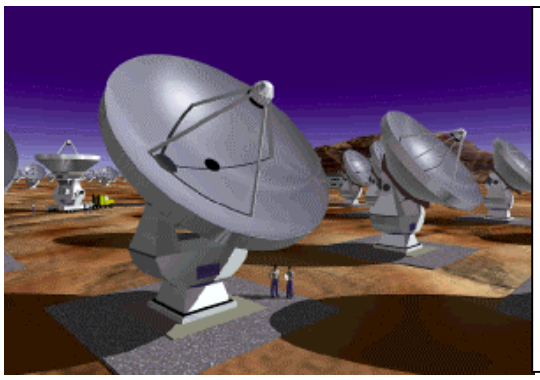

Atacama Large Millimeter Array

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Revision: A

2002-01-08

Plan

Mick Brooks

Test Interferometer Networking Plan

Plan

Mick Brooks
NRAO

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1 Introduction

The purpose of this document is to describe the communications network which will support the Test Interferometer development at the VLA site. Current plans are for up to three prototype antennas to be tested concurrently at the site. The Test Interferometer has recently been renamed the Antenna Test Facility (ATF). The TI acronym should be considered synonymous with ATF throughout this document.

The communications network will support the monitoring and control of the three antennas and centralized equipment located in the existing VLA control building and support trailers. Note that the TI Network does not transport the sampled astronomical data from the antennas to the correlator, and a description of that system is outside the scope of this document. The only science-related data products transported by the TI network are the monitor data, holography data and total power samples.

In addition to the monitor and control traffic, the TI network needs to provide telephony services in each of the antenna structures, the site trailers and the central control building. These will initially be provided as analog PBX extensions on the existing VLA site switch, but the network should be capable of supporting Voice Over Internet Protocol (VoIP) as a future solution. It is also planned that there be web-camera traffic between the antennas and the control building. Other support functions include network connections for temporary office spaces in the Science Laboratory Operations Building (SLOB), connections to meteorology towers and the holography beacon, network access from contractor trailers and external access to NRAO's intranet.

This document describes the physical interconnection and network switching elements required to support the Test Interferometer. In addition, the configuration of the switch ports and protocols are documented.

2 Physical Network Topology

The proposed layout of the computer network is shown in Figure 1. Analog telephone connectivity is not illustrated in this diagram. All "10/100 Fiber" connections terminate on 10/100 RJ45 switch ports and use media converters (not shown for clarity) for the fiber link. An additional Cisco Catalyst 2924 Ethernet switch is used for 10/100 aggregation in the SLOB; it also is not illustrated for reasons of clarity. Connections shown as "10/100 STP" are shielded twisted pair CAT 5 cable.

In the diagram, a VoIP call manager is included although it is proposed that this not be purchased for the initial network installation. By using existing PBX extensions, the telephone network will effectively parallel the computer network and each will be independent of a failure in the other network. The longer range plan is to trial VoIP at the VLA site for its suitability to use at the Chilean site.

The main location for staff controlling and evaluating the antennas will be a trailer situated quite close to the antennas themselves. Other office locations are in the SLOB (I have no idea what this acronym is, but the SLOB is a set of offices near the main VLA control building).

The intention is to initially outfit the antenna Gb links with the standard Cisco GBIC5486 which can reach 10 km on single-mode fiber. In the future, extended 5487 modules can be used for testing; these modules allow for 70-100 km links.

