monitor and maintain the system. No trained GIS personnel. Others to provide data entry.

**GIS:**

- No GIS capability.

**What could we leverage/use for the project:**

- Server(s).
- Network infrastructure
- Connectivity.

**What would they like from the project:**

- Increased bandwidth.

- Server.

# COASTAL ZONE MANAGEMENT, BELIZE CITY, BELIZE

September 25, 2002

**Hardware:**
- Printer Network only; no server
- Pentium III clone.

**Software:**
- Windows ME

**Connectivity:**
- 56kbps dial-up connection
- Considering going in with Fisheries department and MBRS to increase connectivity via fiber ARCOS.

**Network:**
- Wiring for 10 nodes.

**Security:**
- None. No server or firewall. Building houses MBRS and Fisheries department.

**Uses:**
- Print sharing and file sharing.

**Hardware Standards:**
- None.

**Power:**
- Reported to be generally good.
- All machines have individual UPS capability at the present time.

**Space:**
- The cable patch panel rack is located in a closet and they would locate any/all equipment in a small room which is also used for GIS machines.

**Personnel:**
- Highly trained GIS to monitor system and provide data entry.

**GIS:**
- GIS lab exists with sufficient hardware and software to accommodate the project. PC Arc Info 3.5.2 and ArcView 3.2. ERDAS Imagine.

**What could we leverage/use for the project:**
- Cabling infrastructure. Its proximity to the MBRS should allow us to run a line from the third floor.

**What would they like from the project:**

- Increased bandwidth (with MBRS and Fisheries).
- Server; Mail Proxy Server; Bandwidth

# MESOAMERICAN BARRIER REEF SYSTEM PROJECT, BELIZE CITY, BELIZE

September 25, 2002

**Hardware:**

- Dell Poweredge 2400

**Software:**

- Windows 2000

**Connectivity:**

- 56kbps dial-up connection
- Considering going in with Fisheries department and CZM to increase connectivity via fiber ARCOS.

**Network:**

- Wiring for 15 nodes.

**Security:**

- Server; no firewall or outside access. Building houses CZM, MBRS and Fisheries department.

**Uses:**

- Internet connection sharing; Print sharing and file sharing.

**Hardware Standards:**

- Dell.

**Power:**

- Reported to be generally good.
- No UPS capability at the present time.

**Space:**

- The cable patch panel rack is located in a closet and they would locate any/all equipment in Mary's office. The server is presently located in the accounting area.

**Personnel:**

- IT person will require training in systems and GIS to monitor system.

**GIS:**

- None.

**What could we leverage/use for the project:**

- Cabling infrastructure. Server?

**What would they like from the project:**

- NA

# APPENDIX B

# EQUIPMENT SPECIFICATIONS

## Dell 2650 Server Specifications

**System Processor**

Intel$^®$ Xeon 2.2GHz with NetBurst Micro-architecture with Hyper-Threading technology

**Front Side Bus**

400MHz front side bus that allows for faster data throughput than 133MHz front side bus speeds

**Cache**

512KB L2 Advanced Transfer Cache

**Chipset**

ServerWorks GC-LE chipset supports 5 PCI buses: 3 PCI-X (1 X 64bit/133MHz, 2 X 64bit/100MHz), 1 x 64bit/66MHz, 1 legacy bus (32bit/33MHz)

**Memory**

2GB 200MHz DDR SDRAM
6 DIMM sockets on system board configurable for Spare Bank

**Expansion Slots**

3 full length PCI-X slots (1 X 64bit/133MHz, 2 X 64bit/100MHz)

**Drive Controller**

Dual-channel integrated Ultra3 (Ultra160) SCSI Adaptec$^®$ AIC-7899 (160Mb/s) controller provides latest high performance SCSI technologies available without taking up PCI slots
Optional Adaptec Ultra3 (Ultra160) SCSI 39160 card

**RAID Controller**

PERC 3/Di) with battery-backed cache (internal channels only with 128MB battery-backed cache

**Drive Bays**

Hard Drive bays for 5 X 1" hot-plug SCSI drives
Media bay for one 24X EIDE CD-ROM or 8X IDE DVD ROM, one 3.5" 1.44MB diskette drive
Backplane split for a 2 + 3 configuration

**Hard Drives**

5 - 73GB (10,000 rpm) SCSI

**Cluster Support**

2-node SCSI
2-node Fibre Channel

**Communications**

Intel Pro/100+ Dual Port Server Adapter

**Input Devices**

Windows keyboard

**Ports**

2 9-pin serial, 2 Universal Serial Bus, video, PS/2 mouse, PS/2 keyboard, 3 RJ45

**Power**

Hot plug, redundant 500 watts power supplies
Voltage: 100-240 VAC

**Extras**

Spare Bank configurable ECC memory
Chipkill supported with 512KB and 1GB ECC memory DIMMs
Dual channel embedded Ultra 3 RAID with battery-backed cache
Dual embedded NICs with failover and load balancing support
2 x Hot-pluggable redundant power supplies and hot-plug fans
Hot-pluggable hard drives
High availability Fibre and SCSI cluster support
Front mounted keyboard, video and monitor ports

**Chassis**

Rack-Mountable Chassis: 3.375" (8.5725cm) H x 19.00" (48.26cm) W x 27.50" (69.85cm) D
2U rack height
Active ID includes an illuminated indicator that provides basic system status information
Front mounted keyboard, video and monitor ports provide easy access for crash cart
Front mounted LCD alphanumeric display shows error messages and codes and illuminates different colors to indicate system status
Cable-less motherboard design routes all internal connections through the printed wire assemblies to improve ease of serviceability (one cable in the system to connect backplane to control panel)
Weight: Up to 55 lb.

**Graphics**

Integrated ATI-Rage XL controller w/8MB of SDRAM (not upgradeable)

**Management**

Embedded Remote Access (ERA) allowing remote management of servers
Pre Executable Environment (PXE) support of embedded NICs
Fault monitoring of voltage, fan, and thermal conditions to help ensure notification in case of potential problems
Management of drive array under optional PowerEdge Expandable RAID Controller
Tracks memory errors that have been corrected by the ECC memory
Automatic Server Recovery will reboot and restart the server if the OS hangs without user intervention
User-definable OS thresholds can be set, allowing administrators to tune systems and eliminate bottlenecks to performance
Email or paging through Dell OpenManage™ keeps administrators informed of potential server problems before they become critical
Asset management features enable customers to inventory server configuration, CPU, memory and disk information, helping keep track of systems and keep them up-to-date
Dell OpenManage Server Setup CD included with every server to get your PowerEdge up, running, and contributing to your infrastructure quickly

