SECTION ONE

INTRODUCTION AND KEY DATES

1.01 INTRODUCTION

The Hawaii Department of Transportation, Highways Division is soliciting proposals to upgrade the existing communication system for the Interstate Route H-3 Intelligent Transportation System (ITS). This request for proposals (RFP) provides interested Offerors with sufficient information to enable them to prepare and submit proposals for consideration by HDOT to satisfy a need for replacing communications equipment at fifteen (15) hub locations that provide communications links for existing ITS equipment.

Work items include, but are not limited to:

a. Procure, install, integrate, and test communication related edge equipment at fifteen (15) hub locations within the H-3 Tunnel and along roadway approaches to the tunnel.
b. Test four existing spare fibers for each of at least twenty-three (23) cable sections as per the termination tables in Exhibit A to ensure continued suitability for use.
c. For non-operational spare fibers, terminate and splice the necessary fiber optic cables identified.
d. Provide training for HDOT maintenance staff for new communications equipment and infrastructure.
e. Remove and dispose of replaced equipment and cabling as specified in this RFP.

The work does not include the replacement of the ITS equipment at the various field locations (e.g. cameras, detectors, signs).

1.02 CANCELLATION

The RFP may be cancelled and any or all proposals rejected in whole or in part, without liability, when it is determined to be in the best interest of the State.

1.03 RFP SCHEDULE AND SIGNIFICANT DATES

The schedule set out herein represents the State's best estimate of the schedule that will be followed. All times indicated are Hawaii Standard Time (HST). If a component of this schedule, such as "Proposal Due" date is delayed, the rest of the schedule will likely be shifted by the same number of days. The approximate schedule is as follows:

Advertising of Request for Proposals	September 29, 2011
Pre-Proposal Conference	October 20, 2011
Deadline to Submit Written Questions	November 3, 2011
Addendum 1 – Answers to Questions	November 17, 2011
Proposals Due	December 8, 2011 2:00 p.m. (HST)
Discussions with Priority-Listed Offerors (if necessary)	January 10 – 12, 2012
Best and Final Offer (if necessary)	February 2, 2012 2:00 p.m. (HST)
Anticipated Contractor Selection	April 2, 2012
Anticipated Contract Start Date (Notice to Proceed)	August 2, 2012

SECTION TWO

BACKGROUND AND SCOPE OF WORK

2.01 OPCOM SYSTEM OVERVIEW

The existing communications network for the H-3 system include OPCOM communication multiplexers at fifteen (15) hub locations and associated fiber optic cable plant consisting of 24 or 12 fiber MM cables within the tunnel and 48 SM cables on the approach roadways. See Exhibits A and C for more details about the fiber termination tables and available spare fiber. The hub locations are listed below in Table 1 along with other pertinent information.

Table 1. Hub Locations

Hub No.	Ring	Node No.	H-3 Hub Location	Rdwy, Tunnel, Bldg, Portal
1	Halawa	HW-3	Halawa OB Approach, station 342+60	Rdwy
2	Halawa	HW-2	Halawa IB Approach, station 475+60	Rdwy
3	Tunnel	TUN-10	Halawa OB Portal Bldg. Level 2	Portal
4	Tunnel	TUN-8	Cross Passage XP-1	Tunnel
5	Tunnel	TUN-7	Cross Passage XP-5	Tunnel
6	Tunnel	TUN-5	Cross Passage XP-9	Tunnel
7	Tunnel	TUN-4	Haiku OB Portal Bldg. Level 2	Portal
8	Haiku	HK-3	Haiku OB Approach, station 11+60	Rdwy
9	Tunnel	TUN-9	Halawa IB Portal Bldg. Level 2	Portal
10	Tunnel	TUN-2	Cross Passage XP-3	Tunnel
11	Tunnel	TUN-3	Cross Passage XP-7	Tunnel
12	Tunnel	TUN-6	Haiku IB Portal Bldg. Level 2	Portal
13	Haiku	HK-2	Haiku IB Approach, station 1110+30	Rdwy
14	Halawa	HW-1	TOC Equipment Room	Bldg
14	Haiku	HK-1	TOC Equipment Room	Bldg
14	Tunnel	TUN-1	TOC Equipment Room	Bldg
14	Tunnel	TUN-1	TOC Equipment Room	Bldg
14	Tunnel	TUN-1	TOC Equipment Room	Bldg
15	Tunnel	11	O & M Building	Bldg

As a point of reference, the existing OPCOM communications system provides three independent and physically separated communication rings named Halawa (Figure 1), Haiku (Figure 2) and Tunnel (Figure 3) that supply data and voice communications links between all field devices and the Traffic Operations Center (TOC) (Hub 14) where the central command and control ITS equipment and servers are installed. Each ring consists of at least three hubs and each hub contains OPCOM multiplex equipment and associated communication cards which provide interfaces to various voice and RS232/RS485 serial data services.

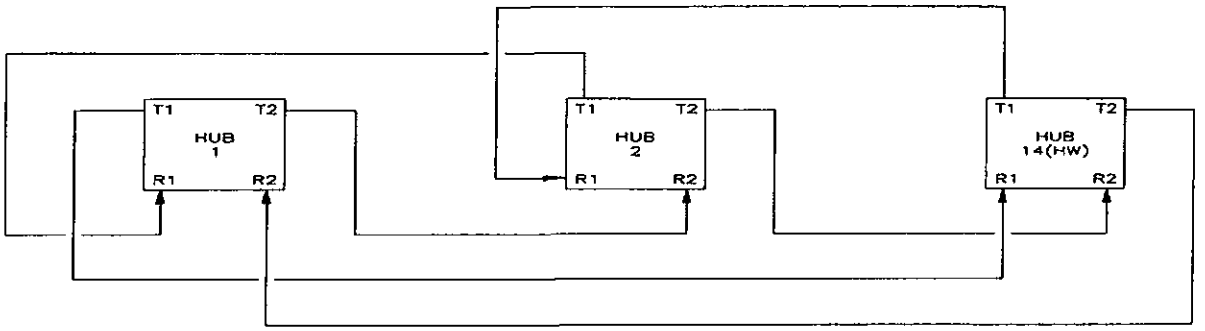


Figure 1. Halawa Ring

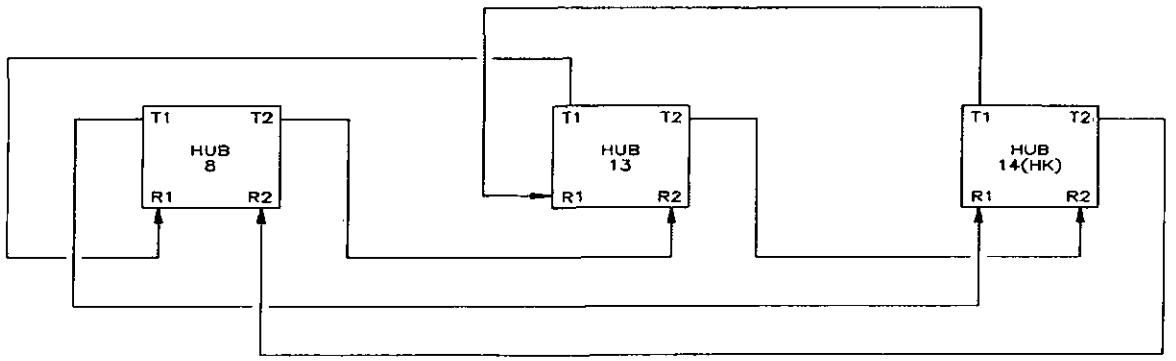


Figure 2. Haiku Ring

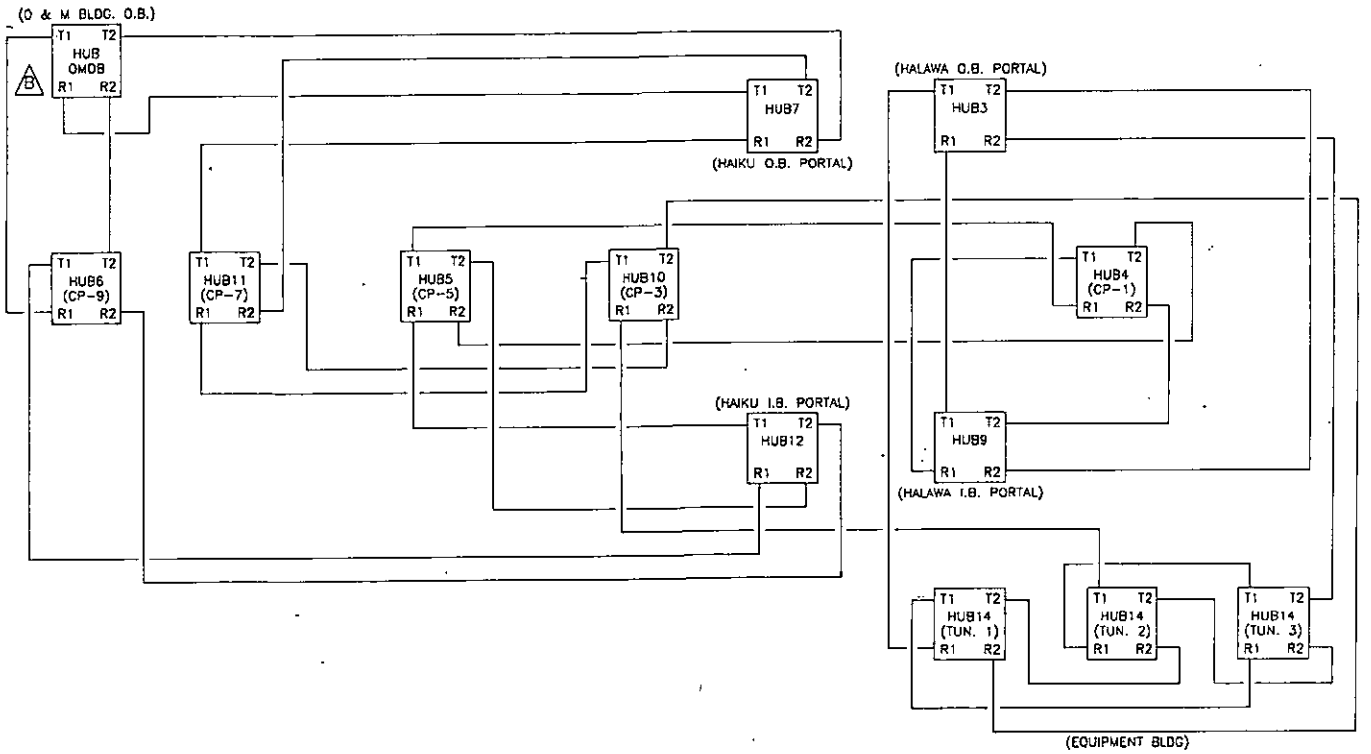


Figure 3. Tunnel Ring

2.02 EXISTING OPCOM HUB EQUIPMENT

Table 2 shows the number of the existing OPCOM multiplexers and associated data and voice communications cards at each of the Hub locations.

Table 2. Existing OPCOM Equipment

		OPCOM Multiplexer						
Hub No.	H-3 Hub Location	ML 4436 Singlemode Card Dual Optics ML4401 PS	ML 4403 Multimode Card Dual Optics ML4401 PS	ML 4417 Card (Voice - 3 port)	ML 4405 Card (RS232 - 4 port)	ML4420-1 Card (RS485 - 4 Port)	ML4420-2 Card (RS485 - 4 Port)	ML 4414 Diagnostics
1	Halawa OB Approach, station 342+60	1	0	4	2	0	0	0
2	Halawa IB Approach, station 475+60	1	0	7	2	0	0	0
3	Halawa OB Portal Bldg. Level 2	0	1	1	1	0	1	0
4	Cross Passage XP-1	0	1	4	2	0	1	0
5	Cross Passage XP-5	0	1	4	1	0	1	0
6	Cross Passage XP-9	0	1	4	1	0	1	0
7	Haiku OB Portal Bldg. Level 2	0	1	3	2	1	1	0
8	Haiku OB Approach, station 11+60	1	0	4	1	0	0	0
9	Halawa IB Portal Bldg. Level 2	0	1	2	1	0	1	0
10	Cross Passage XP-3	0	1	4	1	0	1	0
11	Cross Passage XP-7	0	1	4	1	0	1	0
12	Haiku IB Portal Bldg. Level 2	0	1	3	2	1	1	0
13	Haiku IB Approach, station 1110+30	1	0	4	2	0	0	0
14	TOC Equipment Room	2	4	54 (ML4418)	20	1	1	3
15	O & M Building	0	1	1	1	0	1	0
	Totals =	8	16	103	40	3	11	3

2.03 EXISTING ITS LOCATIONS UTILIZING THE OPCOM HUB EQUIPMENT

Table 3 shows the number of existing ITS data or voice services utilizing the OPCOM multiplexers hubs for communications back to the TOC. The "Notes" Table below provides pertinent information for each type of interface.