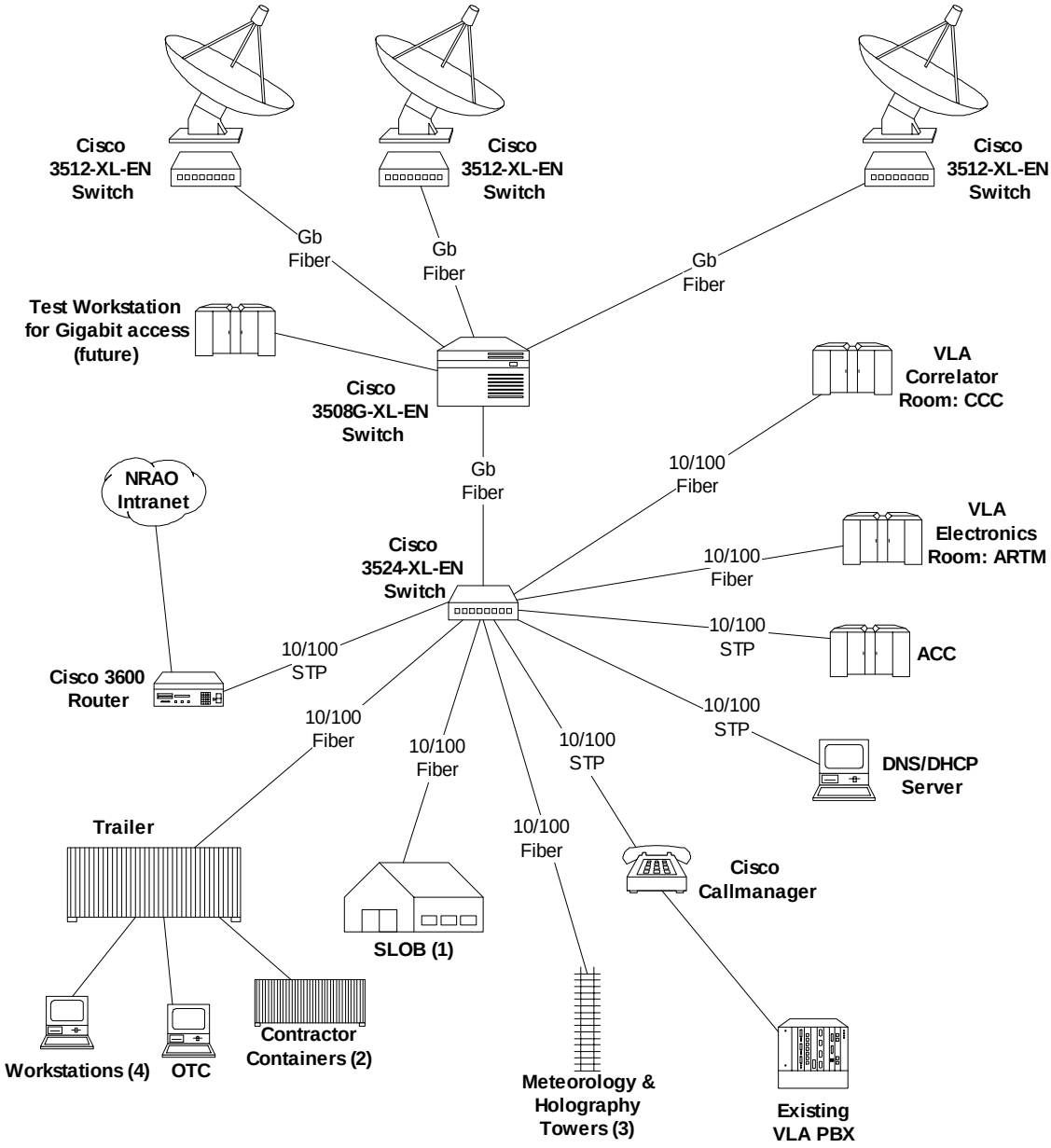


Figure 1: Physical Network Topology

It is important to note that there will be an OTC per prototype antenna to support simultaneous optical pointing characterizations to be carried out. This is not shown in Figure 1; OTCs will be added as prototype antennas are delivered to the site.

3 Network Services

3.1 Subnets

The ALMA TI network should be allocated several subnets from the available range. The subnet IP range is 146.88.48.0 to 146.88.51.0. This subnet should be named atf.alma.nrao.edu. It may be useful to define additional subnets within this range for the purposes of QOS.