## Environmental and Regulatory Environmental

Operating Temperature: 10º C to 35º C (50º F to 95º F)
Storage Temperature: -40º C to 65º C (-40º F to 149º F)
Operating Relative Humidity: 8% to 80% (non-condensing)
Storage Relative Humidity: 5% to 95% (non-condensing)
Operating Vibration: 0.25G at 3Hz to 200Hz for 15 minutes
Storage Vibration: 0.5G at 3Hz to 200Hz for 15 minutes
Operating Shock: 1 shock pulse in the negative Z axis of 41G for up to 2ms
Storage Shock: 6 shock pulses of 71G for up to 2ms
Operating Altitude: -16m to 3,048m (-50 ft to 10,000 ft)
Storage Altitude: -16m to 10,600m (-50 ft to 35,000 ft)

## Regulatory

FCC (U.S. only) Class A;DOC (Canada) Class A;CE Mark (EN 55022 Class A, EN55024, EN61000-3-2, EN61000-3-3, EN60950);VCCI Class A;UL 1950;CSA 950;EN 60950

## Hardware Support

2    Year Onsite warranty


**Three-Year Limited Warranty**

Dell Computer Corporation ("Dell") manufactures its hardware products from parts and components that are new or equivalent to new in accordance with industry-standard practices. Dell warrants that the hardware products it manufactures will be free from defects in materials and workmanship. The limited warranty term is two years beginning on the date of invoice, as further described in the following text. Damage due to shipping the products to you is covered under this limited warranty. Otherwise, this limited warranty does not cover damage due to external causes, including accident, abuse, misuse, problems with electrical power, servicing not authorized by Dell, usage not in accordance with product instructions, failure to perform required preventive maintenance, and problems caused by use of parts and components not supplied by Dell.

This limited warranty does not cover any items that are in one or more of the following categories: software; external devices (excepted as specifically noted); accessories or parts added to a Dell system after the system is shipped from Dell; accessories or parts added to a Dell system through Dell's system integration department; accessories or parts that are not installed in the Dell factory; or DellWare products. Monitors, keyboards, and mice that are Dell branded or that are included on Dell's standard

price list are covered under this limited warranty; all other monitors, keyboards, and mice (including those sold through the DellWare program) are not covered. Product batteries for portable computers are covered only during the initial one-year period of this limited warranty.

## Dell Precision™ Workstation 530

| | |
|---|---|
| Processor | Intel® Xeon™ Processor, 1.80GHz, 512K Cache |
| Memory: | 384MB PC800 ECC RDRAM® (4 RIMMS™) |
| Keyboard: | Entry Level Quietkey Keyboard, PS/2, (No Hot Keys) |
| Monitor: | 17 inch Dell (16.0 inch vis) M782 Flat CRT Monitor M782 |
| Graphics Card: | nVIDIA,Quadro2 EX,32MB,VGA    QUAD2EX |
| 1st Hard Drive: | 20GB ATA-100 IDE, 1 inch (7200 rpm) |
| Floppy Drive: | 3.5" 1.44MB Floppy Drive |
| Operating System: | Microsoft® Windows® XP Professional |
| Mouse: | Dell, PS/2 (2-button, no scroll) |
| CD ROM: | 20/48X, IDE CD-ROM |
| Hardware Support Services: | 3Yr Parts + Onsite Labor (Next Business Day)    (Warranty) |

### Processors and Chipset

Intel® Xeon™ 1 processors at 1.8 Ghz
512KB Advanced Transfer L2 Cache

Intel 860 Chipset with 400MHz system bus

### Memory

384MB  dual-channel RDRAM® PC800

### Storage and Ports

Hard Drives: 20GB$^2$ ATA/100 7,200RPM hard drive

Optical Devices: EIDE CD-ROM

Removable Media: 3.5" Floppy Drive

### I/O Ports

Two 9-pin serial connectors; 16550-compatible
25-pin parallel connector (bi-directional)
15-pin Video DIN connector(s) (on optional graphics adapters)
6-pin mini-DIN PS/2 keyboard connector
6-pin mini-DIN PS/2 mouse connector
RJ45 NIC connector
Four USB-compliant 4-pin connectors
1/8-inch Audio line-in miniature audio jack
1/8-inch Audio line-out miniature audio jack
1/8-inch Audio microphone-in miniature audio jack
Two IEEE 1394 ports

### Graphics Cards and Monitors

Mainstream Graphics: nVIDIA$^®$ GeForce2 GTS$^®$ (32MB DDR)

Dell M781p 17" (16.0" viewable) Monitor

**Additional Features**
**I/O Slots**

One 4XAGP Pro110
Five PCI slots
Three 32 bit/33 MHz
Two 64 bit/66 MHz
Two IEEE 1394 ports

**Communications**

Integrated Network Interface - 3Com$^®$ 3C920v3 Fast EtherLink XL 10/100 PCI with Wakeup on LAN

**Input Devices**

Enhanced QuietKey™ (Spacesaver) keyboard with 3 programmable hotkeys
Dell 2-button PS/2 mouse

**Software**

Tested Operating Systems
Microsoft: Windows XP$^®$ Professional,

**Chassis**

Dimensions (WxHxD) - 8.89" x 19.87" x 19.8"

**Power**

460 watt power supply

**Regulatory**

FCC (U.S. only) Class B

**Three-Year Limited Warranty**

Dell Computer Corporation ("Dell") manufactures its hardware products from parts and components that are new or equivalent to new in accordance with industry-standard practices. Dell warrants that the hardware products it manufactures will be free from defects in materials and workmanship. The limited warranty term is two years beginning on the date of invoice, as further described in the following text. Damage due to shipping the products to you is covered under this limited warranty. Otherwise, this limited warranty does not cover damage due to external causes, including accident, abuse, misuse, problems with electrical power, servicing not authorized by Dell, usage not in accordance with product instructions, failure to perform required preventive maintenance, and problems caused by use of parts and components not supplied by Dell.

This limited warranty does not cover any items that are in one or more of the following categories: software; external devices (excepted as specifically noted); accessories or parts added to a Dell system

after the system is shipped from Dell; accessories or parts added to a Dell system through Dell's system integration department; accessories or parts that are not installed in the Dell factory; or DellWare products. Monitors, keyboards, and mice that are Dell branded or that are included on Dell's standard price list are covered under this limited warranty; all other monitors, keyboards, and mice (including those sold through the DellWare program) are not covered. Product batteries for portable computers are covered only during the initial one-year period of this limited warranty.

## Cisco1721-VPN/K9

- A RISC processor to support high-performance routing, encryption, and broadband services

- One autosensing 10/100 Fast Ethernet port

- Two WAN interface card (WIC) slots that support the same data WAN interface cards as the Cisco 1600, 2600, and 3600 routers

- One auxiliary (AUX) port (up to 115.2-kbps asynchronous serial)

- One console port

- One internal expansion slot for the hardware-assisted VPN encryption card (MOD1700-VPN

By supporting industry standards, IPSec, Layer 2 Tunneling Protocol (L2TP), and DES and 3DES, the Cisco 1721 and 1720 routers deliver robust VPN solutions to ensure data privacy, integrity, and authenticity.