Table 3. Existing ITS - Port Count

Hub No.	H-3 Hub Location	Type and number of ITS elements serviced								
		PLC (RS232)	Traffic Controller (RS232)	Sign Controller (RS232)	CCTV PTZ (RS232)	Emergency Phone (FXS)	Fire Alarm Panel (RS485)	Card Key Panel (RS485)	Barrier Gate (RS232)	RS232 & RS485 Totals
1	Halawa OB Approach, station 342+60	0	10	0	5	12	0	0	0	15
2	Halawa IB Approach, station 475+60	0	5	1	3	22	0	0	0	9
3	Halawa OB Portal Bldg. Level 2	1	1	1	1	3	1	0	0	5
4	Cross Passage XP-1	1	4	2	4	11	1	0	0	12
5	Cross Passage XP-5	1	2	2	4	11	1	0	0	10
6	Cross Passage XP-9	1	2	2	4	11	1	0	0	10
7	Haiku OB Portal Bldg. Level 2	1	4	3	1	8	1	1	0	11
8	Haiku OB Approach, station 11+60	0	4	0	2	12	0	0	0	6
9	Halawa IB Portal Bldg. Level 2	1	1	1	1	5	1	0	0	5
10	Cross Passage XP-3	1	2	2	4	11	1	0	0	10
11	Cross Passage XP-7	1	2	2	4	11	1	0	0	10
12	Haiku IB Portal Bldg. Level 2	1	3	2	5	9	1	1	0	13
13	Haiku IB Approach, station 1110+30	0	4	0	4	12	0	0	1	9
14	TOC Equipment Room	-	-	-	-	-	-	-	-	-
15	O & M Building	1	0	0	1	3	1	0	0	3
	Totals =	10	44	18	43	141	10	2	1	128

RS232 = 115
RS485 = 12
FXS = 141

Notes:	
1.0	**RS232 Interfaces**
1.1	Programmable Logic Controllers – Within the tunnels the PLC provides the interconnections necessary for the supervisory control and data acquisition (SCADA) system known as DYNAC. The PLC controllers utilize RS232 channels via the OPCOM ML4405 data cards.
1.2	170 Traffic Controllers – within the tunnel and roadways the traffic controllers utilize RS232 channels via the OPCOM ML4405 data cards installed at all the hubs except Hub 15. These RS232 channels are operate at 9600 baud rate, with even parity, 8 bits.
1.3	Sign Controllers – within the tunnel and adjacent roadways the sign controllers utilize RS232 channels via the OPCOM ML4405 data cards installed at Hubs 2, 3, 4, 5, 6, 7, 9, 10, 11, and 12. These RS232 channels are operate at 9600 baud rate, with no parity.
1.4	CCTV Pan-tilt-zoom drivers – within the tunnel and roadways the cameras utilize RS232 channels via the OPCOM ML4405 data cards. The video signals are transmitted via a Fibertek Multiplexer / Catel system on separate fibers at all the hubs.
1.5	Barrier Gate at the Haiku side of the tunnel utilizes the RS232 channel via the OPCOM ML 4405 data card installed at Hub 13.
2.0	**RS485 Interfaces**
2.1	Card Key Readers– within the tunnel and the O&M Building the access control card key readers utilize RS485 channels via the OPCOM ML4420-1 data cards at Hub 7 and Hub 12.
2.2	Fire Alarm Control Panels – within the tunnel the fire alarm controllers utilize RS485 channels via the OPCOM ML4420-2 data cards at Hubs 3, 4, 5, 6, 7, 9, 10, 11, 12, and 15.
3.0	**Voice Channels**
3.1	Emergency Phones – within the tunnel and roadways the emergency phones utilize voice channels via the OPCOM ML 4417 voice cards at all the hubs. The OPCOM ML 4418 cards are the central voice cards utilize at the TOC.
4.0	**Fiber Optic Interface Cards and Diagnostic Cards**
4.1	Each hub location utilizes a fiber optic card to interface with the fiber optic cable plant. The OPCOM ML 4436 are utilized for the single mode links while the ML 4403 are for the multimode links. At the TOC an OPCOM ML 4414 card is used for diagnosing hub status and configuration of the system.

2.04 COMMUNICATION DESIGN OVERVIEW

This section lays out the communication design for migration of the H3 tunnel operations communications system from the existing legacy OPCOM based system to the new Ethernet-based communications infrastructure to be installed by the Offeror. A central purpose of the design is to replace the OPCOM infrastructure in such a way that the existing edge equipment (both ITS field equipment and ITS central command and control infrastructure) is unaffected by and unaware of the changes to the intermediate communications infrastructure.

Physical Configuration

The proposed system is to use existing cabinets and fiber plant to establish an Ethernet Backbone via installation of Gigabit Ethernet switches with the appropriate fiber uplinks (multimode / singlemode) at the various hubs along the H3 facility. A minimum of two pairs of fiber will be used at each hub to establish a ring topology to ensure redundancy similar to the topology of the existing

OPCOM network. A diagram of the proposed physical connectivity is provided in Exhibit D.

Logical Configuration

The physical cable plant allows for the configuration of a ring Ethernet topology as indicated in the diagrams provided in Exhibit D with Hub 14 at the TOC being the primary common point of access between the various rings. The logical configuration is to be similar to the existing OPCOM based infrastructure - a three ring topology. The first ring encompasses Hub 1, Hub 2, and Hub 14 - the Halawa approach. The second ring contains Hub 8, Hub 13, and Hub 14 - the Haiku approach. The remainder of the hubs will be part of the Tunnel ring. The logical diagram provided in Exhibit D depicts the ring infrastructure as the proposed system shall communicate. Per the physical diagram provided, the fiber in the tunnel travels between the various hubs in primarily a linear manner. The logical diagram presents, at a high level, how the Ethernet Backbone switches shall be connected and configured to create a logical ring topology.

Edge Devices

Much of the existing edge equipment (both ITS field and ITS central command and control) utilizing the existing OPCOM network communicates via various types of serial links as noted in Section 2.02. These serial communications are multiplexed via OPCOM infrastructure for transmission over fiber to the DYNAC command and control system. Migration of this serial communications infrastructure from the existing OPCOM to the Ethernet infrastructure requires installation of terminal servers at the various hubs where existing OPCOM infrastructure is currently placed. Each port on the various terminal servers deployed at the remote field hubs is to be configured for the specific serial device connected to it such that all data transmitted or received from the field device is forwarded or received by the similarly configured terminal server at the TOC (Hub 14) which in turn is connected to the existing appropriate DYNAC interface. The terminal servers shall act to bridge the serial communications between the field equipment and the DYNAC system via the deployed Ethernet based communications network.

Outside of the serial based communications, the other major service utilizing the OPCOM system is an emergency phone and intercom system. Similar to the serial communications, migration of these services to the Ethernet based communications system requires the installation of voice gateways which act to bridge the analog voice channels and phone signaling between the field phones and the central PBX (located at Hub 14) via the Ethernet communications network.

Exhibit D contains high level design diagrams which depict how the Ethernet-based communication network is to be interfaced with the existing serial and telephone interfaces.

2.05 HAWAII DEPARTMENT OF TRANSPORTATION RESPONSIBILITIES

(1) HDOT staff will review all deliverables submitted by the chosen Offeror in a timely manner. In no case, however, shall HDOT staff be expected to review deliverables in less than ten business days unless they have given their written agreement to do so prior to submittal of any such deliverable.

(2) HDOT will work with the chosen Offeror to accommodate staging at the H-3 facility limited to existing space availability. Site visit will include review of available staging areas. Use of the HDOT staging area will be at the Contractor's own risk. Any damage or loss due to use of this staging area will be the responsibility of the Contractor.

(3) Training facility for Contractor to provide the required training

(4) HDOT will provide pertinent IP address information and device configuration details at a device level for the chosen Offeror.

(5) The software and programming of the Network Monitoring Station will be completed by HDOT.

(6) HDOT will update all of its H-3 facility as-built records.

2.06 SCOPE OF WORK

The Scope of Work for this procurement includes the following work:

Task 1: Communications Migration Plan
Task 2: Procurement of Communications Equipment
Task 3: Installation of Communications Equipment
Task 4: Not Used.
Task 5: Test Existing Spare Fiber
Task 6: Splice, Terminate and Retest Spare Fiber
Task 7: System Testing and Acceptance
Task 8: Training and System Documentation
Task 9: Warranty and Support Services
Task 10: Spare Parts Inventory

2.06.01 Task 1: Communications Migration Plan

The Contractor shall develop and submit a Communications Migration Plan for the work detailing a proposed step by step migration methodology developed to minimize communications disruptions during installation for review and approval by HDOT. The communications migration plan shall include, at a minimum, the following:

1. Procurement List detailing the proposed communications equipment meeting the specifications of this RFP

2. Electrical, mechanical, and environmental specifications along with manufacturers' cut sheets for each proposed device on the Procurement List
3. Schematic diagrams depicting typical equipment installation configurations for each type of proposed device on the Procurement List and pin outs of all necessary serial or fiber interface cables
4. Detailed Installation procedures that meet the specifications set out by this RFP (Task 3) including at a minimum:
    a. Proposed installation schedule. The schedule must detail work tasks by location with emphases on system transition. The schedule shall clearly denote milestones in which components of the communication system will be unavailable and / or offline to ensure appropriate coordination with HDOT staff
    b. Proposed pre-installation equipment configuration and testing procedures that meet the specifications set out by this RFP (Tasks 3 and 7)
    c. Proposed installation procedures at Hub 14 (TOC) and field hubs
    d. Proposed Communications System Test procedures
    e. Proposed Communications System transition procedures
    f. Proposed Equipment removal procedures
    g. Proposed Equipment and cable labeling standards
    h. Proposed Configuration documentation

The Contractor shall provide a revised Communications Migration plan for final review and approval. The revised plan shall address each review comment on the Communications Migration Plan to the satisfaction of HDOT.

Deliverables:

1. Draft Communications Migration Plan. Three (3) bound hard copies and electronic PDF version in a CD-ROM.
2. Final Communications Migration Plan. Three (3) bound hard copies and electronic PDF version in a CD-ROM.

Measurement.

The Engineer will not measure communications migration plan for payment.

Payment.

The Engineer will not pay for accepted communications migration plan separately and will consider the cost for accepted communications migration plan as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.02 Task 2: Procurement of Communications Equipment

The Contractor shall furnish the required communications equipment. The following table provides a detailed estimate of the required networking, serial, and telephone hardware required to implement the communications design outlined in previous sections.

Table 4. Estimate of the Required Hardware

Hub No.	H-3 Hub Location	Terminal Server	Voice Gateway	Network Switch	Fiber Network Switch	T-1 Extender	Network Monitor
1	Halawa OB Approach, station 342+60	1	1	1			
2	Halawa IB Approach, station 475+60	1	1	1			
3	Halawa OB Portal Bldg. Level 2	1	1	1			
4	Cross Passage XP-1	1	1	1			
5	Cross Passage XP-5	1	1	1			
6	Cross Passage XP-9	1	1	1			
7	Haiku OB Portal Bldg. Level 2	1	1	1			
8	Haiku OB Approach, station 11+60	1	1	1			
9	Halawa IB Portal Bldg. Level 2	1	1	1			
10	Cross Passage XP-3	1	1	1			
11	Cross Passage XP-7	1	1	1			
12	Haiku IB Portal Bldg. Level 2	1	1	1			
13	Haiku IB Approach, station 1110+30	1	1	1			
14	TOC Equipment Room	14	14	1	1	1	1
15	O & M Building	1	1	1		1	

Table 4A. Estimate of Required Hardware Per Ring

Ring	Terminal Server	Voice Gateway	Network Switch	Fiber Network Switch	T-1 Extender	Network Monitor
Halawa	4	4	2			
Haiku	4	4	2			
Tunnel	20	20	11	1	2	1
TOTALS	**28**	**28**	**15**	**1**	**2**	**1**

The equipment specifications listed below detail the requirements of each type of device. In addition to the listed specifications an approved Manufacturer and Model of each device is included. The approved device meets or exceeds the listed specification. Offerors are not limited to the approved devices and may propose alternate Manufacturers and Models. Any deviation from the specifications must be indicated in the proposal. Final approval of equipment must be obtained from HDOT prior to procurement as part of the Communications Migration Plan.

Terminal Server Device

1. This item shall include a 16 port terminal server which translates bidirectional data between serial and Ethernet formats.
2. This device shall be 19" rack mountable with associated brackets/hardware, serial cabling, and power cords.
3. This unit shall be environmentally hardened with conformal coated boards when available through the manufacturer to withstand environmental elements in the project area. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendation and standard practices.

4. The Contractor shall supply all required serial cabling and connectors based on information in this RFP. All cables shall be factory terminated and tested. Pinout and cable length will be determined prior to installation by the Contractor and documented as part of the Communications Migration Plan. The Contractor must furnish tools and connectors to create and field test any necessary or proposed custom cables.
5. The terminal server shall at a minimum follow the following specific requirements:

Ethernet Interface

a. Number of ports :1
b. Speed: 10/100 Mbps
c. Connector: RJ-45

Serial Interface/ Communications

a. Serial Ports: 16
b. Serial Standards: RS-232/RS-422/RS-485
c. Data Bits: 5,6,7,8
d. Stop Bits: 1,1.5,2
e. Parity: None, Even, Odd, Space, Mark
f. Flow Control: RTS/CTS, DTR/DSR, XON/XOFF
g. Baudrate: Standard Baud Rates
h. RS-232 Signals: TxD, RxD, RTS, CTS, DTR, DSR, DCD, GND
i. RS-422 Signals: Tx+, Tx-, Rx+, Rx-, GND
j. RS-485-4w: Tx+, Tx-, Rx+, Rx-, GND
k. RS-485-2w: Data+, Data-, GND

Software and Configuration

a. Network Protocols: ICMP, IP, TCP, UDP, DHCP (client), Telnet, DNS, SNMP V1/V2/V3, HTTP, SMTP, ARP, DDNS
b. Configuration: Web Console, Serial Console, Telnet Console
c. Inherent latency: less than 10 ms
d. Automatic Reboot Trigger: Watch Dog Timer or Similar
e. Built-in LCD panel for configuration

Operation Modes

a. TCP Server, TCP Client, UDP, Pair Connection (Terminal Server to Terminal Server – Serial Extension Mode)

Power

a. Power: 100-240VAC

Size

a. Height: 1U
b. Depth: 9" Max

Environmental

a. Operating Temp 0° to 55°C or better
b. Operating Humidity: 5% to 95% RH or better

Approved Manufacturer and Model

a. Moxa NPort 6650-16 or Approved Equal

Gigabit Network Switch

1. This item shall include a modular slot based network switch to provide redundant Ethernet Network Switch capabilities.
2. This device shall be 19" rack mountable with associated brackets/hardware, console cabling, and power cords.
3. This unit shall be environmentally hardened with conformal coated boards when available through the manufacturer to withstand environmental elements in the project area. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendation and standard practices.
4. The Contractor shall supply all required shielded Ethernet Cat6 and Fiber Optic cabling and connectors based on information in this RFP. All predetermined length cables shall be factory terminated and tested. Cable length will be determined prior to installation by the Contractor. In certain instances a field terminated shielded Cat6 cable may be required. The Contractor must furnish tools and connectors to create and field test any necessary or proposed custom cables.
5. The gigabit network switch shall at a minimum follow the following specific requirements.