3.2 Domain Name Services

For development purposes, it is necessary that the network have its own DNS server. ALMA would provide the necessary hardware for such a server and would administer the server.

3.3 Dynamic Host Control Protocol Services

Personnel from many different organizations including the antenna contractors and other scientific institutes will be spending time at the site with their portable computers, so the ability to allocate dynamic IP addresses for these transitory machines is essential. Again, it is desirable that such services run on a machine administered by ALMA staff.

4 Logical Configuration

In order to prioritize TI M&C traffic at a higher level than other network traffic, such as future VoIP telephones or web-enabled cameras, it is proposed that we use the IP precedence field for particular stations to ensure switching priority. Virtual Local Area Networks (VLANS) could also be defined on a port-by-port basis and should be investigated further during the antenna evaluation. The proposed priority configuration for the TI Network consists of two priority levels, one for M&C traffic and one for all other traffic, and is illustrated in Figure 2.

Each access port on a switch in the network has three possible types of prioritization. These are the IEEE 802.1Q protocol priority, switch-based per-port priority and a priority level associated with each defined VLAN. We intend to use only the IEEE priority field for switch ports designated as M&C stations.

The Ethernet stations indicated in red (and with dotted connection lines) in the diagram are for monitor and control data between each antenna's Antenna Bus Master (ABM) and the central control building's Array Control Computer (ACC) and real time machines. These stations will have the highest priority in the two-level scheme.

Other ancillary network devices (in blue, and using solid connection lines) are given a lower priority based on their switch port. These devices may be laptops temporarily in use at an antenna, workstations in the trailers and other general purpose devices. These devices may be used to view data products such as monitor data or correlator outputs at any location such as the SLOB, the control room or the trailer.

If VoIP service is introduced this simple prioritization scheme may need to be reviewed. Voice traffic suffers serious degradation if subjected to latency, and VoIP stations may need to be assigned the highest priority in the network. This should be thoroughly tested to determine the effect on M&C traffic. Likewise, if VoIP traffic is set to a lower priority than M&C, the effect on call quality should be investigated.

Table 1 shows the port settings which should be configured to enable this scheme. This table should be maintained as the switches as configured in the field.