Cisco IOS Software supports an extensive set of basic and advanced network security features, including access control lists (ACLs); user authentication, authorization, and accounting (such as PAP/CHAP, TACACS+, and RADIUS); and data encryption. To increase security, integrated Cisco IOS Firewall protects internal LANs from attacks with context-based access control (CBAC). IPSec tunneling with Data Encryption Standard (DES) and 3DES encryption provides standards-based data privacy, integrity, and authenticity as e-business data travels through a public network.

The Cisco 1710 Security Access Router enables e-business application deployment by offering:

- Comprehensive security— Business-class security over always-on, broadband Internet connections

- High-performance VPN—Wire-speed VPN through hardware encryption

- Advanced quality of service (QoS) Features—Bandwidth optimization and traffic prioritization

- Remote manageability— Ease-of-installation, reliability, and manageability supported by CiscoWorks2000

- All-in-one solution—Integration of multiple functions, including VPN, stateful inspection firewall, intrusion detection system (IDS), full-featured Cisco IOS[®] Software multiprotocol routing (IP, IPX, AppleTalk), and advanced QoS features

The Cisco 1710 Security Access Router delivers a comprehensive feature set, including support for:

- Secure Internet, intranet, and extranet access with VPN and firewall

- Dual Ethernet for flexibility in using any high-speed broadband connection

- Standards-based IEEE 802.1Q virtual LAN (VLAN)

- Point-to-Point Protocol over Ethernet (PPPoE)

- Dynamic Host Configuration Protocol (DHCP) client and server

- Network Address Translation (NAT)/Port Address Translation (PAT)

- Tunneling with generic route encapsulation (GRE), Layer 2 Tunneling Protocol (L2TP), and Layer 2 Forwarding (L2F)

The Cisco 1710 integrates robust firewall functionality and intrusion detection system (IDS) for every perimeter of the network. It adds greater depth and flexibility to Cisco IOS security solutions such as authentication and encryption by including state-of-the-art security features such as stateful, application-based filtering, Context-Based Access Control (CBAC), denial of service protection, dynamic per-user authentication and authorization, defense against network attacks, Java blocking, and real-time alerts.

- **Advanced QoS Features.** Cisco IOS QoS features control the allocation of VPN bandwidth to mission-critical applications. The Cisco 1710 supports advanced QoS features such as committed access rate (CAR), policy routing, Low-Latency Queuing (LLQ), Priority Queuing/Class-Based Weighted Fair Queuing (PQ/CBWFQ), Weighted Random Early Detection (WRED), Generic Traffic Shaping (GTS), Resource Reservation Protocol (RSVP), and DiffServ.

- **Multiprotocol Routing.** With Cisco IOS Software, the Cisco 1710 offers optional multiprotocol routing (IP, IPX, and AppleTalk), IBM/Systems Network Architecture (SNA), and transparent bridging. Competing security solutions cannot match the full-featured routing functionality (RIP, OSPF, IGRP, EIGRP, and BGP) of the Cisco end-to-end network solution.

- **IEEE 802.1Q VLAN.** Using the IEEE 802.1Q VLAN standard, the Cisco 1710 enables enterprises to set up multiple VLANs and route between them for added security within the internal corporate network and ease of network resource management.

- **Dynamic Host Configuration Protocol (DHCP) Server/Client.** DHCP provides a way for network administrators to centrally manage and automate the assignment of Internet Protocol (IP) addresses in an organization's network. With DHCP server, the Cisco 1710 is the central point for assigning IP addresses to individual IP devices on the network. DHCP client allows enterprises and service providers to deploy the Cisco 1710 without having to statically assign IP address information to the Ethernet WAN interface.

- **PPP over Ethernet (PPPoE).** This Cisco IOS Software feature enables the router to be authenticated on a service provider's network or corporate home gateway using PPP, providing support for service provider access control as well as usage tracking and service billing.

Cisco IOS Software is the industry standard networking software and delivers proven reliability. The use of Cisco IOS technologies ensures that a VPN can scale reliably to large networks through the support of Internet Key Exchange (IKE) and digital certificates with leading certificate authorities (CAs), scalable routing protocol features such as Open Shortest Path First (OSPF) protocol and Enhanced Interior

Gateway Routing Protocol (EIGRP), Border Gateway Protocol (BGP), and reliability services such as Hot Standby Router Protocol (HSRP).

| Features | Benefits |
|---|---|

**Security**

*Stateful inspection firewall.* The Cisco IOS Firewall includes context-based access control for dynamic firewall filtering, denial-of-service detection and prevention, Java blocking, and real-time alerts

Allows internal users to access the Internet with secure, per-application-based, dynamic access control while preventing unauthorized Internet users from accessing the internal LAN

*High-performance VPN encryption.* IPSec DES and 3DES VPN module for high-speed, hardware-based encryption

Provides high-speed hardware-assisted encryption up to T1/E1 performance

Enables creation of wire-speed VPNs by providing industry-standard data privacy, integrity, and authenticity as data traverses public networks

*Device authentication and key management.* IKE, X.509v3 digital certification, support for Certificate Enrollment Protocol (CEP) with certificate authorities (CAs) such as Verisign and Entrust

Ensures proper identity and authenticity of devices and data. Enables scalability to very large IPSec networks through automated key management.

*VPN tunneling with IPSec, GRE, L2TP, L2F*      Choice of standards-based tunneling methods to create VPNs for IP and non-IP traffic

Allows any standards-based IPSec or L2TP client to interoperate with Cisco IOS tunneling technologies

*Cisco Easy VPN Remote*

Allows the router to act as remote VPN client and have VPN policies pushed down from the VPN concentrator

*Cisco Easy VPN Server*

Allows the router to terminate remote access VPNs initiated by mobile and remote workers running Cisco VPN client software on PCs; and allows the router to terminate site-site VPNs initiated by IOS routers using the Cisco Easy VPN Remote feature

**Advanced QoS**

*Quality of Service (QoS).* (CAR, policy routing, LLQ, WFQ, PQ/CBWFQ, GTS, FRTS, RSVP, DiffServ)

Allocates and optimizes bandwidth to priority applications for improved performance

**All-in-One Solution**

*Device integration.* Integrated advanced routing, firewall, encryption, VPN tunnel server in a single device.