Ethernet Interfaces

a. Number of ports :24 (Minimum)
b. Speed: 10/100TX
c. Connector: RJ-45

Fiber Interfaces

a. Number of ports: 4 (Minimum)
b. Speed: 1000FX
c. Connector: ST (Contractor must field verify)
d. Fiber Type: Multimode/Singlemode (Varies by location, Contractor must verify)
e. Transceiver Rating: Varies (Contractor must verify)

Software and Configuration

a. Network Protocols: UDP, TFTP, IP, ICMP, TCP, ARP, Telnet, IGMP, DHCP (client), SNTP, HTTP, IGMP, SNMP V1/V2/V3
b. Configuration: Web Console, Serial Console, Telnet Console, CLI
c. Switching latency: less than 10 µs

Power

a. Power: 120-240VAC

Environmental

a. Operating Temp 0º to 55ºC or better
b. Operating Humidity: 5% to 95% RH or better

Size

a. Height: 1U
b. Depth: 14" Max

Approved Manufacturer and Model

a. RuggedCom RSG2300 or Approved Equal

Gigabit Fiber Network Switch (Hub 14)

1. This item shall include a modular slot based network switch to provide redundant Ethernet Network Switch capabilities.
2. This device shall be 19" rack mountable with associated brackets/hardware, console cabling, and power cords.
3. This unit shall be environmentally hardened with conformal coated boards when available through the manufacturer to withstand environmental elements in the project area. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendation and standard practices.
4. The Contractor shall supply all required shielded Ethernet Cat6 and Fiber Optic cabling and connectors based on information in this RFP. All predetermined length cables shall be factory terminated and tested. Cable length will be determined prior to installation by the Contractor. In certain instances a field terminated shielded Cat6 cable may be required. The Contractor must furnish tools and connectors to create and field test any necessary or proposed custom cables.
5. The Gigabit Fiber Network Switch shall at a minimum follow the following specific requirements:

Ethernet Interfaces

a. Number of ports :1 (Minimum)
b. Speed: 10/100/1000TX
c. Connector: RJ-45

Fiber Interfaces

a. Number of ports: 8 (Minimum)
b. Speed: 1000FX
c. Connector: ST (Contractor must field verify)
d. Fiber Type: Multimode/Singlemode (Varies by fiber ring, Contractor must verify)
e. Transceiver Rating: Varies (Contractor must verify)

Software and Configuration

a. Network Protocols: UDP, TFTP, IP, ICMP, TCP, ARP, Telnet, IGMP, DHCP (client), SNTP, HTTP, IGMP, SNMP V1/V2/V3
b. Configuration: Web Console, Serial Console, Telnet Console, CLI
c. Switching latency: less than 10 µs

Power

a. Power: 120-240VAC

Environmental

a. Operating Temp 0° to 55°C or better
b. Operating Humidity: 5% to 95% RH or better

Size

a. Height: 1U
b. Depth: 14" Max

Approved Manufacturer and Model

a. RuggedCom RSG2200 or Approved Equal

Voice Gateway

1. This item shall include a 16 port Voice Gateway which translates bidirectional analog telephone signal between standard copper phone cables and Ethernet formats. The Voice Gateway shall extend existing PBX copper analog phone service over an IP Ethernet network to various analog copper based phone/intercom/speaker.
2. This device shall be 19" rack mountable with associated brackets/hardware, serial cabling, and power cords.
3. This unit shall be environmentally hardened with conformal coated boards when available through the manufacturer to withstand environmental elements in the project area. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendation and standard practices.
4. The Contractor shall supply all required telephone cabling and connectors based on information in this RFP. All cables shall be factory terminated and tested. Pinout and cable length will be determined prior to installation by the contractor and documented as part of the Communications Migration Plan.

5. The Voice Gateway shall at a minimum follow the following specific requirements:

Ethernet Interface

a. Number of ports :1 (Minimum)
b. Speed: 10/100 Mbps
c. Connector: RJ-45

Telephone Interface

a. Ports: 24
b. Connector: RJ-11/RJ-45
c. Analog Modules: FXS/FXO (Dependent on installation location)

Software and Configuration

a. Network Protocols: IP, TCP, UDP, DHCP (client), Telnet, SNMP V2/V3, HTTP, HTTPS, TFTP
b. Configuration: Web Console, Telnet Console, Serial Console

Operation Modes

a. Remote PBX Extension between FXO & FXS devices over IP Network
b. One to one port mapping (Voice Gateway to Voice Gateway – Analog telephone signal extension over Ethernet)
c. Standards: SIP, RTP/RTCP, H.323, G.711, G.726, G723.1, G.165, G.168-2002

Power

a. Power: 100-240VAC

Size

a. Height: 1U
b. Depth: 14" Max

Environmental

a. Operating Temp 0° to 45°C or better
b. Operating Humidity: 10% to 90% RH or better

Approved Manufacturer and Model

a. AudioCodes Mediant 1000 or Approved Equal

Network Monitoring Station

1. This item shall include a network monitoring station which includes a workstation, LCD monitor, and software capable of monitoring network health via SNMP (Simple Network Management Protocol)
2. This monitoring station shall include a computer workstation with minimum level specs included below.
3. Monitors and analyzes real-time network performance statistics for routers, switches, servers plus any other SNMP enabled devices and graphically displays network/device status.
4. Provides alerts to network related events such as Link down, Device down, and Packet loss above threshold.
5. Provides e-mail alerts based on events.
6. Network Monitoring Station shall be installed by the Contractor into HDOT specified rack space.
7. The Contractor shall supply all required cabling and connectors based on information in this RFP.
8. The Network Monitoring Station shall at a minimum follow the following specific requirements:

Hardware (Minimum)

a. Processor: Core 2 Duo, 3GHz
b. OS: Windows 2008 Server Standard Edition 5 CAL's With Disks
c. Monitor: 19" LCD (Requires a rack shelf purchased by Contractor)
d. Drive: DVD+/-RW
e. Memory: 8GB RAM
f. Hard Drive: 250 GB (Primary), 1 TB (Secondary)
g. Video Card: Integrated
h. NIC: DUAL 10/100/1000TX RJ-45
i. Keyboard/Mouse: Yes (Requires a rack shelf purchased by Contractor)
j. 19" Rack mountable

SNMP Software

a. Software OS: Windows Server based
b. Monitors: Hardware Status, Switch port status, Average Response Time, Packet Loss, Link Up/Down Status, Bandwidth Usage Per Port

c. Alarms: Hardware Down, Switch Port Down, Average Response Time Beyond Threshold, Packet Loss Beyond Threshold, Link Down, Bandwidth Usage Beyond Threshold
d. Archiving: 6 months
e. SNMP support: V1, V2, V3

Configuration: Web Console

Approved Manufacturer and Model

a. Dell or Approved Equal
b. Solar Winds Orion Network Performance Monitor Software or Approved Equal

T-1 Extender over IP Device

1. This item shall include a T-1 Extender device which transports T-1 signals over an Ethernet IP Network.
2. This unit shall be environmentally hardened with conformal coated boards when available through the manufacturer to withstand environmental elements in the project area. All parts shall be of high quality workmanship, and no part or attachment shall be substituted or applied contrary to the manufacturer's recommendation and standard practices.
3. The Contractor shall supply all required cabling and connectors based on information in this RFP. All cables shall be factory terminated and tested. Pinout and cable length will be determined prior to installation by the Contractor and documented as part of the Communications Migration Plan. The Contractor must furnish tools and connectors to create and field test any necessary or proposed custom cables.

Ethernet Interface

a. Number of ports :1
b. Speed: 10/100 Mbps
c. Connector: RJ-45

T-1 Interface/ Communications

a. Number of Ports: 1
b. Line rate: 1.544 Mbps

Operation Modes

a. T-1 Point to Point Extension over IP

Power

a. Power: 100-240VAC

Environmental

a. *Operating Temp 0° to 50°C or better*
b. *Operating Humidity: 5% to 95% RH or better*

Approved Manufacturer and Model

a. Data Comm for Business IP-6700

The Contractor shall procure, receive, and store the communications equipment at the HDOT staging area (if room is available) or at the Contractor's storage facility. The Contractor shall allow for physical inspection of equipment prior to

payment. Only approved equipment documented in the approved Communications Migration Plan shall be utilized in the proposed communication system upgrade.

Deliverables:

1. Procurement of Communication Equipment, Halawa Ring
2. Procurement of Communication Equipment, Haiku Ring
3. Procurement of Communication Equipment, Tunnel Ring

Measurement.

The Engineer will not measure procurement of communication equipment for payment.

Payment.

The Engineer will not pay for accepted procurement of communication equipment separately and will consider the cost for accepted procurement of communication equipment as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.03 Task 3: Installation of Communication Equipment

Overall installation requirements:

1. Build Parallel Communications Network Prior to Transitioning the Old System – The Contractor shall not shut down the existing system while upgrading the communications network.
2. The system shall be upgraded by sections including phased installations for the Halawa Ring, Haiku Ring, and Tunnel Ring
3. The proposed system installed with equipment which follows the specifications will fit and operate appropriately in the available space and power identified at each hub location

Table 4. Available Space and power at the Hubs

Hub No.	From Hub Location	Available 19" Rack Space	Available Power
1	Halawa OB Approach, station 342+60	24 inches	Yes
2	Halawa IB Approach, station 475+60	24 inches	Yes
3	Halawa OB Portal Bldg. Level 2	None	Yes
4	Cross Passage XP-1	24 inches	Yes
5	Cross Passage XP-5	24 inches	Yes
6	Cross Passage XP-9	24 inches	Yes
7	Haiku OB Portal Bldg. Level 2	None	Yes
8	Haiku OB Approach, station 11+60	24 inches	Yes
9	Halawa IB Portal Bldg. Level 2	None	Yes
10	Cross Passage XP-3	24 inches	Yes
11	Cross Passage XP-7	24 inches	Yes
12	Haiku IB Portal Bldg. Level 2	None	Yes
13	Haiku IB Approach, station 1110+30	24 inches	Yes
14	TOC Equipment Room	Yes	Yes

There is available 19 inch rack space at all of the locations except Hubs 3, 7, 9, 12 and 15 as noted in Table 4. At locations with available space, there is at least 24 inches of available rack space. Refer to Exhibit C, drawing no. 3125-964-3001, where Items 30 and 31 were located in the cabinet.

At hub locations with no available rack space, new equipment can be temporarily placed on a temporary/portable rack provided by the Contractor to be placed adjacent to the hub cabinet while the new parallel communications equipment is installed and tested as these areas are located in limited access areas. After the new system is fully functional, the old equipment shall be removed and the new equipment can be transitioned to the existing cabinet space with minimum down time.

Device Configuration:

Device IP and general configuration will be provided by HDOT based upon the system design outlined in this RFP. The Contractor shall program the Network Switches, Terminal Servers, T-1 Extender and Voice Gateways with HDOT provided IP address, base equipment configurations and modify the base equipment configurations to reflect the hub location the equipment is installed.

T-1 Extender:

1. Configured with an IP address provided by HDOT.
2. Configured the device to create a point to point connection to bridge the T-1 over an IP Network.
3. Enable Simple Network Management Protocol (SNMP) and configured with the appropriate credentials provided by HDOT.

Network Switches:

Generally the network switches will need the following configured:

1. Configured with an IP address provided by HDOT.
2. Configured with user/passwords as provided by HDOT.
3. Enable Rapid Spanning Tree (RSTP) and configured with the appropriate priorities which will be provided by HDOT.
4. Enable Simple Network Management Protocol (SNMP) and configured with the appropriate credentials provided by HDOT.

Terminal Servers:

1. Configured with an IP address provided by HDOT.
2. Configured terminal servers to bridge/extend the serial signal to create a one to one serial connection between Hub 14(TOC) and the field hubs. For example, Terminal Server 1 - Serial Port 5 to be installed at Hub 14 (TOC) will be programmed to Pair with Terminal Server 2 Serial Port 5 to be installed at Hub 10.
3. Configured terminal servers to communicate with correct Serial protocol. For example Serial Port 1 through 6 will need to be

configured for RS-232 and Ports 7-8 will need to be configured for RS-485.

4. Enable Simple Network Management Protocol (SNMP) and configured with the appropriate credentials provided by HDOT.

Voice Gateways:

1. Configured with an IP address provided by HDOT.
2. Configured Voice Gateways to bridge/extend the analog signal to create a one to one analog telephone connection between Hub 14 (TOC) and the field hubs. For example, Voice Gateway 1 - FXS Port 5 to be installed at Hub 14 (TOC) will be programmed to Pair with Voice Gateway 2 FXO Port 5 to be installed at Hub 10.
3. Enable Simple Network Management Protocol (SNMP) and configured with the appropriate credentials provided by HDOT.

Communications and Migration and Installation Sequence:

The following is a recommended system installation and migration sequence of the communications system. This installation sequence assumes that procurement of equipment, cables, and cabinet upgrades are complete. The Offeror may use this sequence or propose a different sequence but must provide details in which they propose to install the system.

Tunnel Ring:

The tunnel ring contains 10 hub locations which includes the TOC at Hub 14. Fiber must be identified and tested/terminated according to Section 2.06.05 of this RFP. Once the fiber is terminated, installation of all the required equipment shall begin at Hub 14.

Hub 14 (TOC)

1. Program equipment with HDOT provided IP Address and specified configurations and install the following into available cabinet space.
    a. 1 qty - Gigabit Fiber Network Switch
    b. 1 qty - Gigabit Network Switch
    c. 14 qty - Terminal Servers
    d. 14 qty - Voice Gateways
    e. 1 qty – T1 Extender
    f. 1 qty - Network Monitoring Station
    g. Associated brackets, cabling, power cords, labels

2. Once Hub 14 is complete the remaining 9 hub locations on the tunnel ring can be installed. The Gigabit Network Switches will need to be connected via the identified and tested fiber optic cables according to the Proposed Physical System diagram in Exhibit D.

Remaining Hub Locations

1. Program equipment with HDOT provided IP Address and specified configurations and install the following into available cabinet space
    a. 1 qty - Gigabit Network Switch
    b. 1 qty - Terminal Server
    c. 1 qty - Voice Gateway
    d. 1 qty – T1 Extender, as per equipment specifications under Task 2.
    e. Associated brackets, cabling, power cords, labels
2. After each hub of the tunnel ring is complete, a functional test as required in Section 2.06.07 shall be completed to test the newly created network.

Edge Device Migration:

At this point the OPCOM network and Ethernet network in the tunnel ring is operating in parallel. In addition the Terminal Servers and Voice Gateways are configured and tested to provide serial and telephone from hub locations to Hub 14 (TOC). Edge devices such as PLC's Signs and Phones can now be individually migrated off the OPCOM network to the newly installed equipment on the Ethernet network. To minimize disruption of the live tunnel control and communication systems the Contractor shall migrate one edge device at a time and immediately test. The Contractor shall provide staff at Hub 14 (TOC) and at the field hub which the device will be migrated. HDOT staff will assist in testing functionality of the migrated devices with specific specialized tunnel control systems.