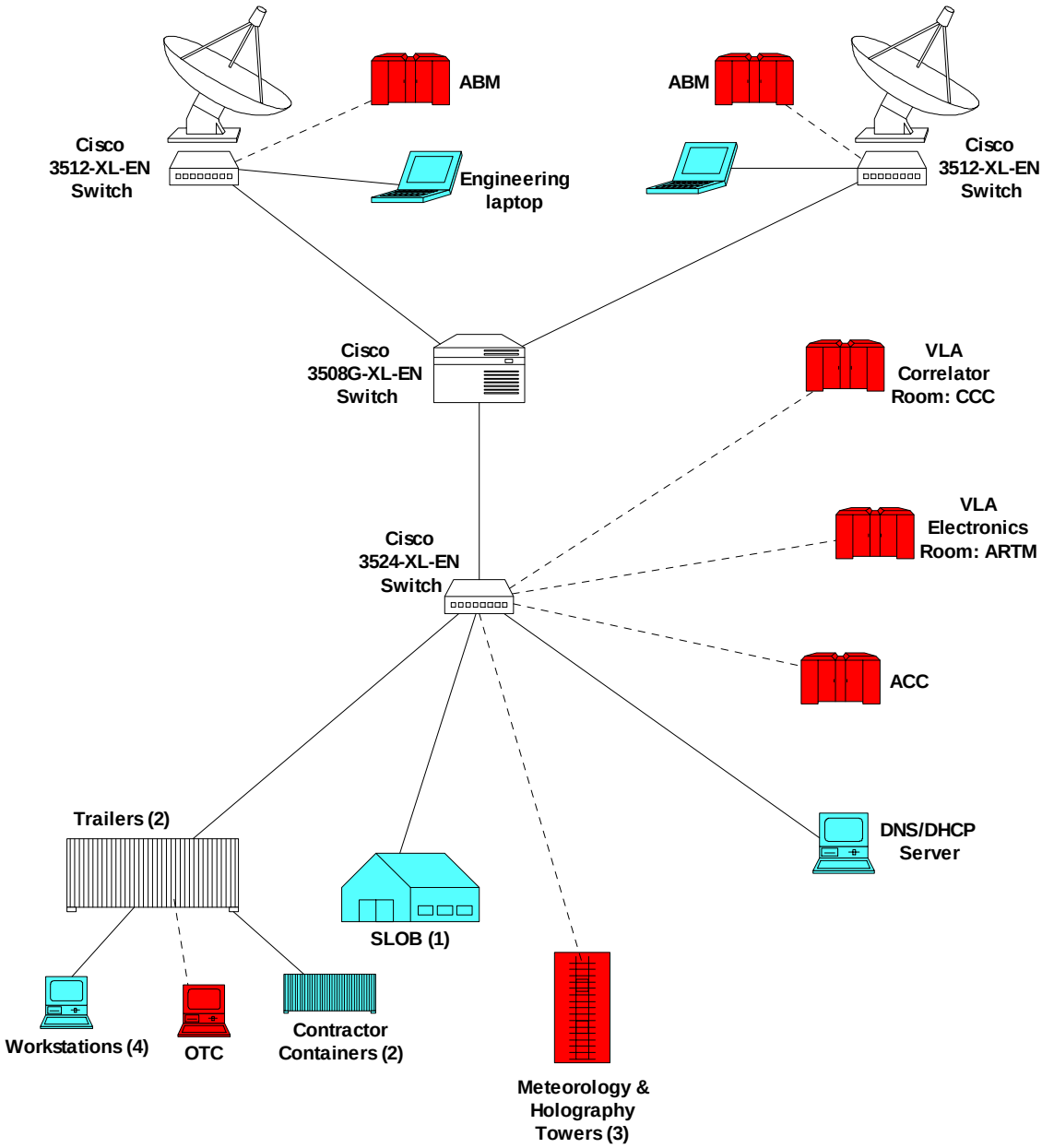


Figure 2: Logical Topology: The red Ethernet stations (with dotted connection lines) are related to M&C traffic and the blue stations (with solid connection lines) with general purpose, lower priority traffic.

Table 1: Port Settings

Port Parameter	**Gigabit Port Settings**	**M&C Port Settings (red and dotted)**	**General Purpose Port Settings (blue and solid)**
Port	Gigabit	Fast Ethernet	Fast Ethernet
Gigabit Flow Control	Asymmetric	N/A	N/A
Status	Up	Up	Up
Duplex	Full	Full (All MVME2700 ports need to be set as Half)	Full
Speed	N/A	100 Mbps	Auto
Port Fast	Enabled	N/A	Enabled
VLAN Info	N/A	N/A	N/A
VLAN Mode	Trunk	Static	Trunk

5 Issues

- Should we support 3 antennas initially? Alternatively we can buy the equipment in phases as the prototype antennas arrive.

The proposal is to outfit a single antenna in 2002.

- Each ALMA partner should pay 1/3 of total networking costs

ESO should pay half of the total, two antenna cost.

- Which groups should budget for what?

Computer networking and telephony costs will be borne by the Computer groups. Meteorology towers, holography towers, site trailers and so on will be borne by the Systems group.

- The VLA PBX is an NEAX NEC IMG , version 5200. However it is administered by New Mexico Tech, so any additional extensions or installation of VoIP interfaces needs to be coordinated with Mark Reynolds of NMT and Terry Lopez at the AOC

- When and how do we purchase the CallManager?

This should be delayed until the problems with the VLA PBX interface can be negotiated with NMT.