Reduces costs and simplifies management compared to solutions based upon multiple separate devices

**Enhanced Management**

*IEEE 802.1Q VLAN*

Enables efficient traffic separation, provides better bandwidth utilization, and alleviates scaling issues by logically segmenting the physical LAN infrastructure into different subnets so that packets are switched only between ports within the same VLAN

*Dynamic Host Configuration Protocol (DHCP) Server*

Reduces the work necessary to administer an IP network by enabling the hosts on an IP network to obtain their IP address from the Cisco 1710 router

*Dynamic Host Configuration Protocol (DHCP) Client*

Provides a mechanism for centrally managing the IP addresses for remote Cisco 1710 routers

*Network Address Translation (NAT)/Port Address Translation (PAT)*

Simplifies deployment and reduces Internet access costs

*Auxiliary (AUX) port*

Enables dial-up connection for remote management

*Manageable via SNMP, Telnet, and console port*

Allows remote monitoring, configuration, and diagnostics for all functions integrated in the Cisco 1710, reducing management time and costs

*Ease of use and installation.* Cisco SETUP configuration utility, AutoInstall, color-coded ports/cables, and LED status indicators. Simplifies and reduces deployment time and costs with graphical LAN/VPN policy configurator; command-line, context-sensitive configuration questions; and straightforward cabling

**Flexibility**

*Feature-rich Cisco IOS support including multiprotocol routing (IP, IPX, AppleTalk, IBM/SNA) and bridging*

Provides industry's most robust, scalable, and feature-rich internetworking software support using the accepted standard networking software for Internet and private WANs

*Dual-Ethernet configuration*

Takes advantage of broadband access technologies such as cable and DSL to increase WAN connectivity speeds and reduce WAN access costs

Offers the flexibility to connect any broadband modems

*Autosensing 10/100 Fast Ethernet*

Simplifies implementation in mixed Ethernet environments

**Physical Interfaces/Ports**

- One 10/100BASE-TX Fast Ethernet port (RJ-45)

    - Automatic speed detection

    - Automatic duplex negotiation

    - IEEE 802.1Q VLAN routing (Cisco 1721 only)

- Two WAN interface card slots

    - Supports any combination of two WAN interface cards as shown in Table 3

- One auxiliary (AUX) port

    - RJ-45 jack with EIA/TIA-232 interface

    - Asynchronous serial data terminal equipment (DTE) with full modem controls Carrier Detect, data set ready (DSR), Request To Send (RTS), Clear To Send (CTS)

    - Asynchronous serial data rates up to 115.2 kbps

- One console port

    - RJ-45 jack with EIA/TIA-232 interface

    - Asynchronous serial DTE

    - Transmit/receive rates up to 115.2 kbps (default 9600 bps, not a network data port)

    - No hardware handshaking such as RTS/CTS

- One internal expansion slot for support of hardware-assisted services such as VPN encryption (up to T1/E1 performance)

**Dimensions and Weight**

- Width: 11.2 in.(28.4 cm)

- Height: 3.1 in. (7.85 cm)

- Depth: 8.7 in. (22.1 cm)

- Weight (maximum): 2.9 lb (1.32 kg)

**Power**

- Locking connector on power socket

- AC input voltage: 100 to 240 VAC

- Frequency: 47 to 64 Hz

- AC input current: 0.5 amps

- Power dissipation: 20W (maximum)

## Environmental

- Operating temperature: 32° to 104° F (0° to 40° C)

- Nonoperating temperature: -4° to 149° F (-20° to 65° C)

- Relative humidity: 10 to 85% noncondensing operating; 5 to 95% noncondensing, nonoperating

## Safety

UL 1950;CSA 22.2—No. 950;EN60950;EN41003;AUSTEL TS001;AS/NZS 3260;ETSI 300-047;BS 6301 (power supply)

## EMI

AS/NRZ 3548 Class A;Class B;FCC Part 15 Class B;EN60555-2 Class B;EN55022 Class B;VCCI Class II;CISPR-22 Class B

## Immunity

55082-1 Generic Immunity Specification Part 1: Residential and Light Industry;IEC 1000-4-2 (EN61000-4-2);IEC 1000-4-3 (ENV50140);IEC 1000-4-4 (EN61000-4-4);IEC 1000-4-5 (EN61000-4-5);IEC 1000-4-6 (ENV50141);IEC 1000-4-11;IEC 1000-3-2

**Warranty** : Limited Lifetime

**Cisco Limited Lifetime Hardware Warranty Terms**

The following are special terms applicable to your hardware warranty. Your formal Warranty Statement, including the warranty applicable to Cisco software, appears in the Cisco Information Booklet that accompanies your Cisco product.

**Duration of Hardware Warranty:** As long as the original End User continues to own or use the Product, provided that: fan and power supply warranty is limited to five (5) years. In the event of discontinuance of product manufacture, Cisco warranty support is limited to five (5) years from the announcement of discontinuance.

**Replacement, Repair or Refund Procedure for Hardware:** Cisco or its service center will use commercially reasonable efforts to ship a replacement part within ten (10) working days after receipt of the RMA request. Actual delivery times may vary depending on Customer location.

Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

**To Receive a Return Materials Authorization (RMA) Number:** Please contact the party from whom you purchased the product. If you purchased the product directly from Cisco, contact your Cisco Sales and Service Representative.

**Complete the form below and keep for ready reference**.

| | |
|---|---|
| Product purchased from: | |
| Their telephone number: | |
| Product Model and Serial number: | |
| Maintenance Contract number: | |

## Cisco WS-C2950-24 Port Switch

- **WS-C2950-24**    24 10/100 ports

- 1 rack-unit (RU) standalone, fixed-configuration, managed 10/100 switch

Standard Image (SI) Software

## Product Features and Benefits

**Feature**             **Benefit**
**Availability**

- **Superior Redundancy for Fault Backup**    IEEE 802.1D Spanning-Tree Protocol support for redundant backbone connections and loop-free networks simplifies network configuration and improves fault tolerance.

- Support for Cisco Spanning-Tree Protocol enhancements such as UplinkFast, BackboneFast and PortFast technologies ensure quick fail-over recovery enhancing overall network stability and availability.

- Support for Cisco's optional, 300-watt redundant AC power system provides a backup power source for up to four units for improved fault tolerance and network uptime.

- Provides unidirectional link detection (UDLD) for detecting and disabling unidirectional links on fiber-optic interfaces caused by incorrect fiber-optic wiring or port faults.

- **Integrated Cisco IOS Features for Bandwidth Optimization** Bandwidth aggregation through EtherChannel® technology enhances fault tolerance and offers higher-speed aggregated bandwidth between switches, to routers and individual servers. Port Aggregation Protocol (PAgP) is available to simplify configuration.

- Per-port broadcast, multicast, and unicast storm control prevents faulty end stations from degrading overall systems performance.

- Per virtual LAN (VLAN) Spanning-Tree Plus (PVST+) allows for Layer 2 load sharing on redundant links to efficiently utilize the extra capacity inherent in a redundant design.

- VLAN Trunking Protocol (VTP) pruning limits bandwidth consumption on VTP trunks by flooding broadcast traffic only on trunk links required to reach the destination devices. Dynamic Trunking Protocol (DTP) enables dynamic trunk configuration across all ports in the switch.