The following is an example of the specific steps in migrating two example devices:

Camera PTZ and Emergency Phone Example Migration at Hub 10

1. Test Camera PTZ control to verify functionality on OPCOM system.
2. Unplug the Camera PTZ serial cable at Hub 10 from the OPCOM system
3. Unplug the Camera PTZ serial cable at Hub 14 (TOC) which directly corresponds to the Camera PTZ serial cable at Hub 10.
4. Plug the Camera PTZ serial cable at Hub 10 to Port 1 on the terminal server.
5. Plug the Camera PTZ serial cable at Hub 14 (TOC) to Port 1 on the terminal server assigned to communicate to Hub 10.
6. Camera PTZ control shall now be tested and be fully functional prior to proceeding. If the test fails, plug the serial cables back into the OPCOM system while troubleshooting takes place. Repeat these steps for all remaining serial devices at this hub location.
7. Test functionality of Emergency telephone to verify initial functionality on the OPCOM system.
8. For the Emergency telephone system the steps are the same. Unplug the analog telephone cable at Hub 10.

9. Unplug the analog telephone cable at Hub 14 (TOC) which directly corresponds to the port which the telephone cable was unplugged at Hub 10
10. Plug the analog telephone cable at Hub 10 into port 1 of the Voice Gateway.
11. Plug the analog telephone cable at Hub 14 into port 1 of the Voice Gateway assigned to communicate to Hub 10.
12. The Emergency telephone which was just migrated shall now be tested and be fully functional prior to proceeding. If the telephone is not functioning, plug the analog telephone cable back into the OPCOM system while troubleshooting takes place.
13. Once all devices are migrated and pass individual testing at Hub 10, these steps will need to be followed to migrate the next Hub location.

This process of testing and migrating devices will ensure downtime for individual devices will be minimal and that the system will continue to function.

Halawa and Haiku Rings:

The two remaining communication rings encompass the Halawa and Haiku approaches. The Halawa and Haiku Rings contain 4 hub locations which will be connected to the TOC at Hub 14. Fiber must be identified and tested according to Section 2.06.05 of this RFP. Once the fiber is ready, installation of all the required equipment shall begin at the hub locations for the Halawa and Haiku communication rings to operate the Ethernet based system in parallel with the OPCOM system. The Gigabit Network Switches will need to be connected via the identified and tested fiber optic cables according to the Proposed Physical System diagram in Exhibit D.

Hub Locations

1. Program equipment with HDOT provided IP Address and specified configurations and install the following into available cabinet space
    a. 1 qty - Gigabit Network Switch
    b. 1 qty - Terminal Server
    c. 1 qty - VOIP Gateway
    d. Associated brackets, cabling, power cords, labels
2. After each hub of the tunnel ring is complete a functional test as required in Section 2.06.07 shall be completed to test the newly created network.

Edge Device Migration:

At this point the OPCOM network and Ethernet network in the tunnel ring is operating in parallel. In addition, the Terminal Servers and VOIP Gateways shall have been configured and tested to provide serial and telephone from hub locations to Hub 14 (TOC). The edge devices will need to be migrated in the same manner as the edge devices in the Tunnel Ring.

Network Monitoring Station

The Contractor shall install the Network Monitoring Station hardware components at Hub 14 (TOC) in available rack space. The exact location on the existing racks will be indicated to the Contractor by HDOT. The software and programming of the Network Monitoring Station will be completed by HDOT.

Staging Area for the Contractor

HDOT will provide a staging area at the H-3 facility to support assembly and pre-testing of the equipment prior to installation at the appropriate Hub locations. The Contractor shall develop the requirements for this staging area and submit them to HDOT at the project kickoff meeting. HDOT will make every effort to accommodate reasonable requests to facilitate the installation of the equipment.

Removal of OPCOM Equipment

The OPCOM equipment and associated electrical components to be removed by the Contractor shall remain the property of HDOT. The Contractor shall verify that the quantities of existing Opcom equipment are as shown in Section 2.02 and shall report all discrepancies to HDOT. The removed OPCOM equipment shall be disconnected, disassembled, and delivered to HDOT at the address below:

HDOT
H-3 Tunnel
Operations and Maintenance Building
Hawaii, Oahu
Phone: (808) 485-6241
Attention: Mr. Miles Ueno

Five days written advance notice shall be given to both HDOT and HDOT H-3 Maintenance Contact prior to delivery of the equipment at the address listed above. Delivery shall occur during the hours of 8:00 a.m. to 2:00 p.m. Monday through Friday. Material will not be accepted without the required advance notice.

The Contractor shall be responsible for unloading the equipment where directed by HDOT at the delivery site.

Cost associated for the removal of the OPCOM equipment and delivery to HDOT should be included in the lump sum items for each hub location in accordance with the Contract Documents and as directed by HDOT.

Cost associated for the installation of the proposed communication equipment shall be included in the lump sum items for each hub location in accordance with the Contract Documents and as directed by HDOT.

Deliverables:

1. Installation of Communication Equipment, Halawa Ring
2. Installation of Communication Equipment, Haiku Ring
3. Installation of Communication Equipment, Tunnel Ring

Measurement.

The Engineer will not measure installation of communication equipment for payment.

Payment.

The Engineer will not pay for accepted installation of communication equipment separately and will consider the cost for accepted installation of communication equipment as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.04 Task 4: Not Used.

2.06.05 Task 5: Test Existing Spare Fibers

The existing fiber optic cable plant includes spare fibers for each of the fiber optic rings. For each ring, the Contractor shall test at least four (4) existing spare fibers in each fiber optic cable sections identified in Exhibit A and report to HDOT any problems with the fibers prior to transition of the communication system to the new hub equipment. Note that some cable sections will require more than four spare fibers to be tested. This work will involve the fiber optic testing of twenty-three (23) fiber optic cable sections as shown in Exhibit A for approximately 100,000 feet in total cable length. All spare fibers have already been designated and labeled at each of the hub locations in accordance with Exhibit A.

The Contractor shall test each complete fiber optic section between hub locations including all patch chords specified to ensure an acceptable continuous link to each hub. This work shall be completed for a whole ring prior to transitioning the new communications system to the new network.

Optical Time Domain Reflectometer (OTDR) Testing

The Contractor shall test the entire length of each fiber in each cable using an OTDR, testing for all the wavelengths that the fiber is designed to carry. HDOT or its representative will witness all OTDR tests. The Contractor shall present the test results to HDOT for approval within one week of the test. The Contractor shall give HDOT durable, labeled plots of the results for each fiber, and shall also provide these plots on electronic media. The plots shall have a record of all

OTDR settings and the OTDR locations written on the trace. The Contractor shall also submit a listing of splices and the associated losses in tabular form, along with calculations demonstrating that the OTDR results for each fiber meet the attenuation requirements of these specifications and that the optical properties of the cable have not been impaired.

If special software is necessary to view the results of the OTDR tests on a personal computer, two licensed copies of the software associated with these test shall be provided to HDOT. The cost of this software will be included in the costs for testing.

For each cable section the Contractor shall perform the following tests:

1. Using the OTDR, test each fiber in the link at 1310 nm and 1550 nm for fiber attenuation, continuity, length and anomalies. Perform the test from both ends. Each fiber shall meet the following criteria:
    a. Attenuation: Not to exceed 0.8 dB/km at 1310 nm and 0.6 dB/km at 1550nm + 0.5 dB/splice + 0.5 dB/connector for links
    b. Remake any splice with a loss exceeding 0.5 dB until its loss falls below 0.2 dB. Record each attempt for purposes of acceptance. Refer to Section 2.06.06 for splice requirements and pay items for the splicing work.
    c. Anomalies shall not exceed 0.5 dB
2. Using an optical source and power meter, measure the attenuation from both ends. The measured attenuation shall meet the requirements defined for the attenuation using the OTDR.

The Contractor shall, at a minimum, include the following documentation and tests in the fiber optic cable testing:

1. List of test equipment
2. Cable attenuation measurements in both directions at all wavelengths, including average link losses, for every fiber tested, in every segment, of every cable
3. Loss for each splice and connection
4. OTDR trace to each fiber tested with every event annotated as to what caused the event
5. Calculations demonstrating that the OTDR results for each fiber tested meet the attenuation requirements of the cable

Successful completions of the above tests are the basis for acceptance. If the above criteria are not met, the Contractor shall isolate the problem and replace the splice or termination of cable that causes the fiber not to meet the acceptance criteria. If splice or termination work is necessary, with HDOT's prior authorization, this work will be paid at the contract price per pay unit, as shown in the proposal schedule for "Splice Existing Fiber" and "Terminate Existing Fiber". See Section 2.06.06 for the splice and termination work requirements. The Contractor shall take extreme care when performing this work as to not damage

any of the existing fiber optic splices and terminations. The Contractor will be responsible for any damages caused while testing the existing fibers.

For each ring, the Contractor shall document all test results and submit to HDOT for review and approval.

Deliverables:

1. OTDR test results, Halawa Ring. Three (3) copies and electronic copy on a CD-ROM.
2. OTDR test results, Haiku Ring. Three (3) copies and electronic copy on a CD-ROM.
3. OTDR test results, Tunnel Ring. Three (3) copies and electronic copy on a CD-ROM.
4. Two (2) licenses of software to view OTDR test results, if applicable.

Measurement.
The Engineer will not measure testing of existing spare fibers for payment.

Payment.
The Engineer will not pay for accepted testing of existing spare fibers separately and will consider the cost for accepted testing of existing spare fibers as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.06 Task 6: Splice, Terminate and Test Non-Working Fiber Optic Cables

In the process of completing Task 5, the Contractor may encounter non-working fibers that need to be re-spliced or re-terminated. Although it is anticipated that the existing spare fibers are ready for use, the Contractor may need to splice, terminate, or replace existing fibers that may not be operational. The Contractor shall notify HDOT which non-working fibers require re-splicing or re-termination and shall not proceed with this work without HDOT authorization. This work will be paid on a per unit basis as per the unit prices submitted by the Contractor in the proposal schedule for 'Splice Existing Fibers' and 'Terminate Existing Fibers'. The work completed under these items shall meet the following requirements:

1. Splicing: For connection of the fiber optic cable to fiber optic distribution panel or splicing to other cables, cut only those fibers needed for the connection or splice. Use splice trays to hold the spliced and unspliced fibers, with each fiber neatly secured to the tray. Contain all buffer tubes entirely within the splice tray, with no tubes being exposed. Package each spliced fiber in a protective sleeve or housing. Completely re-coat bare fibers with a protective, room-temperature vulcanizing (RTV) coating, gel or similar substance as recommended by the cable manufacturer, prior to application of the sleeve or housing, so as to protect the fiber from scoring, dirt, or microbending.

2. Termination: In hubs where optical fibers are to be connected to terminal equipment, provide matching connectors with factory-installed fiber pigtails of sufficient length, plus five feet of slack, and splice them to the corresponding optical fibers. Do not field install connectors. Provide fiber optic pigtails buffered and strengthened with aramid to reduce the possibility of accidental damage to the fiber or connection. Properly protect unused optical fibers with sealed end caps.

The Contractor shall complete OTDR testing of the re-spliced or re-terminated fibers per Task 5. This OTDR testing of re-spliced or re-terminated fibers shall not be paid for separately but shall be considered incidental to the Task 6 pay items.

Deliverable:

1. OTDR test results, Halawa Ring. Three (3) copies and electronic copy on a CD-ROM.
2. OTDR test results, Haiku Ring. Three (3) copies and electronic copy on a CD-ROM.
3. OTDR test results, Tunnel Ring. Three (3) copies and electronic copy on a CD-ROM.

Measurement.

(A) The Engineer will not measure testing of non-working fibers for payment.

(B) The Engineer will only measure splicing of non-working fibers required and requested by the Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

(C) The Engineer will only measure termination of non-working fibers required and requested by the Engineer on a force account basis in accordance with Subsection 109.06 – Force Account Provisions and Compensation.

Payment.

The Engineer will not pay for accepted testing of non-working fibers separately and will consider the cost for accepted testing of non-working fibers as included in the contract price of the splice and terminate existing non-working fibers pay items.

Engineer will pay for accepted pay items listed below at contract price per pay unit, as shown in the proposal schedule. Payment will be full compensation for work prescribed in this section and contract documents.

Engineer will pay for each of the following pay items when included in proposal schedule:

Pay Item	Pay Unit
Splice Existing Non-Working Fibers	Force Account
Terminate Existing Non-Working Fibers	Force Account

2.06.07 Task 7: System Testing and Acceptance

Three types of testing shall be required for each unit of equipment furnished: a Functional Test after the installation of the equipment, a System Integration Test after the equipment is fully integrated with the communications network and the other components of the system, and a Thirty (30) days Operational Acceptance Test.

The Contractor shall be responsible for developing detailed test procedures for each type of equipment and conducting the specified tests to verify satisfactory operation of the equipment for each test. The test procedures shall be submitted to HDOT for review and approval prior to the tests. Only approved test procedures shall be used during the tests. Tests shall not be performed unless HDOT or its designated representative is present. The test results shall be compared with the requirements specified herein. Failure to conform to the requirements of any test shall be counted as a defect, and equipment shall be subject to rejection by HDOT or its designated representative.

Rejected equipment may be offered again for retest provided all non-compliances have been corrected and retested by the Contractor and evidence thereof submitted to HDOT. Final inspection and acceptance of equipment shall be made after installation at the locations specified on the plans and as specified herein.

Functional Test at Each Hub Location

The Contractor shall conduct an approved functional test of installed equipment at each Hub location. The test shall, as a minimum, show network connectivity between the field hub and TOC (Hub 14) as well as appropriate redundancy features of the network. Approved data forms shall be completed and turned over to HDOT as the basis for review and rejection of acceptance.

System Integration Test

Following the satisfactory completion of the functional test, the installed equipment will be connected to field ITS equipment (field hub) as well as the central equipment (Hub 14). The System Integration Test shall, as a minimum, exercise the ITS field equipment as an integrated system, e.g. pan-tilt-zoom functions for the CCTV cameras, downloading messages to the dynamic message signs, checking for voice clarity for emergency phones. The test shall demonstrate all remotely controlled features from the TOC and as directed by

HDOT. Approved data forms shall be completed and turned over to HDOT as the basis for review and rejection or acceptance.