- Do we need fiber links from the 3524 to the ARTM and CCC in the control building or is twisted pair sufficient? This would be for reasons of RFI and not for bandwidth.

- Should we upgrade the VLA-AOC fiber link to increase the existing T1 capacity?

Yes we should. ALMA Computing is pursuing this within the NRAO Communications group.

- Should the ACC be fitted with a Gigabit interface?

This should be investigated at a later date. For maximum benefit, the ABMs and ARTMs should be upgraded to Gigabit as well, so this would require hardware selection and device driver testing.

6 References

1. ALMA Test Interferometer Project Book, Chapter 10, http://www.tuc.nrao.edu/~demerson/almapbk/test_int/chap10/chap10.pdf, B. Glendenning, L. D'Addario, M. Brooks, 2000-02-15

2. ALMA Test Interferometer Communications Cabling Plan, J.G. Mangum, Draft, 2001-08-29

3. ALMA Software Glossary, http://alma.aoc.nrao.edu/development/computing/docs/joint/draft/Glossary.htm, J. Schwartz, Draft, 2001-09-20

4. ALMA Test Facility home page: http://www.tuc.nrao.edu/~jmangum/alma/atf/

Appendix A. Equipment List

Per Antenna

Catalyst 3512-XL-EN

Gigabit interfaces modules: either WS-G5486 SM or MM fiber or WS-G5487 SM extended reach

Central Building

Catalyst 3508G-XL-EN Gigabit aggregation switch with GBICs to match antenna GBICs

Catalyst 3524-XL-EN with WS-G5486 for link to 3508.