- Internet Group Management Protocol (IGMP) snooping provides for fast client joins and leaves of multicast streams and limits bandwidth-intensive video traffic to only the requestors. Multicast VLAN Registration (MVR), IGMP filtering and fast-join and immediate leave are available as enhancements.

**Security**

- **Network-Wide Security Features**    A private VLAN edge provides security and isolation between ports on a switch, ensuring that voice traffic travels directly from its entry point to the aggregation device through a virtual path and cannot be directed to a different port.

- Support for the 802.1x standard allows users to be authenticated regardless of which LAN port they are accessing, and provides unique benefits to customers who have a large base of mobile (wireless) users accessing the network.

- Port Security secures the access to a port based on the MAC address of a users device. The aging feature removes the MAC address from the switch after a specific timeframe to allow another device to connect to the same port.

- MAC Address Notification allows administrators to be notified of new users added or removed from the network.

- Multilevel security on console access prevents unauthorized users from altering the switch configuration.

- TACACS+ and RADIUS authentication to enable centralized control of the switch and restrict unauthorized users from altering the configuration.

- Cisco CMS Software Security Wizards ease the deployment of security features for restricting user access to a server, a portion of the network or access to the network.

**Quality of Service (QoS)**

- **Layer 2 Quality of Service** Support for reclassifying frames based either on 802.1p class of service (CoS) value or default CoS value per port assigned by network manager.

- Four queues per egress port supported in hardware.

- The Weighted Round Robin (WRR) scheduling algorithm ensures that low-priority queues are not starved.

- Strict priority queue configuration via Strict Priority Scheduling ensures that time-sensitive applications such as voice always follow an expedited path through the switch fabric.

**Management**

- **Superior Management** Simple Network Management Protocol (SNMP) and Telnet interface support delivers comprehensive in-band management, and a command-line interface (CLI)-based management console provides detailed out-of-band management.

- An embedded Remote Monitoring (RMON) software agent supports four RMON groups (history, statistics, alarms, and events) for enhanced traffic management, monitoring, and analysis.

- A SPAN port can mirror traffic from one or many ports to another port for monitoring all nine RMON groups with an RMON probe or network analyzer.

- Trivial File Transfer Protocol (TFTP) reduces the cost of administering software upgrades by downloading from a centralized location.

- Network Timing Protocol (NTP) provides an accurate and consistent timestamp to all switches within the intranet.

- Multifunction LEDs per port for port status, half-duplex/full-duplex, 10BASE-T/100BASE-TX /1000BASE-T indication, as well as switch-level status LEDs for system, redundant power supply, and bandwidth utilization provide a comprehensive and convenient visual management system.

- **Ultra-Flexible and Scalable Stacking and Cisco Switch Clustering Technology and CiscoWorks** Cisco Cluster Management Suite (CMS) Software allows the user to manage up to 16 inter-connected Cisco Catalyst 3550, 2950, 3500 XL, 2900 XL, and 2900 LRE XL switches without the limitation of being physically located in the same wiring closet, and with the option of using a single IP address for the entire cluster if desired.

- Manageable through CiscoWorks network management software on a per-port and per-switch basis providing a common management interface for Cisco routers, switches and hubs.

- Full backward compatibility of the Cisco CMS Software ensures that any Cisco Catalyst 3550, 2950, 3500 XL, 2900 XL, or 2900 LRE XL switch can be managed with a Cisco Catalyst 2950 Switch.

- The cluster software upgrade feature allows the user to automatically upgrade the system software on a group of Cisco Catalyst 3550, 2950, 3500 XL, 2900 XL, and 2900 LRE XL switches.

- Cisco Cluster Management Suite provides enhanced online help for context-sensitive assistance.

- Easy-to-use graphical interface provides both a topology map and front panel view of the cluster.

- Catalyst 2950 Series switches are manageable via CiscoWorks 2000 products via SNMP, which provide full enterprise-class network management.

- **Ease of Use and Ease of Deployment**      Auto-configuration eases deployment of switches in the network by automatically configuring multiple switches across a network via a bootp server.

- Auto-sensing on each port detects the speed of the attached device and automatically configures the port for 10-or 100- operation, easing the deployment of the switch in mixed 10and 100BaseT environments.

- Auto-negotiating on all ports automatically selects half- or full-duplex transmission mode to optimize bandwidth.

- Cisco Discovery Protocol (CDP) Versions 1 and 2 enable a CiscoWorks network management station to automatically discover the switch in a network topology.

- Cisco VTP supports dynamic VLANs and dynamic trunk configuration across all switches.

- Support for dynamic VLAN assignment through implementation of VLAN Membership Policy Server (VMPS) client functionality provides flexibility in assigning ports to VLANs.

- Voice VLAN simplifies telephony installations by keeping voice traffic on a separate VLAN for easier network administration and troubleshooting.

- The default configuration stored in Flash ensures that the switch can be quickly connected to the network and can pass traffic with minimal user intervention.

## Product Specifications

Feature            Description

- **Performance**      8.8-Gbps switching fabric

- Catalyst 2950-12: 2.4-Gbps maximum forwarding bandwidth

- Catalyst 2950-24: 4.8-Gbps maximum forwarding bandwidth

- Catalyst 2950SX-24: 8.8-Gbps maximum forwarding bandwidth (Forwarding Rates based on 64-byte packets)

- Catalyst 2950-12: 1.8-Mpps wire-speed forwarding rate

- Catalyst 2950-24: 3.6-Mpps wire-speed forwarding rate

- Catalyst 2950SX-24: 6.6-Mpps wire-speed forwarding rate

- 8-MB packet buffer memory architecture shared by all ports

- 16-MB DRAM and 8-MB Flash memory

- Configurable up to 8,000 MAC addresses

- **Standards**     IEEE 802.1x support

- IEEE 802.3x full duplex on 10BASE-T and 100BASE-TX ports

- IEEE 802.1D Spanning-Tree Protocol

- IEEE 802.1p class-of-service (CoS) prioritization

- IEEE 802.1Q VLAN

- IEEE 802.3 10BASE-T specification

- IEEE 802.3u 100BASE-TX specification

- **Y2K**

  Y

  2K compliant

- **Connectors and Cabling** 10BASE-T ports: RJ-45 connectors, two-pair Category 3, 4, or 5 unshielded twisted-pair (UTP) cabling 100BASE-TX ports: RJ-45 connectors; two-pair Category 5 UTP cabling

- Management console port: 8-pin RJ-45 connector, RJ-45-to-DB9 adapter cable for PC connections; for terminal connections, use RJ-45-to-DB25 female data-terminal-equipment (DTE) adapter (can be ordered separately from Cisco, part number ACS-DSBUASYN=)

- **Power Connectors**       Customers can provide power to a switch by using either the internal power supply or the Cisco Redundant Power System (RPS) 300. The connectors are located at the back of the switch.

- Internal Power Supply Connector

- The internal power supply is an auto-ranging unit.