Thirty (30) Days Operational Acceptance Test

Following the satisfactory completion of the System Integration Test at all hub locations, a thirty (30) days operational test shall be conducted without a system failure. A system failure is defined as any equipment or software failure including system problems due to equipment or software malfunctions, inability of the equipment to detect or report an incident, wrong settings, power loss, communications breakdown, loose connectors, or any malfunctions caused by poor workmanship with the installation by the Contractor. During this period, the HDOT will utilize the system, exercise all functional features of the system and report any problems or failures experienced. In the event of a failure of any Contractor supplied equipment or software, the Contractor shall fix the problem to the satisfaction of HDOT and the test shall be restarted. In the event of a failure of equipment installed by others or malfunction of any existing hardware, the test shall be suspended until the problems have been corrected, and then the test shall be resumed from the point of suspension. A final report including documentation for failures and repairs shall be completed and turned over HDOT as the basis for review and rejection or acceptance of the communication system.

Deliverables:

1. Functional Test Results, Halawa Ring
2. Functional Test Results, Haiku Ring
3. Functional Test Results, Tunnel Ring
4. System Integration Test Results, Halawa Ring
5. System Integration Test Results, Haiku Ring
6. System Integration Test Results, Tunnel Ring
7. Thirty (30) Days Operational Acceptance Test Results

Measurement.

The Engineer will not measure system testing and acceptance for payment.

Payment.

The Engineer will not pay for accepted system testing and acceptance separately and will consider the cost for accepted system testing and acceptance as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.08 Task 8: Training and System Documentation

Training

Training Plan

Submit for review and approval, a Training Plan which shall address Technician Training, System Administration Training and Maintenance

Training for the new communication system. The Training Plan shall include at a minimum:

1. A description of all training courses including identification of the purpose and goals of each course, duration of the course and identification of the facility and training equipment requirements (e.g., overhead projectors, televisions, DVD player, specific System hardware elements).
2. The classroom instructors who shall conduct the training and description of their skills, experience and qualifications.
3. Individual course curricula, course materials, manuals, study guides and workbooks.
4. Course critique and evaluation forms for students.
5. Post-training and/or on-the-job technical reference guides.
6. A detailed schedule for the delivery of all training courses.

Training Program

After approval of the Training Plan and prior to the beginning of the Acceptance Test, conduct the specified training to the staff. The training program shall be implemented through the use of formal classroom training and/or other forms of presentation as recommended by the Offeror. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of System commands which they may have to use in the course of performing their designated functions. HDOT shall be provided with complete sets of training materials and operating manuals during the training sessions, which they will retain for use on the job at the completion of training. Formal training shall also include a comprehensive testing program for determining that the intended training has been successfully imparted. The Offeror shall:

1. Submit the training manual for review and approval by HDOT.
2. Upon completion of each training program, prepare and submit to HDOT a training report, which shall summarize the results of the training program, including a list of attendees and individual test results, course evaluation forms and recommendations for follow-up training or modifications to the curriculum.
3. Conduct the required training at the scheduled times and locations designated by HDOT consistent with the approved Training Plan. Three training sessions shall be provided for a minimum of six (6) hours each and include the staff noted below. The training shall include operation instructions, theory of operations, equipment functions, preventive maintenance procedures, troubleshooting and repair of all equipment. Hands-on use of the equipment and communication server shall be included in the training. The full complement of training courses shall be conducted over the duration of this contract to accommodate shift personnel, vacations, new personnel and one make-up session (combined session). The training shall include the following groupings of staff:

Staff Category	Number of Staff
Technicians/Electricians	10
Supervisors/Managers/Engineers	6
System Administrators	3

Training Manuals
Provide the Training Manuals and any other associated course materials, study guides and workbooks, as described in the approved Training Plan. These manuals shall be for instructional use during the Training Program, for study and for refresher use to provide training of all the features and functions of the System during normal operations. These manuals shall also be suitable for HDOT use to train new technicians, supervisors, system administrators and maintenance staff on an ongoing basis.

System Documentation
Off-the-shelf manuals provided by the proposed manufacturers of the equipment will be acceptable for the system documentation. The manuals shall include the following:

User Manual
A User Manual shall be provided which contains graphical depictions and explanations of system operation for all operator functions specified for the equipment. This manual shall be for instructional, study and refresher use and shall explain all the features and functions of the System for day-to-day operation (e.g., log-on, monitors, print reports). The manual shall also have a section for problems and/or exception conditions so the user can resolve common operating problems (e.g., trouble shoot network problems, restart the System in the event of a component failure). The manual shall also contain instructions on how to perform normal maintenance.

System Administrator's Manual
A System Administrator's Manual shall be provided which contains graphical depictions and written descriptions of all functions required for system maintenance and specified under System Administrator Training. This manual shall contain all procedures necessary for the proper monitoring and administration of the System. At a minimum, the manual shall contain separate sections that cover the following topics: backup and recovery, performance analysis, scheduled maintenance, audit and control, report production, contingency plan, configuration control, system diagnostics, database integrity, special requests and expendable supplies. A separate, removable section of the System Administration Manual shall contain information on the proper administration and control of the security features built into the System. Some of the information to be contained in this section includes: maintenance of user identifiers, password control, and security policy review. This System Administrator's manual shall also

include computer-generated listings of all system programs as an addendum under separate cover.

Deliverables:

1. Training Plan
2. Training Program
3. Training Manuals. Twenty (20) bound hard copies and electronic copy in PDF format on a CD-ROM.
4. User Manuals
5. System Administrator's Manual

Measurement.
The Engineer will not measure training and system documentation for payment.

Payment.
The Engineer will not pay for accepted training and system documentation separately and will consider the cost for accepted training and system documentation as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.09 Task 9: Warranty and Support

After approval of the Thirty (30) Days Operational Acceptance Test, a warranty period of one (1) year shall be included for all equipment, parts, and labor. The need for an on-site field service call shall be made by HDOT or its representatives after sufficient discussions with the Contractor's telephone response personnel and after these discussions have resulted in the determination that a problem does exist and that it cannot be resolved in a sufficient manner without a field service call to the site.

The response time for service calls requiring phone-support shall be less than 4 hours. The response time for service calls requiring an on-site visit shall be less than 24 hours including repair time.

All personnel responding to field service calls shall be factory-trained personnel capable of diagnosing and repairing the problem.

The warranty shall include maintenance visits at least every 6 months (twice during the Warranty Period) to re-calibrate equipment and exchange any component necessary for the maintenance of the equipment as recommended by the manufacturer.

Due to the severity of the subsystems the communications network supports, the warranty shall allow HDOT employees (who attended the training sessions) to replace any component in order to bring the communications system back on line. The Contractor shall indicate in the proposal response which components can be replaced by HDOT staff.

The Warranty contract shall be assigned to HDOT. The maintenance and warranty period will follow the final approval of the operational acceptance test milestone.

Maintenance Documentation

The Contractor shall provide manufacturer-recommended maintenance checklists for all field and central equipment. The Contractor shall keep a record of all maintenance activities and identify any types of equipment or devices that are experiencing abnormally high failure rates and take corrective action. The Contractor shall generate a monthly report documenting system failures, malfunctions, remedies, corrective actions taken to correct communication problems. These reports shall be submitted to HDOT within one week after the end each month.

Deliverables:

1. Warranty, one (1) year
2. Monthly maintenance activity reports
3. Monthly system failure/corrective action reports

Measurement.

The Engineer will not measure warranty and support for payment.

Payment.

The Engineer will not pay for accepted warranty and support separately and will consider the cost for accepted warranty and support as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.10 Task 10: Spare Parts Inventory

The Contractor shall provide the following, operable, spares to HDOT at the conclusion of the 30 Days Operational Acceptance Test.

1. Three (3) terminal servers, as per equipment specifications under Task 2
2. Six (6) voice gateway servers, as per equipment specifications under Task 2
3. One (1) fiber optic network switch, as per equipment specifications under Task 2
4. Two (2) network switches, as per equipment specifications under Task 2
5. Two (2) fiber transceivers of EACH TYPE used to populate the network switches and fiber optic network switch for the project, as per equipment specifications under Task 2.
6. One (1) T-1 Extender, as per equipment specifications under Task 2
7. Ten Percent (10%) spare of all factory or custom cables used to attach equipment, as per equipment specifications under Task 2.
8. Not used.

Delivery of the Spare Parts

HDOT
H-3 Tunnel
Operations and Maintenance Building
Hawaii, Oahu
Phone: (808) 485-6241
Attention: Mr. Miles Ueno

Five days written advance notice shall be given to both HDOT and the H-3 Maintenance Contact prior to delivery of the equipment at the address listed above. Delivery shall occur during the hours of 8:00 a.m. to 2:00 p.m. Monday through Friday. Material will not be accepted without the required advance notice.

The Contractor shall be responsible for unloading the equipment where directed by HDOT at the delivery site.

The Spare Parts Inventory will measured on lump sum basis provided in accordance with the Contract Documents or as directed by HDOT.

The unit price bid for this item shall include the cost of furnishing all labor, materials, and equipment necessary for the spare parts inventory including, but not limited to, equipment, connections, splices, interconnect cables, wires, fiber optic patch cables, fiber optic distribution panels, surge protectors, fiber optic cable rack hardware, controllers, electronic peripherals and interface equipment. The unit price will include the documentation, delivery and the testing referenced herein shall be included under the price bid for this item. Payment will be made once the equipment has been delivered and approved by HDOT.

Deliverable: Spare parts

Measurement.
The Engineer will not measure spare parts inventory for payment.

Payment.
The Engineer will not pay for accepted spare parts inventory separately and will consider the cost for accepted spare parts inventory as included in the contract price of 697.1000 – Communication Systems Upgrade.

2.06.11 Project Management and Reporting

Schedule
Provide a project schedule to HDOT for review and approval of the tasks associated with all Phases of this project within two weeks of Notice to Proceed. The schedule, created in the latest version of Microsoft Project, shall detail, at a minimum the tasks provided below, as well as all tasks/subtasks the Contractor

requires to complete each task of the RFP in a clear and efficient manner. In addition, the schedule should identify the milestones listed below:

1. Notice to Proceed
2. Implementation Plan
3. Fiber Optic Cable Testing
4. List of Equipment and Equipment Submittals
5. Begin procurement
6. Field Installation
7. Central Installation
8. Halawa Ring Test (Part of the System Integration Test)
9. Haiku Ring Test (Part of the System Integration Test)
10. Tunnel Ring Test (Part of the System Integration Test)
11. 30 Day Operational Acceptance Test
12. Training
13. System Documentation

Attend and conduct biweekly project status meetings. The Contractor shall provide agendas to all meeting invitees three business days prior to the meeting. The Contractor shall take meeting minutes for all meetings and distribute them to all invitees within three (3) business days after the meeting. Meeting minutes shall be consecutively numbered throughout the entire project and submitted in PDF format.

The Contractor shall develop a Project Management Program including Quality Control and Quality Assurance to ensure the project is completed on time and in a quality manner. Contractor shall provide monthly reports documenting the status of the project, adherence to the project schedule, and remedial measures taken to fix any problems.

Project management and Quality Control Quality Assurance is incidental to the project and should be included as part of the pay items for this project.

Contractor and HDOT shall meet within two weeks of issuance of a Notice to Proceed to review Contractor's schedule, resource plan and other information relevant to project start-up.

The Contractor shall submit two copies of each submittal and electronic PDF version in a CD-ROM for review by HDOT. After incorporating the comments to the satisfaction of HDOT, resubmit two (2) final copies and the CD-ROM(s), labeled with the date and "FINAL" stamp, along with the project name, and number.

Deliverables:

1. Project schedule
2. Biweekly project status meeting agendas and minutes
3. Project management program

4. Monthly project status reports

Measurement.
The Engineer will not measure project management and reporting for payment.

Payment.
The Engineer will not pay for accepted project management and reporting separately and will consider the cost for accepted project management and reporting as included in the contract price of 697.1000 – Communication Systems Upgrade.

SECTION THREE

PROPOSAL FORMAT AND CONTENT

3.01 INTRODUCTION

One of the objectives of this RFP is to make proposals preparation easy and efficient, while giving Offerors ample opportunity to highlight their proposals. The evaluation process must also be manageable and effective. When an Offeror submits a proposal, it shall be considered a complete plan for accomplishing the tasks described in this RFP and any supplemental tasks the Offeror has identified as necessary to successfully complete the obligations outlined in this RFP.

The proposal shall describe in detail the Offeror's ability and availability of services to meet the goals and objectives of this RFP as stated in Section 2.06.

Proposals must:

1. Include a transmittal letter to confirm that the Offeror shall comply with the requirements, provisions, terms, and conditions specified in this RFP.

2. Include signed Proposal, page P-7 and others, as applicable, with the complete name and address of Offeror's firm and the name, e-mail address, mailing address, telephone number, and fax number of the person the HDOT should contact regarding the Offeror's proposal.

3. Provide all of the information requested in this RFP in the order specified.

4. Be organized into sections, following the exact format using all titles, subtitles, and numbering, with tabs separating each of the sections described below. Each section must be addressed individually and pages must be numbered. More detail on the content of each of these required sections is in Sections 3.02 through 3.05 of this RFP.

    a. Transmittal Letter

    b. Experience and Capabilities.

    c. Work Plan

    d. Pricing. See Proposal Schedule.

    e. Exceptions to this RFP.

3.02 EXPERIENCE AND CAPABILITIES

TEAM EXPERIENCE:
Provide a complete client listing for all of Offeror's related projects. For each Major Subcontractor, provide a complete client listing for that subcontractor's projects that are substantially similar to the work that the subcontractor will be performing on this project. For each project, include the following information: client name; a contact person from the client with personal knowledge of your work for that client; the contact person's phone number and e-mail address; the start and end dates of the project; your firm's role (prime contractor, subcontractor, vendor) on the project; the total value of the project and your firm's contract value (if different); and a brief description of the project.

Indicate the number of years Offeror and each Major Subcontractor has been in business and the number of years Offeror and each Major Subcontractor has performed services specified by this RFP.