SLOB Switch

Catalyst 2924 switch for 10/100 STP aggregation in SLOB

Router for Connection to NRAO Intranet

Use new Cisco 3600 Router, need new interface module

Media Converters

2 pairs of media converters for met tower fiber links

1 pair of media converters for holography tower fiber link

2 pairs of media converters for site trailer fiber links

1 pair of media converters for SLOB fiber link

Total: 6 pairs of media converters, 10/100 Mb STP – MM Fiber

Telephones

Analog phone extensions

SLOB: 5

Antennas: 3 x 2

Towers: 3

Trailers 2 x 2

Control Room: 1

Trailer: 2

Total extensions and number of analog phones: 21

Options

VoIP Phones

VoIP call manager

Minimum Equipment list to support VA antenna

1 x Catalyst 3512-XL-EN

4 WS-G5486 GBICs

1 x Catalyst 3508G-XL-EN

1 x Catalyst 3524-XL-EN

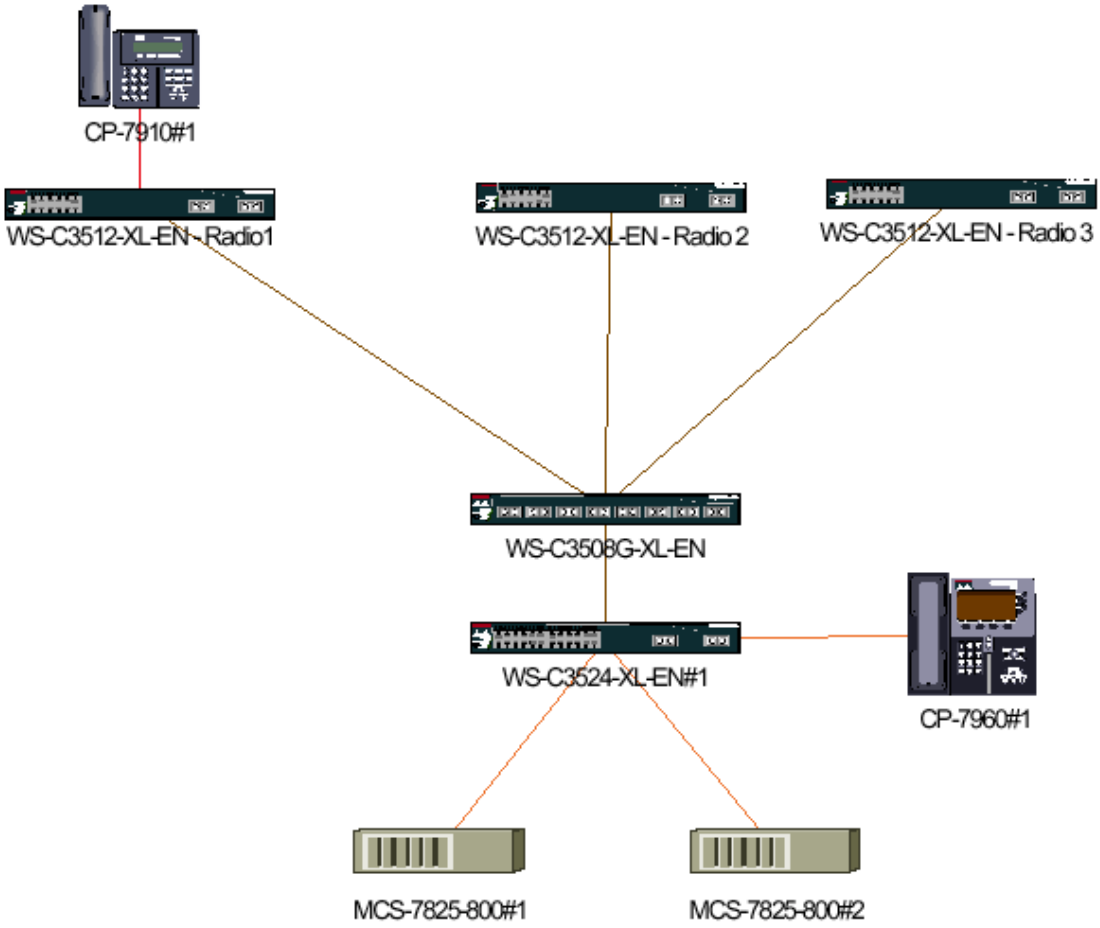
6 pairs of media converters

17 phone extensions and analog phones

Note that this does not include any spares.

Appendix B. Cisco Quotation

Note that it should be possible to get NRAO's usual 30-33% discount from Cisco. This is not factored into the quote included here. Also the quoted support level is not available at the VLA site, so will have to be changed in the final quotation. The numbers of parts listed in the following quotation are not final. Appendix A takes precedence over the numbers listed here.



National Radio Astronomy Observatory						
Infrastructure Part List						
Part Number	**Description**	**Listed Price**	**Discount(%)**	**Price**	**Qty**	**Total**
	Gigabit switch					
WS-C3508G-XL-EN	Catalyst 3508G XL Enterprise Edition	4,995.00	0.00	4,995.00	1	4,995.00
WS-G5487=	1000Base-ZX extended reach GBIC(singlemode)	7,495.00	0.00	7,495.00	1	7,495.00
WS-G5486=	1000BASE-LX/LH "Long Wave/Long Haul" GBIC(SMF or MMF)(spare)	1,500.00	0.00	1,500.00	3	4,500.00
CAB-AC	Power Cord,110V	0.00	0.00	0.00	1	0.00
CON-SNTP-WS-C3508G	24x7x4 Svc,WS-C3508G	760.00	0.00	760.00	1	760.00
	Antenna site switches					
WS-C3512-XL-EN	Catalyst 3512 XL Enterprise Edition	2,495.00	0.00	2,495.00	3	7,485.00
WS-G5486=	1000BASE-LX/LH "Long Wave/Long Haul" GBIC(SMF or MMF)(spare)	1,500.00	0.00	1,500.00	2	3,000.00
WS-G5487=	1000Base-ZX extended reach GBIC(singlemode)	7,495.00	0.00	7,495.00	1	7,495.00
CAB-AC	Power Cord,110V	0.00	0.00	0.00	3	0.00
CON-SNTP-WS-C3512	24x7x4 Svc,WS-C3512	355.00	0.00	355.00	3	1,065.00
	24 port switch					
WS-C3524-XL-EN	Catalyst 3524 XL Enterprise Edition	2,995.00	0.00	2,995.00	1	2,995.00
WS-G5486=	1000BASE-LX/LH "Long Wave/Long Haul" GBIC(SMF or MMF)(spare)	1,500.00	0.00	1,500.00	1	1,500.00
CAB-AC	Power Cord,110V	0.00	0.00	0.00	1	0.00
CON-SNTP-WS-C3524	24x7x4 Svc,WS-C3524	426.00	0.00	426.00	1	426.00
			Infrastructure Total (US Dollar) :			***41,716.00***