- The internal power supply supports input voltages between 100 and 240 VAC.

- Use the supplied AC power cord to connect the AC power connector to an AC power outlet.

- Cisco RPS Connector

- The connector offers connection for an optional Cisco RPS 300 that uses AC input and supplies DC output to the switch.

- The connector offers a 300-watt redundant power system that can support six external network devices and provides power to one failed device at a time.

- The connector automatically senses when the internal power supply of a connected device fails and provides power to the failed device, preventing loss of network traffic.

- Attach only the Cisco RPS 300 (model PWR300-AC-RPS-N1) to the redundant-power-supply receptacle.

- **Indicators**      Per-port status LEDs: link integrity, disabled, activity, speed, and full-duplex indications

- System status LEDs: system, RPS, and bandwidth utilization indications

- **Dimensions and Weight**
  **(H x W x D)**      1.72 x 17.5 x 9.52 in. (4.36 x 44.45 x 24.18 cm)

- One rack-unit high (1.72 in./4.36 cm)

- One rack-unit high (1.72 in./4.36 cm)

- 6.5 lb (3.0 kg)

- **Environmental Ranges**   Operating temperature: 32° to 113° F (0º C to 45° C)

- Storage temperature: -13° to 158° F (-25° to 70° C)

- Operating relative humidity: 10 to 85% (non-condensing)

- Operating altitude: Up to 10,000 ft (3,000 m)

- Storage Altitude: Up to 15,000 ft (4,500 m)

- **Power Requirements**      Power consumption: 30W (maximum), 102 BTUs per hour

- AC input voltage/frequency: 100 to 127 or 200 to 240 VAC (auto-ranging), 50 to 60 Hz

- DC Input Voltages for Cisco RPS 300 Redundant Power System (RPS): +12V @ 4.5A

- **Mean Time Between Failure (MTBF)—Predicted**
        268,292 hours (Catalyst 2950-24)

- **Safety Certifications**      UL 60950/CSA 22.2 No. 950

- IEC 60950/EN 60950

- AS/NZS 3260, TS001

- CE Marking

**Warranty**      Lifetime limited

### Cisco Limited Lifetime Hardware Warranty Terms

The following are special terms applicable to your hardware warranty. Your formal Warranty Statement, including the warranty applicable to Cisco software, appears in the Cisco Information Booklet that accompanies your Cisco product.

**Duration of Hardware Warranty:** As long as the original End User continues to own or use the Product, provided that: fan and power supply warranty is limited to five (5) years. In the event of discontinuance of

product manufacture, Cisco warranty support is limited to five (5) years from the announcement of discontinuance.

**Replacement, Repair or Refund Procedure for Hardware:** Cisco or its service center will use commercially reasonable efforts to ship a replacement part within ten (10) working days after receipt of the RMA request. Actual delivery times may vary depending on Customer location.

Cisco reserves the right to refund the purchase price as its exclusive warranty remedy.

**To Receive a Return Materials Authorization (RMA) Number:** Please contact the party from whom you purchased the product. If you purchased the product directly from Cisco, contact your Cisco Sales and Service Representative.

**Complete the form below and keep for ready reference**.

| | |
|---|---|
| Product purchased from: | |
| Their telephone number: | |
| Product Model and Serial number: | |
| Maintenance Contract number: | |

**APC Smart-UPS 3000VA RM 3U 120V**
**Part Number :** SU3000RM3U

**Product Overview**

Description
APC Smart-UPS RM, 3000VA/2250W, Input 120V/ Output 120V, Interface Port DB-9 RS-232, SmartSlot, Rack Height 3 U

General Features
Automatic Voltage Regulation (AVR), Hot Swap Batteries, Intelligent Battery Management, Load Meter, Network-grade line conditioning, Overload Indicator, Rack Mount, Replace Batt Indicator, Self-testing, Sine-wave output, Site wiring fault indicator, SmartSlot, Software, User Replaceable batteries

Includes                 CD with software, Rack Mounting support rails, Smart UPS signalling RS-232 cable, User Manual

**Includes**

Management software included

**Options**

**Documentation**

User Manual & Installation Guides
Smart-UPS - 450/700/1000/1400/2200/3000 120VAC User Manual
Smart-UPS and Smart-UPS RM Accessories - 2200/3000 Receptacle Plate ; Installation Guide

**Communications & Management**

Interface port                DB-9 RS-232 , SmartSlot

Available Smart Slot Interface Quantity

Control panel            LED status display with load and battery bar-graphs and On Line : On Battery : Replace Battery : and Overload Indicators

Audible alarm            Alarm when on battery : distinctive low battery alarm : configurable delays

Emergency Power Off (EPO)

**Output**

Output power capacity   3,000 VA

Output power capacity   2,250 Watts

Nominal output voltage  120 V

Waveform type         Sinewave

Output Connections (8) NEMA 5-15R

**Input**

Nominal input voltage    120 V

Input frequency         50/60 Hz +/- 3 Hz (auto sensing)

Input Connection Type NEMA L5-30P

Cord Length           8 feet

Input voltage range for main operations

Input voltage adjustable range for main operations

**Surge Protection and Filtering**

Surge energy rating

Filtering Full time multi-pole noise filtering : 0.3% IEEE surge let-through : zero clamping response time ;meets UL 1449

**Runtime**

Typical backup time
at half load 13.1 minutes (1125 Watts)

Typical backup time
at full load 5.6 minutes (2250 Watts)

Runtime Chart                    Smart-UPS RM

**Batteries**
Battery type Maintenance-free sealed Lead-Acid battery with suspended electrolyte : leakproof
Typical recharge time **
Replacement battery cartridge

**Physical**

Maximum height dimensions 5.25 inches ( 13.34 cm)
Maximum width dimensions 19.00 inches ( 48.26 cm)
Maximum depth dimensions 25.00 inches ( 63.50 cm)

Rack Height                 3 U
Net weight 114.00 lbs ( 51.82 kg)
Shipping Weight 132.00 lbs ( 60.00 kg)
Shipping Height              10.00  inches ( 25.40 cm)
Shipping Width 24.50  inches ( 62.23 cm)
Shipping Depth               37.50  inches ( 95.25 cm)

**Environmental**

Operating Environment  0 - 40 °C (32 - 104°F)
Operating Relative Humidity 0 - 95%
Operating Elevation       0-10000 feet (0-3000 m)
Storage Temperature    -15 - 45 °C (5 - 113°F)
Storage Relative Humidity 0 - 95% Non-condensing
Storage Elevation         0-50000 feet (0-15000 m)

Audible noise at 1 meter from surface of unit

Online thermal dissipation

**Conformance**

Approvals                    CSA, FCC A, UL 1449, UL 1778

**Standard warranty**     2 years repair or replace , optional on-site warranties available , optional
extended warranties available

American Power Conversion (APC) warrants its products to be free from defects in materials and
workmanship for a period of two years from the date of purchase. Its obligation under this warranty is
limited to repairing or replacing, at its own sole option, any such defective products. To obtain service
under warranty you must obtain a Returned Material Authorization (RMA) number from customer
support (see the *Service* section of the *User's Manua*l).