KEY PERSONNEL:
Include a list and resumes of Key Personnel who will be working on this project, regardless of whether they work for Offeror or a subcontractor. At a minimum, this list shall include:

Project Manager – This person will serve as the Offeror's overall Point of Contact for the project. Document the experience of this individual to demonstrate a minimum of three (3) projects and five (5) years successfully managing projects of similar size and content.

Installation Manager - This person will serve as the Offeror's overall installation manager for the project. Document the experience of this individual to demonstrate a minimum of three (3) projects successfully completing projects of similar size.

Technical Lead - This person will serve as the Offeror's overall technical lead for the design of project. Document the experience of this individual to demonstrate a minimum of three (3) projects successfully installing projects of similar size.

Two (2) Technicians - These persons will perform the installation of the project equipment including hub installations, cabinet installation, fiber splicing, and perform the OTDR testing. Document the experience of these individuals to demonstrate a minimum of three (3) projects successfully installing projects of similar size. These persons must be certified in fiber optic installations and networks.

Show where these personnel will be physically located during the time they are engaged in the work. Include through a resume or similar document the educational background and experience for each team member that demonstrates their expertise in the role assigned to them for this project (i.e.,

project management, design, installation, testing). Indicate the responsibilities each will have in this project and how long each has been with your company.

SUMMARY OF JUDGMENTS:
Provide a summary listing of judgments or pending lawsuits or actions against; adverse contract actions, including termination(s), suspension, imposition of penalties, or other actions relating to failure to perform or deficiencies in fulfilling contractual obligations against your firm and Major Subcontractors. If none, so state.

FINANCIAL CONDITION:
Provide a general description of the financial condition of Offeror and Major Subcontractors and identify any conditions (e.g. bankruptcy, pending litigation, planned office closures, impending merger) that may impede the Offeror's or any Major Subcontractors' ability to complete the project.

SUPPLEMENTAL INFORMATION:
Supplement the information called for in this Section as needed with additional description, and provide examples of relevant documentation from other, similar projects.

3.03 WORK PLAN

Offeror shall submit a proposal that includes an overall strategy, timeline and plan for the work proposed as well as expected results, potential risks, and strategies to mitigate those risks. The Work Plan should demonstrate Offeror's understanding of the project and convey to the reviewers how the Offeror will complete all elements of the project in a timely, cost-effective manner. The timeline shall show the duration and dependencies for all major tasks. All assumptions used in the schedule (such as HDOT review periods or other items dependent on HDOT) should be described explicitly.

Offeror shall describe its technical approach, including:

1. Techniques for sequence and relationships of major steps, and methods for managing the project.
2. Comprehensive equipment list including manufacturer information, model numbers and quantities
3. Ease of integration with Offeror's technology
4. Overall installation requirements as per Task 3
5. A discussion of the risks to successful completion of the project and the strategy for mitigating those risks

3.04 PRICING

Refer to Proposal Schedule.

3.05 EXCEPTIONS

Offeror shall list any exceptions taken to the terms, conditions, specifications, or other requirements listed herein. If the Offeror takes no exception, the Offeror shall state as such in its proposal. Offeror shall reference the RFP section where exception is taken, a description of the exception taken, and the proposed alternative, if any.

SECTION FOUR

EVALUATION CRITERIA

The evaluation of proposals received in response to the RFP will be conducted comprehensively, fairly and impartially. Structural, quantitative scoring techniques will be utilized to maximize the objectivity of the evaluation. The Evaluation Committee will evaluate each proposal in accordance with the criteria set forth below. The evaluation criteria and corresponding points are listed below. The award will be made to the responsive, responsible Offeror whose proposal is determined to be the most advantageous to the State of Hawaii based on the evaluation criteria listed in this section.

The total number of points used to score this contract is 100.

1. Experience and Capabilities (30)

    a. Team Experience
    b. Key Personnel
    c. Summary Judgments
    d. Financial Condition
    e. Supplemental Information

2. Work Plan (30)

3. Pricing (35). Points for costs will be allocated using the following formula (where "OC" represents the Offeror's Amount for Comparison of Bids, as shown in the Proposal Schedule, and "LC" represents the lowest Amount for Comparison of Bids of any of the Offerors):

    $(LC \div OC) \times 35$

4. Proposal and Documentation, including clarity, organization, completeness, and readability of the proposal (5)

SECTION FIVE

REQUEST FOR PROPOSAL PROCESS OVERVIEW

5.01 SCOPE

All services provided to the Hawaii Department of Transportation shall be in accordance with this RFP, including the special provisions in this section, and the Scope of Work specified herein.

5.02 RESPONSIBILITY OF OFFERORS

Offeror is advised that if awarded a contract under this solicitation, Offeror shall, upon award of the contract, furnish proof of compliance with the requirements of §103D-310(c), HRS:

1. Chapter 237, tax clearance;
2. Chapter 383, unemployment insurance;
3. Chapter 386, workers' compensation;
4. Chapter 392, temporary disability insurance;
5. Chapter 393, prepaid health care; and
6. Chapter 103D-310(c), Certificate of Good Standing (COGS) for entities doing business in the State.

Refer to the Award of Contract provision herein for instructions on furnishing the documents that are acceptable to the State as proof of compliance with the above-mentioned requirements.

5.03 OFFEROR QUALIFICATIONS

Offeror shall meet all of the qualifications required by this RFP. Failure to meet the qualifications as specified in Section 3.02, Experience and Capabilities, will likely have an adverse affect on Offeror's proposal evaluation.

5.04 TERM OF CONTRACT

Successful Offeror shall be required to enter into a formal written contract to commence work on this project.

See Proposal page P-1 for the completion time.

5.05 CONTACT PERSON

For the purposes of this contract, Mr. Benson Chow , State of Hawaii Department of Transportation Highways Division, Traffic Branch, 601

Kamokila Boulevard, Room 602 Kapolei, Hawaii, 96707, Telephone: (808) 692-7676, Facsimile: (808) 692-7690, or authorized representative, is designated the as the Contact Person for this contract.

5.06 OVERVIEW OF THE RFP PROCESS

a. The RFP is issued pursuant to Subchapter 6 of HAR Chapter 3-122, implementing HRS Section 103D-303.

b. The procurement process begins with the issuance of the RFP by HDOT and the formal response by HDOT to any written questions or inquiries regarding the RFP. Changes to the RFP will be made only by Addendum.

c. Proposals shall not be opened publicly, but shall be opened in the presence of two (2) or more procurement officials. The register of proposals and Offerors' proposals shall be open to public inspection after posting of the award.

d. All proposals and other material submitted by Offerors become the property of the State and may be returned only at the State's option.

e. The Procurement Officer, or an evaluation committee selected by the Procurement Officer, shall evaluate the proposals in accordance with the evaluation criteria in Section Four. The proposals shall be classified initially as acceptable, potentially acceptable, or unacceptable.

f. Proposals may be accepted on evaluation without discussion with the Offerors. However, if deemed necessary, prior to entering into discussions, a "priority list" of responsible Offerors submitting acceptable and potentially acceptable proposals shall be generated. The priority list may be limited to three responsible Offerors who submitted the highest-ranked proposals. The objective of these discussions is to clarify issues regarding the Offeror's proposal before the BAFO is tendered.

g. If there is a need for any substantial clarification or change in the RFP, the RFP shall be amended by an addendum to incorporate such clarification or change. Addenda to the RFP shall be distributed only to priority listed Offerors who submit acceptable or potentially acceptable proposals.

h. Following any discussions, priority listed Offerors will be invited to submit their BAFO, if required. The Procurement Officer or an evaluation committee reserves the right to have additional rounds of

discussions with the top three (3) Priority Listed Offerors prior to the submission of the BAFO. If Offeror does not submit a notice of withdrawal or a BAFO, the Offeror's immediate previous offer shall be construed as its BAFO.

i. After receipt and evaluation of the BAFOs in accordance with the evaluation criteria in Section Four, the Procurement Officer or an evaluation committee will make its recommendation. The Procurement Officer will award the contract to the Offeror whose proposal is determined to be the most advantageous to the State taking into consideration price and the evaluation factors set forth in Section Four.

j. The contents of any proposal shall not be disclosed during the review, evaluation, discussion, or negotiation process. Once award notice is posted, all proposals, successful and unsuccessful, will become available for public inspection. Those sections that the Offeror and the State agree are confidential and/or proprietary should be identified by the Offerors and shall be excluded from access.

k. The Procurement Officer or an evaluation committee reserves the right to determine what is in the best interest of the State for purposes of reviewing and evaluating proposals submitted in response to the RFP. The Procurement Officer or an evaluation committee will conduct a comprehensive, fair and impartial evaluation of proposals received in response to the RFP.

l. The RFP, any addenda issued, and the successful Offeror's proposal shall become a part of the contract. All proposals shall become the property of the State of Hawaii.

5.07 CONFIDENTIAL INFORMATION

If a person believes that any portion of a proposal, offer, specification, protest, or correspondence contains information that should be withheld as confidential, then the Procurement Officer named on the cover of this RFP should be so advised in writing and provided with justification to support a confidentiality claim. Price is not considered confidential and will not be withheld.

An Offeror shall request in writing nondisclosure of designated trade secrets or other proprietary data considered confidential. Such data shall accompany the proposal, be clearly marked, and shall be readily separable from the proposal in order to facilitate eventual public inspection of the non-confidential portion of the proposal.

Pursuant to HAR Section 3-122-58, the head of the purchasing agency or designee shall consult with the Attorney General and make a written determination in accordance with HRS Chapter 92F. If the request for confidentiality is denied, such information shall be disclosed as public information, unless the person appeals the denial to the Office of Information Practices in accordance with HRS Section 92F-42(12).

5.08 REQUIRED REVIEW

Offeror shall carefully review this solicitation for defects and questionable or objectionable matter. Comments concerning defects and questionable or objectionable matter must be made in writing and should be received by the State of Hawaii, Department of Transportation, Highway Division, prior to the deadline for written questions as stated in the RFP Schedule and Significant Dates. This will allow issuance of any necessary corrections and/or amendments to the RFP. It will help prevent the opening of a defective solicitation and exposure of Offeror's proposal upon which award could not be made. Any exceptions taken to the terms, conditions, specifications, or other requirements listed herein, must be listed in the *Exceptions* section of the Offeror's proposal, if the exception is unresolved by the Proposal Due date.

5.09 QUESTIONS PRIOR TO OPENING OF PROPOSALS

A prospective Offeror may submit a request, in writing, to the Contact person identified in Section 5.05 for clarification or interpretation of any aspect of this request for proposal. If it should appear to a prospective Offeror that the performance of the work under the request for proposal, or any matter relating thereto, is not sufficiently described or explained in this request for proposals, or that any conflict or inconsistency exists between different parts of this proposal is in conflict with Federal, State, or County law, statutes, ordinance, rules, or regulations, then the prospective Offeror shall submit a request for clarification. No responses will be made to oral inquiries. Written requests for clarification or interpretation of this request for proposal may be submitted by facsimile number (808) 692-7690 or sent to the following:

State of Hawaii
Department of Transportation
Highways Division/Traffic Branch
601 Kamokila Blvd., Rm. #602
Kapolei, HI 96707
Attn: Benson Chow

Written requests for clarification or interpretation shall be received by the date indicated in Section One, 1.04 RFP Schedule and Significant Dates, or as amended.

5.10 CANCELLATION OF RFP AND PROPOSAL REJECTION

The State reserves the right to cancel this RFP and to reject any and all proposals in whole or in part when it is determined to be in the best interest of the State, pursuant to HAR Section 3-122-96 through 3-122-97.

5.11 PROPOSAL AS PART OF THE CONTRACT

This RFP and all or part of the successful proposal will be incorporated into the contract.

5.12 CONTRACT MODIFICATIONS - UNANTICIPATED AMENDMENTS

During the course of this contract, the Contractor may be required to perform additional work that will be within the general scope of the initial contract. When additional work is required, the Contract Administrator will provide the Contractor a written description of the additional work and request the Contractor to submit a firm time schedule for accomplishing the additional work and a firm price for the additional work.

Changes to the contract may be modified only by written document (contract modification) signed by the State of Hawaii, Department of Transportation, Highways Division and Contractor personnel authorized to sign contracts on behalf of the Contractor.

The Contractor will not commence additional work until a signed contract modification has been issued.

5.13 PROTEST

A protest shall be submitted in writing within five (5) working days after the aggrieved person knows or should have known of the facts giving rise thereto; provided that a protest based upon the content of the solicitation shall be submitted in writing prior to the date set for receipt of offers. Further provided that a protest of an award or proposed award shall be submitted within five (5) working days after the posting of award of the contract.

The notice of award, if any, resulting from this solicitation shall be posted on the Procurement Reporting System, which is available on the SPO website: http://www.hawaii.gov/spo2/source/.

Any protest pursuant to §103D-701, HRS, and Section 3-126-3, HAR, shall be submitted in writing to the Contact Person listed in Section 5.05.

5.14 GOVERNING LAW: COST OF LITIGATION

The validity of this contract and any of its terms or provisions, as well as the rights and duties of the parties to this contract, shall be governed by the laws of the State of Hawaii. Any action of law or equity to enforce or interpret the provisions of this contract shall be brought in a state court or competent jurisdiction in Honolulu, Hawaii.

In case the State shall, without any fault on its part, be made a part to any litigation commenced by or against the Contractor in connection with this contract, the Contractor shall pay all costs and expenses incurred by or imposed on the State, including attorneys' fees.

5.15 SUBMISSION OF PROPOSAL

The submission of a proposal shall constitute an incontrovertible representation by the Offeror of compliance with every requirement of the RFP, and that the RFP documents are sufficient in scope and detail to indicate and convey reasonable understanding of all terms and conditions of performance of the work.

Before submitting a proposal, each Offeror must:

a. Examine the solicitation documents thoroughly. Solicitation documents include this RFP, any attachments, plans referred to herein, and any other relevant documents;

b. Become familiar with State, local, and federal laws, statutes, ordinances, rules, and regulations that may in any manner affect cost, progress, or performance of the work.

5.16 PROPOSAL PREPARATION

a. Proposal, page P-7. Proposals shall be submitted using Offeror's exact legal name as registered with the Department of Commerce and Consumer Affairs, if applicable; and to indicate exact legal name in the appropriate spaces on Proposal, page P-7. Failure to do so may delay proper execution of the contract.