National Radio Astronomy Observatory

IP Telephony Part List

Part Number	Description	Listed Price	Discount(%)	Price	Qty	Total
	IP Phones					
CP-7910	Cisco IP Phone 7910, Bid Set (Including User License)	295.00	0.00	295.00	6	1,770.00
CP-PWR-CUBE=	IP Phone power transformer for 7900 series phones	45.00	0.00	45.00	6	270.00
CP-PWR-CORD-NA=	7900 Series Transformer Power Cord, North America	10.00	0.00	10.00	6	60.00
CON-SNTP-7910	24x7x4 Svc, 7910	19.00	0.00	19.00	6	114.00
CP-7960	Cisco IP Phone 7960, Manager Set (w/User License)	645.00	0.00	645.00	3	1,935.00
CP-PWR-CUBE=	IP Phone power transformer for 7900 series phones	45.00	0.00	45.00	3	135.00
CP-PWR-CORD-NA=	7900 Series Transformer Power Cord, North America	10.00	0.00	10.00	3	30.00
CON-SNTP-7960	24x7x4 Svc, 7960 + user license	41.00	0.00	41.00	3	123.00
	Redundant Call Managers					
MCS-7825-800	Media Convergence 7825 PIII 800 MHz	0.00	0.00	0.00	2	0.00
CAB-AC	Power Cord,110V	0.00	0.00	0.00	2	0.00
SW-CCM-3.1-MCS	CallManager 3.1 Software for MCS servers	5,995.00	0.00	5,995.00	2	11,990.00
MCS-7825-800-HW	Hardware option- Software NOT included	6,000.00	0.00	6,000.00	2	12,000.00
CON-SNTP-SAUCCM3.1	24x7x4 Svc, CallManager 3.1 software	1,200.00	0.00	1,200.00	2	2,400.00
CON-SNTP-MCS7825-8	24x7x4 Svc, Media Convergence 7825 PIII 800 MHz	768.00	0.00	768.00	2	1,536.00
	Digital Voice Gateway					
CISCO2621	Dual 10/100 Ethernet Router with 2 WIC Slots, 1 NM Slot	3,095.00	0.00	3,095.00	1	3,095.00
CAB-AC	Power Cord,110V	0	0.00	0.00	1	0.00
S26CP-12201	Cisco 2600 Series IOS IP PLUS	700	0.00	700.00	1	700.00
MEM2600-32U48D	32- to 48-MB DRAM Factory Upgrade for the Cisco 2600 Series	1,000.00	0.00	1,000.00	1	1,000.00
MEM2600-8U16FS	8 to 16 MB Flash Factory Upgrade for the Cisco 2600 Series	700	0.00	700.00	1	700.00
NM-HDV-1T1-24	Single-Port 24 Channel T1 Voice/Fax Network Module	7,400.00	0.00	7,400.00	1	7,400.00
CON-SNTP-26XX	Cisco26XX SMARTnet Premium Maintenance	627	0.00	627.00	1	627.00

Telephony Total (US Dollar) : 45,390.00

Sum Total (US Dollar): 87,106.00