Products must be returned with transportation charges prepaid and must be accompanied by a brief description of the problem encountered and proof of date and place of purchase. This warranty does not apply to equipment which has been damaged by accident, negligence, or misapplication or has been altered or modified in any way. This warranty applies only to the original purchaser who must have properly registered the product within 10 days of purchase.

EXCEPT AS PROVIDED HEREIN, AMERICAN POWER CONVERSION MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

EXCEPT AS PROVIDED ABOVE, IN NO EVENT WILL APC BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THIS PRODUCT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. Specifically, APC is not liable for any costs, such as lost profits or revenue, loss of equipment, loss of use of equipment, loss of software, loss of data, costs of substitutes, claims by third parties, or otherwise.

## NETWORK MANAGEMENT CARD EX
**Part Number :** AP9617

### Product Overview

Description
Network interface cards that provide standards-based remote management of UPSs.

### General Features

10/100 BaseT Connection, Boot-P support, Data Logging, Email/Pager Notification, Event logging, Flash Upgradeable, MD5 Authentication Security, Modular/Expandable, Multiple System Shutdown, Network Time Protocol, Scheduling, Standards-based management

Includes CD with software, RS-232 configuration cable

### Documentation

User Manual & Installation Guides
📄Installing Multiple Management Cards (Online Version)
📄Network Management Card AP9617 Installation and Quick Start Manual
📄Network Management Card AP9617 User Manual
📄Network Management Card AP9617, AP9618, and AP9619 Installation and Quick Start Manual
📄Network Management Card AP9617/AP9618/AP9619 User Manual

### Physical

Net weight          0.30 lbs  ( 0.14 kg)
Net Height 1.50  inches   ( 3.81 cm)

Net Width 4.75  inches   ( 12.07 cm)
Net Depth 4.25  inches   ( 10.80 cm)
Shipping Weight      2.00 lbs  ( 0.91 kg)
Shipping Height 2.86  inches   ( 7.26 cm)
Shipping Width 9.00  inches   ( 22.86 cm)
Shipping Depth 6.50  inches   ( 16.51 cm)

**Environmental**

Operating Temperature 0 - 45 °C (32 - 113 °F)
Storage Temperature -15 - 65 °C (5 - 149 °F)
Operating Relative Humidity 0 - 95 %
Storage Relative Humidity 0 - 95 %
Operating Elevation  0-10000  feet (0-3000 m)
Storage Elevation 0-50000  feet (0-15000 m)

**Conformance Approvals:** BSMI, C-tick, CE, EN 55022 Class A, EN 55024, FCC Part 15 Class A, VCCI

**Standard warranty**: 2 years repair or replace

American Power Conversion (APC) warrants its products to be free from defects in materials and workmanship for a period of two years from the date of purchase. Its obligation under this warranty is limited to repairing or replacing, at its own sole option, any such defective products. To obtain service under warranty you must obtain a Returned Material Authorization (RMA) number from customer support (see the *Service* section of the *User's Manua*l).

Products must be returned with transportation charges prepaid and must be accompanied by a brief description of the problem encountered and proof of date and place of purchase. This warranty does not apply to equipment which has been damaged by accident, negligence, or misapplication or has been altered or modified in any way. This warranty applies only to the original purchaser who must have properly registered the product within 10 days of purchase.

EXCEPT AS PROVIDED HEREIN, AMERICAN POWER CONVERSION MAKES NO WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. Some states do not permit limitation or exclusion of implied warranties; therefore, the aforesaid limitation(s) or exclusion(s) may not apply to the purchaser.

EXCEPT AS PROVIDED ABOVE, IN NO EVENT WILL APC BE LIABLE FOR DIRECT, INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OF THIS PRODUCT, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE. Specifically, APC is not liable for any costs, such as lost profits or revenue, loss of equipment, loss of use of equipment, loss of software, loss of data, costs of substitutes, claims by third parties, or otherwise.

**Dell Powevault 110 LTO Tape Drive**

**Form Factor:**  External
**Capacity:**  100 GB native, 200 GB compressed
**Media Type:**  LTO Ultrium
**Recording Format:**  LTO Ultrium Generation 1

**Depth:** 8"
**Height:** 3.25"
**Weight:** 4.2 lbs
**Width:** 5.75"
**Average Seek / Access Time:** 71s
**Compliant Standards:** CSA Certification to C22.2, No. 950 Amd 4, UL Listed to UL 1950 Amd 4, CE Declaration of Conformity CE 73/23/EEC Amended by (93/68/EEC)
**Controller Interface Type:** Ultra wide SCSI-2
**Data Transfer Rate:** 15 MBps native, 30 MBps compressed
**Device Type:** Internal Tape Drive
**Dimensions (WxDxH):** 5.75" x 8" x 3.25"
**Dimensions (WxDxH) / Weight:** 5.75" x 8" x 3.25" / 4.2 lbs
**Environmental Parameters:** Operating temperature 50°F to 95°F; 20% to 80% humidity
**Interface Type:** Ultra wide SCSI-2
**Max Operating Temperature:** 95°F
**Min Operating Temperature:** 50°F
**Power Consumption Operational:** +5V @ 5.2A typical, +12V @ 0.7A typical, +5V @ 6.3A (max), +12V @2.75A (max)
**Humidity Range Operating:** 20% to 80%
**Max Altitude Operating:** 15,000 ft
**Native / Compressed Capacity:** 100 GB / 200 GB
**Vibration Tolerance Operating:** 0.3G pk 5-250 Hz (sine), 0.3G rms 5-250 Hz (random)
**Shock Tolerance Operating:** 5G 3ms (no performance change), 2G 11ms (no performance change), 8G 11ms (no data loss)

## WARRANTY

Dell manufactures its hardware Products from parts and components that are new or equivalent to new in accordance with industry standard practices and Dell warrants that the Products (excluding Third Party Products and software) will be free from defects in materials, workmanship and design for a period of 12 months from the date of purchase and that spare parts used in repairing Maintained Products under any Service Offering will be free from defects in materials, workmanship and design for a period of 90 days from installation in the Maintained Products or the remainder of the Warranty Period or Service Offering appropriate to or purchased by the Customer in respect of the Maintained Products, whichever is the longer.

In respect of Third Party Products, the Customer shall only be entitled to the benefit of any warranty or guarantee given by the Third Party manufacturer.

If, before the expiry of the warranty period or appropriate Service Offering, Dell receives written notice from the Customer of any breach of the warranty then Dell shall, within a reasonable time, repair or, at its option, replace Products or spare parts that are defective or otherwise remedy such defects.