The authorized signature Proposal, page P-7 shall be an original signature in ink. If unsigned or the affixed signature is a facsimile or a photocopy, the offer shall be automatically rejected unless

accompanied by other material, containing an original signature, indicating the Offeror's intent to be bound.

b. Offer Guaranty. See Section 102.08 – Proposal Guaranty.

c. Tax Liability. Work to be performed under this solicitation is a business activity taxable under HRS Chapter 237, and if applicable, taxable under HRS Chapter 238. Vendors are advised that they are liable for the Hawaii GET at the current 4% rate and the applicable use tax at the current 1/2% rate. If, however, an Offeror is a person exempt by the HRS from paying the GET and therefore not liable for the taxes on this solicitation, Offeror shall state its tax exempt status and cite the HRS chapter or section allowing the exemption.

d. Taxpayer Preference. For evaluation purposes, pursuant to HRS §103D-1008, the Offeror's tax-exempt price offer submitted in response to an IFB shall be increased by the applicable retail rate of general excise tax and the applicable use tax. Under no circumstance shall the dollar amount of the award include the aforementioned adjustment.

e. Original Proposal and Copies to be Submitted. Offeror shall submit one (1) original proposal marked "ORIGINAL", six (6) bound hard copies of the original marked "COPY", and one (1) electronic copy, in a format readable by Adobe Reader, on a CD. It is imperative to note that the Offeror submit only one original and the required number of copies. DO NOT SUBMIT MORE THAN ONE ORIGINAL.

   Offeror is encouraged to submit typewritten offers. If handwritten, it should be clearly printed. Offeror is cautioned that illegible offers, or any items within an offer, may be automatically rejected to avoid any errors in interpretation by the reviewers during the evaluation process.

f. Costs for developing the Proposal are solely the responsibility of the Offeror, whether or not any award results from this solicitation. The State of Hawaii will not reimburse such costs.

g. All proposals become the property of the State of Hawaii.

h. Copies of documents transmitted by Offerors via facsimile machines shall be limited to the modifications or withdrawal of an offer pursuant to HAR Sections 3-122-108 and 3-122-28, respectively.

5.17 SUBMISSION OF PROPOSAL

Offers shall be received at the Contracts Office, Department of Transportation, 869 Punchbowl Street, Honolulu, Hawaii 96813, no later

than the date and time stated in Section 1.04, as amended. Timely receipt of offers shall be evidenced by the date and time registered by the State of Hawaii, Department of Transportation, Contracts Office. Offers received after the deadline shall be returned unopened.

If the Offeror chooses to deliver its offer by United States Postal Service (USPS), please be aware that the USPS does not deliver directly to the State of Hawaii, Department of Transportation, Contracts Office, but to a central mailroom. This may cause a delay in receipt by the Department of Transportation, Contracts Office, and the offer may reach the Department of Transportation, Contracts Office, after the deadline, resulting in automatic rejection.

5.18 PRICING

Pricing shall include labor, materials, supplies, all applicable taxes, **including the GET, currently 4.5%,** and any other costs incurred to provide the specified services.

The pricing shall be the all-inclusive cost, including the GET, to the State and no other costs will be honored.

5.19 ECONOMY OF PRESENTATION

Proposals shall be prepared in a straightforward and concise manner, in a format that is reasonably consistent and appropriate for the purpose. Emphasis will be on completeness and clarity and content. If any additional information is required by the State regarding any aspects of the Offeror's proposal, it shall be provided within four (4) business days.

5.20 PROPOSAL OPENING

Proposals will be opened at the date, time, and place specified in Section One, or as amended. Proposals shall not be opened publicly, but shall be opened in the presence of two or more procurement officials. The register of proposals and Offeror's proposals shall be open to public inspection after posting of the award.

5.21 EVALUATION OF PROPOSALS

The Procurement Officer, or an evaluation committee of at least three (3) qualified state employees selected by the Procurement Officer shall evaluate proposals. The evaluation will be based solely on the evaluation criteria set out in Section Four of this RFP.

Proposals shall be classified initially as acceptable, potentially acceptable, or unacceptable. Discussion may be conducted with priority listed Offerors who submit proposals determined to be acceptable or potentially acceptable of being selected for award, but proposals may be accepted without such discussions. The objective of these discussions is to clarify issues regarding the Offeror's proposals before the best and final offer, if necessary.

If numerous acceptable and potentially acceptable proposals are submitted, the evaluation committee may rank the proposals and limit the priority list to three responsive, responsible Offerors who submitted the highest-ranked proposals.

5.22 DISCUSSION WITH PRIORITY LISTED OFFERORS

Priority listed Offerors may have a discussion with the evaluation committee to discuss their proposal to ensure thorough, mutual understanding. The State in its sole discretion shall schedule the time and location for these discussions, normally within the timeframe indicated in Section 1.04.

5.23 CANCELLATION OF RFP AND PROPOSAL REJECTION

The State reserves the right to cancel this RFP and to reject any and all proposals in whole or in part when it is determined to be in the best interest of the State, pursuant to HAR Section 3-122-96 through 3-122-97.

The State shall not be liable for any costs, expenses, loss of profits or damages whatsoever, incurred by the Offeror in the event this RFP is cancelled or a proposal is rejected.

5.24 ADDITIONAL TERMS AND CONDITIONS

The State reserves the right to add terms and conditions during the contract negotiations. These terms and conditions will be within the scope of the RFP and will not affect the proposal evaluation.

5.25 CONTRACT EXECUTION

Successful Offeror receiving award shall enter into a formal written contract.

No work is to be undertaken by the Contractor prior to the commencement date. The State of Hawaii is not liable for any work, contract, costs, expenses, loss of profits, or any damages whatsoever incurred by the Contractor prior to the official starting date.

5.26 PAYMENT

Payments shall be made to the awarded Contractor based on acceptance of deliverables that meet the expectations of the RFP. The receipt of deliverables shall be due based on the timeline submitted by the Contractor in the proposal, or as amended. The Engineer will make partial payments as follows:

(A) Pay 5 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the communications migration plan.

(B) Pay 5 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the testing of existing fiber.

(C) Pay 5 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the procurement of communications equipment, Halawa ring.

(D) Pay 5 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the procurement of communications equipment, Haiku ring.

(E) Pay 25 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the procurement of communications equipment, Tunnel ring.

(F) Pay 5 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the installation of communications equipment, functional test and system integration test, Halawa ring.

(G) Pay 5 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the installation of communications equipment, functional test and system integration test, Haiku ring.

(H) Pay 25 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the installation of communications equipment, functional test and system integration test, Tunnel ring.

(I) Pay 10 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the thirty (30) days operational acceptance test.

(J) Pay 2 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the training and system documentation.

(K) Pay 0.5 percent of amount bid for 697.1000 – Communication Systems Upgrade per month at the monthly acceptance of the warranty and support services.

(L) Pay 2 percent of amount bid for 697.1000 – Communication Systems Upgrade at acceptance of the spare parts inventory.

HRS Section 103-10, provides that the State shall have thirty (30) calendar days after receipt of invoice or satisfactory completion of contract to make payment. For this reason, the State will reject any offer submitted with a condition requiring payment within a shorter period. Further, the State will reject any offer submitted with a condition requiring interest payments greater than that allowed by HRS §103-10, as amended.

The State will not recognize any requirement established by the Contractor and communicated to the State after award of the contract, which requires payment within a shorter period or interest payment not in conformance with statute.

5.27 AWARD

Method of Award. The award will be made to the responsive, responsible Offeror whose proposal is determined to be the most advantageous to the State based on the evaluation criteria.

Responsibility of Lowest Responsive Offeror. Reference HRS Chapter 103D-310(c). If compliance documents have not been submitted to the State of Hawaii, Department of Transportation, Highways Division, prior to award, the lowest responsive Offeror shall produce documents to the procurement officer to demonstrate compliance with this section.

HRS Chapter 237 tax clearance requirement for award. Instructions are as follows:

Pursuant to HRS §103D-328, lowest responsive Offeror shall be required to submit a tax clearance certificate issued by the Hawaii State Department of Taxation (DOTAX) and the Internal Revenue Service (IRS). The certificate shall have an original green certified copy stamp and shall be valid for six (6) months from the most recent approval stamp date on the certificate. It must be valid on the date it is received by the State of Hawaii, Department of Transportation, Highways Division.

The tax clearance certificate shall be obtained on the State of Hawaii, DOTAX *TAX CLEARANCE APPLICATION* Form A-6 (Rev. 2003) which is available at the DOTAX and IRS offices in the State of Hawaii or the DOTAX website, and by mail or fax:

DOTAX Website (Forms & Information):
http://www.hawaii.gov/tax/a1_1alphalist.htm

DOTAX Forms by Fax/Mail: (808) 587-7572
1-800-222-7572

Completed tax clearance applications may be mailed, faxed, or submitted in person to the Department of Taxation, Taxpayer Services Branch, to the address listed on the application. Facsimile numbers are:

DOTAX:	(808) 587-1488
IRS:	(808) 539-1573

The application for the clearance is the responsibility of the Offeror, and must be submitted directly to the DOTAX or IRS and not to the State of Hawaii, Department of Transportation, Highways Division. However, the tax clearance certificate shall be submitted to the State of Hawaii, Department of Transportation, Highways Division.

HRS Chapters 383 (Unemployment Insurance), 386 (Workers' Compensation), 392 (Temporary Disability Insurance), and 393 (Prepaid Health Care) requirements for award.

Instructions are as follows:

Pursuant to HRS §103D-310(c), the lowest responsive Offeror shall be required to submit a certificate of compliance issued by the Hawaii State Department of Labor and Industrial Relations (DLIR). The certificate is valid for six (6) months from the date of issue and must be valid on the date it is received by the State of Hawaii, Department of Transportation, Highways Division. A photocopy of the certificate is acceptable to the State of Hawaii, Department of Transportation, Highways Division.

The certificate of compliance shall be obtained on the State of Hawaii, DLIR *APPLICATION FOR CERTIFICATE OF COMPLIANCE WITH HAR SECTION 3-122-112,* Form LIR#27 which is available at http://hawaii.gov/labor/formsall.shtml or at the neighbor island DLIR District Offices. The DLIR will return the form to the Offeror who in turn shall submit it to the State of Hawaii, Department of Transportation, Highways Division.

The application for the certificate is the responsibility of the Offeror, and must be submitted directly to the DLIR and not to the State of Hawaii, Department of Transportation, Highways Division. However, the certificate shall be submitted to the State of Hawaii, Department of Transportation, Highways Division.

Compliance with Section 103D-310(c), HRS, for an entity doing business in the State. The lowest responsive Offeror shall be required to submit a *CERTIFICATE OF GOOD STANDING* (Certificate) issued by the State of Hawaii Department of Commerce and Consumer Affairs Business Registration Division (BREG). The Certificate is valid for six months from date of issue and must be valid on the date it is received by the State of Hawaii, Department of Transportation, Highways Division. A photocopy of the certificate is acceptable to the State of Hawaii, Department of Transportation, Highways Division.

To obtain the Certificate, the Offeror must first be registered with the BREG. A sole proprietorship, however, is not required to register with the BREG, and therefore not required to submit the certificate.

On-line business registration and the Certificate are available at www.BusinessRegistrations.com. To register or to obtain the Certificate by phone, call (808) 586-2727 (M-F 7:45 to 4:30 HST). Offerors are advised that there are costs associated with registering and obtaining the Certificate.

Final Payment Requirements. Contractor is required to submit a tax clearance certificate for final payment on the contract. A tax clearance certificate, not over two months old, with an original green certified copy stamp, must accompany the invoice for final payment on the contract.

In addition to the tax clearance certificate, an original "Certification of Compliance for Final Payment" (SPO Form-22), attached, will be required for final payment. A copy of the Form is also available at www.spo.hawaii.gov. Select "Forms for Vendors/Contractors" menu.

Hawaii Compliance Express. Alternately, instead of separately applying for these paper certificates at the various state agencies, vendors may choose to use the Hawaii Compliance Express (HCE), which allows businesses to register online through a simple wizard interface at http://vendors.ehawaii.gov to acquire a "Certificate of Vendor Compliance." The HCE provides current compliance status as of the issuance date. The "Certificate of Vendor Compliance" indicating that vendor's status is compliant with the requirements of HRS Chapter 103D-310(c), shall be accepted for both contracting purposes and final payment.

Vendors that elect to use the new HCE services will be required to pay an annual fee of $15.00 to the Hawaii Information Consortium, LLC (HIC). Vendors choosing not to participate in the HCE program will be required to provide the paper certificates as instructed in the prior sections.

Timely Submission of all Certificates. The above certificates should be applied for and submitted to the State of Hawaii Department of Transportation, Highways Division, as soon as possible. If a valid certificate is not submitted on a timely basis for award of a contract, an offer otherwise responsive and responsible may not receive the award.

5.28 SUBCONTRACTING

No work or services shall be subcontracted or assigned without the prior written approval of the State. No subcontract shall under any circumstances relieve the Contractor of his/her obligations and liability under this contract with the State. All persons engaged in performing the work covered by the contract shall be considered employees of the Contractor.

5.29 CONTRACT INVALIDATION

If any provision of this contract is found to be invalid, such invalidation will not be construed to invalidate the entire contract.

5.30 NON-DISCRIMINATION

The Contractor shall comply with all applicable federal and state laws prohibiting discrimination against any person on the grounds of race, color, national origin, religion, creed, sex, age, sexual orientation, marital status, handicap, or arrest and court records in employment and any condition of employment with the Contractor or in participation in the benefits of any program or activity funded in whole or in part by the State.

5.31 CONFLICTS OF INTEREST

The Contractor represents that neither the Contractor, nor any employee or agent of the Contractor, presently has any interest, and promises that no such interest, direct or indirect, shall be acquired, that would or might conflict in any manner or degree with the Contractor's performance of this contract.

5.32 WAIVER

The failure of the State to insist upon the strict compliance with any term, provision or condition of this contract shall not constitute or be deemed to

constitute a waiver or relinquishment of the State's right to enforce the same in accordance with this contract.

5.33 SEVERABILITY

In the event that any provision of this contract is declared invalid or unenforceable by a court, such invalidity or unenforceability shall not affect the validity or enforceability of the remaining terms of this contract.

5.34 CAMPAIGN CONTRIBUTIONS BY STATE AND COUNTY CONTRACTORS

It has been determined that funds for this contract have been appropriated by a legislative body.