This warranty does not apply to defects resulting from improper or inadequate installation, use or maintenance; actions or modifications by unauthorized third parties or the Customer or accidental or willful damage.

Dell does not give any warranty that the Products are fit for any particular purpose and this warranty is given in place of all warranties, conditions, terms, undertakings and obligations implied by statute, common law, custom, trade, usage, course of dealing or otherwise, all of which are excluded to the fullest extent permitted by law.

**Windows 2000 Active Directory**

## Manageability

### Centralized Management
Active Directory centrally manages Windows users, clients, and servers through a single consistent management interface, reducing redundancy and maintenance costs.

### Group Policy
Group Policy allows administrators to define and control the policies governing groups of computers and users within their organization. Administrators can set group policy for any of the sites, domains, or organizational units in Active Directory. They can also filter its effect by using membership in security groups. Once set, the system maintains group policy without need for further intervention.

### Global Catalog
The Global Catalog holds all objects from all domains in the Windows 2000 Server directory, together with a subset of each object's properties. Designed for high performance, the Global Catalog lets users search by selected attributes to find an object easily, regardless of where it is in the tree.

### IntelliMirror Desktop Management
IntelliMirror® management technologies provide administrators with automatic software distribution and maintenance, centralized desktop-configuration management, and remote operating system installation. For end users, IntelliMirror provides location independence by making user-specific desktop settings, application data and documents available from any machine on the network.

### Automated Software Distribution
Active Directory lets administrators automatically distribute applications to users based on their role in the company. For example, all accountants can automatically receive spreadsheet software.

### Active Directory Service Interfaces (ADSI)
ADSI greatly simplifies the development of directory-enabled applications, as well as the administration of distributed systems. Developers and administrators use this single set of interfaces to manage the resources in a directory service, no matter which network environment contains the resource. ADSI supports interfaces for ActiveX/COM, Lightweight Directory Access Protocol (LDAP), MAPI and Java (JADSI).

### Backward Compatibility
Windows 2000 Server supports a mixed environment of Active Directory domain controllers. Connected computers running software designed prior to Windows 2000 will respond as if they are accessing the domain controllers of the Windows NT® Server 4.0 operating system.

### Delegated Administration
Windows 2000 lets administrators delegate a selected set of administrative privileges to appropriate individuals within the company and specify the specific rights they have over different containers (collections of objects) and objects in the directory.

### Multi-Master Replication
With multi-master replication, the changes made to one domain controller will also be made to all the other domain controllers in the same domain. Even if individual domain controllers are unavailable, multi-master replication assures that the directory is available for changes 100 percent of the time. In addition, by providing multiple copies of the directory across multiple servers, the Windows 2000 Server directory automatically optimizes the use of replication bandwidth across WAN links.

## Security

### Kerberos Authentication
Full support for Kerberos 5 protocol provides fast, single sign-on to Windows 2000-based resources, as well as to other environments that support this protocol.

### Smart Card Support
Supports logon via smart cards for strong authentication to sensitive resources.

### Transitive Domain Trust
Transitive trust agreements greatly reduce the number of trust relationships to manage between Windows domains.

**PKI/x.509**
Support for x.509 certificates and public key infrastructure (PKI) ensures interoperability with and deployment of extranet and e-commerce applications.
**LDAP over SSL**
Support for LDAP over secure sockets layer (SSL) for secure directory transactions for extranet and e-commerce applications.
**Required Authentication Mechanism**
Allows administrators to require the specific type of logon needed including Kerberos, x.509 certificate, or NTLM.
**Attribute-Level Security**
The Global Catalog enforces object and attribute-level security for detailed control of access to information stored in the directory.
**Spanning Security Groups**
In Windows 2000, there are no restrictions on security groups that span domain partitions. This means that groups can be managed centrally.
**LDAP ACL Support**
Consistent interpretation of access control lists (ACLs) through LDAP ensures interoperability for secure extranets and e-commerce applications.


**Interoperability**

**DirSync Support**
DirSync, a proposed Internet Engineering Task Force (IETF) standard, is a synchronization mechanism for exchanging update information between multiple directories.

**Active Directory Connectors (ADC)**
ADC provides directory synchronization and import/export tools. It lets administrators replicate a hierarchy of directory objects between a Microsoft Exchange Server 5.5 directory and Active Directory. It also lets Active Directory connect to Novell Directory Services.
**Open APIs**
All Active Directory functions are available through LDAP, ADSI and MAPI for extending and integrating with other applications, directories, and devices.

**Native LDAP**
Active Directory is implemented as a native LDAP server that doesn't require request translation to ensure interoperability in extranet environments and e-commerce applications.

**DNS Naming**
The native Internet-standard DNS naming service uses Internet protocols to simplify the naming and placement of objects.

**Open Change History**
Active Directory provides built-in, LDAP-based change history interfaces to facilitate its use as a metadirectory and management focal point within organizations.

**DEA Platform**
Active Directory provides a directory-enabled application (DEA) platform which enables applications to make use of the directory for automating aspects of their installation, distribution, and maintenance.

**DEN Platform**
Active Directory, combined with hardware and software support from Cisco Systems, introduces a directory-enabled networking (DEN) platform that allows administrators to allocate network bandwidth and quality of service to users based on their role in the company.

**Extensible Schema**
Active Directory lets developers and administrators extend the directory schema and create new properties and objects. Using the directory as a data store, developers can use this feature to create their own data structures for applications. In addition, users on the network can publish important information in the directory so other users can easily find it.

# APPENDIX C

# INTERNET CHARGES FOR SELECTED NODES

## Summary of Internet charges

| Node | Agency/ISP | Type of Bandwidth | Bandwidth | Cost ($US)/Month |
|---|---|---|---|---|
| Belize City, Belize | BTL | Fiber | 28.8 kbps | $400.00 |
|  |  |  | 64 kbps | $515.00 |
|  |  |  | 128 kbps | $1.002.50 |
|  |  |  | 256 kbps | $1,907.50 |
|  |  |  | 512 kbps | $2,917.50 |
|  |  |  | 1.024 Mbps | $4.530.00 |
|  |  |  | 2.048 Mbps | $7,762.50 |
| Guatemala City, Guatemala | Universidad del Valle de Guatemala | Fiber | 2 Mbps | $3,500.00 |
| Tegucigalpa, Honduras | Red de Desarrollo Sostenible |  | 512 kbps | $1,200.00 |
| Chetumal, Quintana Roo, Mexico | Universidad de Quintana Roo | Fiber | 256 kbps | $1,100.00 |
| Cancun, Mexico | TelMex; UNANP | Fiber | DCO (medium capacity) | $500.00 |
|  |  |  | E1 | ? |
|  |  |  | T1 | ? |
|  |  | ASDL | 256 kbps | $50.00 |
|  |  |  | 512 kbps | $90.00 |
|  |  |  | 2 Mbps | $450.00 |