Therefore, Offeror, if awarded a contract in response to this solicitation, agrees to comply with HRS Section 11-205.5, which states that campaign contributions are prohibited from a State and county government Contractor during the term of the contract if the Contractor is paid with funds appropriated by a legislative body.

5.35 ADDITIONS, AMENDMENTS AND CLARIFICATIONS

Approvals. Any agreement arising out of this offer may be subject to the approval of the Department of the Attorney General as to form, and is subject to all further approvals, including the approval of the Governor, required by statute, regulation, rule, order, or other directive.

Cancellation of Solicitations and Rejection of Offers. The solicitation may be cancelled or the offers may be rejected, in whole or in part, when in the best interest of the purchasing agency, as provided in HAR §§3-122-95 through 3-122-97.

Confidentiality of Material. All material given to or made available to the Contractor by virtue of this contract, which is identified as proprietary or confidential information, will be safeguarded by the CONTRACTOR and shall not be disclosed to any individual or organization without the prior written approval of the STATE.

All information, data, or other material provided by the Offeror or the Contractor to the State shall be subject to the Uniform Information Practices Act, HRS chapter 92F. The Offeror shall designate in writing to the Procurement Officer those portions of its unpriced offer or any subsequent submittal that are trade secrets or other proprietary data that the Offeror desires to remain confidential, subject to HAR §3-122-58, in the case of an RFP, or HAR §3-122-30, in the case of an IFB. The Offeror

shall state in its written communication to the Procurement Officer, the reason(s) for designating the material as confidential, for example, trade secrets. The Offeror shall submit the material designated as confidential in such manner that the material is readily separable from the offer in order to facilitate inspection of the non-confidential portion of the offer.

Price is not confidential and will not be withheld. In addition, in the case of an IFB, makes and models, catalogue numbers of items offered, deliveries, and terms of payment shall be publicly available at the time of opening regardless of any designation to the contrary.

If a request is made to inspect the confidential material, the inspection shall be subject to written determination by the Department of the Attorney General in accordance with HRS chapter 92F. If it is determined that the material designated as confidential is subject to disclosure, the material shall be open to public inspection, unless the Offeror protests under HAR chapter 3-126. If the request to inspect the confidential material is denied, the decision may be appealed to the Office of Information Practices in accordance with HRS §92F-15.5.

Nondiscrimination. No person performing work under this Agreement, including any Subcontractor, employee, or agency of the Contractor, shall engage in any discrimination that is prohibited by any applicable federal, state, or county law.

Records Retention. The Contractor and any Subcontractors shall maintain the books and records that relate to the Agreement and any cost or pricing data for three (3) years from the date of final payment under the Agreement.

Correctional Industries. Goods and services available through Hawaii Correctional Industries (HCI) programs may be the same or similar to those awarded by competitive sealed bids or proposals. Agencies participating in State of Hawaii, Department of Transportation, Highways Division, requirements (price list) contracts may also procure directly from CI and shall not be considered in violation of the terms and conditions of any State of Hawaii, Department of Transportation, Highways Division, contract.

Competency of Offeror. Prospective Offeror must be capable of performing the work for which offers are being called. Either before or after the deadline for an offer, the purchasing agency may require Offeror to submit answers to questions regarding facilities, equipment, experience, personnel, financial status or any other factors relating to the ability of the Offeror to furnish satisfactorily the goods or services being solicited by the STATE. Any such inquiries shall be made and replied to in writing; replies

shall be submitted over the signatures of the person who signs the offer. Any Offeror who refuses to answer such inquiries will be considered non-responsive.

Preparation of Offer. An Offeror may submit only one offer in response to a solicitation. If an Offeror submits more than one offer in response to a solicitation, then all such offers shall be rejected. Similarly, an Offeror may submit only one offer for each line item (if any) of a solicitation. If an Offeror submits more than one offer per line item, then all offers for that line item shall be rejected.

Removal and/or Replacement of Key Personnel. Except as the STATE may otherwise agree, no changes shall be made to the project manager. If, for any reason beyond the reasonable control of the CONTRACTOR, it becomes necessary to replace the project manager, the CONTRACTOR shall provide as a replacement a person of equivalent or better qualifications and approved by STATE.

The CONTRACTOR shall provide a detailed explanation of the circumstances necessitating the proposed substitutions, complete resumes for the proposed substitutes, and any additional information requested by the STATE. Proposed substitutes should have comparable qualifications to those of the persons being replaced. The CONTRACTOR shall notify the STATE within 15 calendar days after the occurrence of any of these events and provide the information required.

If the STATE finds that the project manager has committed serious misconduct or has been charged with having committed a criminal action, or has reasonable cause to be dissatisfied with the performance of the project manager, then the CONTRACTOR shall, at the STATE's written request specifying the grounds therefore, provide as a replacement a person with qualifications and experience acceptable to the STATE.

The STATE will notify the CONTRACTOR within 15 calendar days after receipt of all required information of the decision on substitutions. The CONTRACTOR shall have no claim for additional costs arising out of or incidental to any removal and/or replacement of the project manager.

SECTION SIX

EXHIBITS

Exhibit A:	H-3 HUB COMMUNICATIONS TABLES Hub Locations and other pertinent information FO Termination Tables
Exhibit B:	NOT USED
Exhibit C:	H-3 AS-BUILT DRAWINGS FOR EXISTING OPCOM COMMMUNICATION SYSTEM
Exhibit D:	PROPOSED COMMMUNICATION SYSTEM DIAGRAMS
Exhibit E:	NOT USED

EXHIBIT A
H-3 HUB COMMUNICATIONS TABLES FOR EXISTING SYSTEM

Table 1: Hub Locations

Hub No.	Ring	Node No.	H-3 Hub Location	Rdwy, Tunnel, Bldg, Portal	MPT Shoulder Closing
1	Halawa	HW-3	Halawa OB Approach, station 342+60	Rdwy	Yes
2	Halawa	HW-2	Halawa IB Approach, station 475+60	Rdwy	Yes
3	Tunnel	TUN-10	Halawa OB Portal Bldg. Level 2	Portal	No
4	Tunnel	TUN-8	Cross Passage XP-1	Tunnel	No
5	Tunnel	TUN-7	Cross Passage XP-5	Tunnel	No
6	Tunnel	TUN-5	Cross Passage XP-9	Tunnel	No
7	Tunnel	TUN-4	Haiku OB Portal Bldg. Level 2	Portal	No
8	Haiku	HK-3	Haiku OB Approach, station 11+60	Rdwy	Yes
9	Tunnel	TUN-9	Halawa IB Portal Bldg. Level 2	Portal	No
10	Tunnel	TUN-2	Cross Passage XP-3	Tunnel	No
11	Tunnel	TUN-3	Cross Passage XP-7	Tunnel	No
12	Tunnel	TUN-6	Haiku IB Portal Bldg. Level 2	Portal	No
13	Haiku	HK-2	Haiku IB Approach, station 1110+30	Rdwy	Yes
14	Halawa	HW-1	TOC Equipment Room	Bldg	No
14	Haiku	HK-1	TOC Equipment Room	Bldg	No
14	Tunnel	TUN-1	TOC Equipment Room	Bldg	No
14	Tunnel	TUN-1	TOC Equipment Room	Bldg	No
14	Tunnel	TUN-1	TOC Equipment Room	Bldg	No
15	Tunnel	11	O & M Building	Bldg	No

Table 2: Existing OPCOM Equipment

Hub No.	H-3 Hub Location	OPCOM Multiplexer						
		ML 4436 Singlemode Card Dual Optics ML4401 PS	ML 4403 Multimode Card Dual Optics ML4401 PS	ML 4417 Card (Voice - 3 port)	ML 4405 Card (RS232 - 4 port)	ML4420-1 Card (RS485 - 4 Port)	ML4420-2 Card (RS485 - 4 Port)	ML 4414 Diagnostics
1	Halawa OB Approach, station 342+60	1	0	4	2	0	0	0
2	Halawa IB Approach, station 475+60	1	0	7	2	0	0	0
3	Halawa OB Portal Bldg. Level 2	0	1	1	1	0	1	0
4	Cross Passage XP-1	0	1	4	2	0	1	0
5	Cross Passage XP-5	0	1	4	1	0	1	0
6	Cross Passage XP-9	0	1	4	1	0	1	0
7	Haiku OB Portal Bldg. Level 2	0	1	3	2	1	1	0
8	Haiku OB Approach, station 11+60	1	0	4	1	0	0	0
9	Halawa IB Portal Bldg. Level 2	0	1	2	1	0	1	0
10	Cross Passage XP-3	0	1	4	1	0	1	0
11	Cross Passage XP-7	0	1	4	1	0	1	0
12	Haiku IB Portal Bldg. Level 2	0	1	3	2	1	1	0
13	Haiku IB Approach, station 1110+30	1	0	4	2	0	0	0
14	TOC Equipment Room	2	4	54 (ML4418)	20	1	1	3
15	O & M Building	0	1	1	1	0	1	0
	Totals =	8	16	103	40	3	11	3

Table 3: Existing ITS - Port Count		Type and number of ITS elements serviced							
Hub No.	H-3 Hub Location	PLC (RS232)	Traffic Controller (RS232)	Sign Controller (RS232)	CCTV PTZ (RS232)	Emergency Phone (FXS)	Fire Alarm Panel (RS485)	Card Key Panel (RS485)	Barrier Gate (RS232)
1	Halawa OB Approach, station 342+60	0	10	0	5	12	0	0	0
2	Halawa IB Approach, station 475+60	0	5	1	3	22	0	0	0
3	Halawa OB Portal Bldg. Level 2	1	1	1	1	3	1	0	0
4	Cross Passage XP-1	1	4	2	4	11	1	0	0
5	Cross Passage XP-5	1	2	2	4	11	1	0	0
6	Cross Passage XP-9	1	2	2	4	11	1	0	0
7	Haiku OB Portal Bldg. Level 2	1	4	3	1	8	1	1	0
8	Haiku OB Approach, station 11+60	0	4	0	2	12	0	0	0
9	Halawa IB Portal Bldg. Level 2	1	1	1	1	5	1	0	0
10	Cross Passage XP-3	1	2	2	4	11	1	0	0
11	Cross Passage XP-7	1	2	2	4	11	1	0	0
12	Haiku IB Portal Bldg. Level 2	1	3	2	5	9	1	1	0
13	Haiku IB Approach, station 1110+30	0	4	0	4	12	0	0	1
14	TOC Equipment Room	-	-	-	-	-	-	-	-
15	O & M Building	1	0	0	1	3	1	0	0
	Totals =	10	44	18	43	141	10	2	1

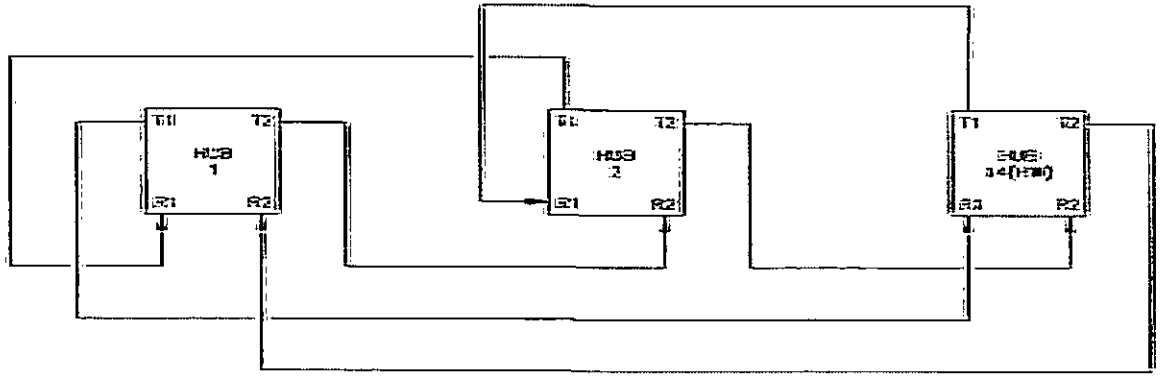
RS232 = 115
RS485 = 12
FXS = 141

Notes:	
1	**RS232 Interfaces**
1.1	Programmable Logic Controllers – Within the tunnels the PLC provides the interconnections necessary for the supervisory control and data acquisition (SCADA) system known as DYNAC. The PLC controllers utilize RS232 channels via the OPCOM ML4405 data cards.
1.2	170 Traffic Controllers – within the tunnel and roadways the traffic controllers utilize RS232 channels via the OPCOM ML4405 data cards installed at all the hubs except Hub 15. These RS232 channels are operate at 9600 baud rate, with even parity, 8 bits.
1.3	Sign Controllers – within the tunnel and adjacent roadways the sign controllers utilize RS232 channels via the OPCOM ML4405 data cards installed at Hubs 2, 3, 4, 5, 6, 7, 9, 10, 11, and 12. These RS232 channels are operate at 96 00 baud rate, with no parity.
1.4	CCTV Pan-tilt-zoom drivers – within the tunnel and roadways the cameras utilize RS232 channels via the OPCOM ML4405 data cards. The video signals are transmitted via a Fibertek Multiplexer / Catel system on separate fibers at all the hubs.
1.5	Barrier Gate at the Haiku side of the tunnel utilizes the RS232 channel via the OPCOM ML 4405 data card installed at Hub 13.
2	**RS485 Interfaces**
2.1	Card Key Readers– within the tunnel and the O&M Building the access control card key readers utilize RS485 channels via the OPCOM ML4420-1 data cards at Hub 7 and Hub 12.
2.2	Fire Alarm Control Panels – within the tunnel the fire alarm controllers utilize RS485 channels via the OPCOM ML4420-2 data cards at Hubs 3, 4, 5, 6, 7, 9, 10, 11, 12, and 15.
3	**Voice Channels**
3.1	Emergency Phones – within the tunnel and roadways the emergency phones utilize voice channels via the OPCOM ML 4417 voice cards at all the hubs. The OPCOM ML 4418 cards are the central voice cards utilize at the TOC.
4	**Fiber Optic Interface Cards and Diagnostic Cards**
4.1	Each hub location utilizes a fiber optic card to interface with the fiber optic cable plant. The OPCOM ML 4436 are utilized for the single mode links while the ML 4403 are for the multimode links. At the TOC an OPCOM ML 4414 card is used for diagnosing hub status and configuration of the system.

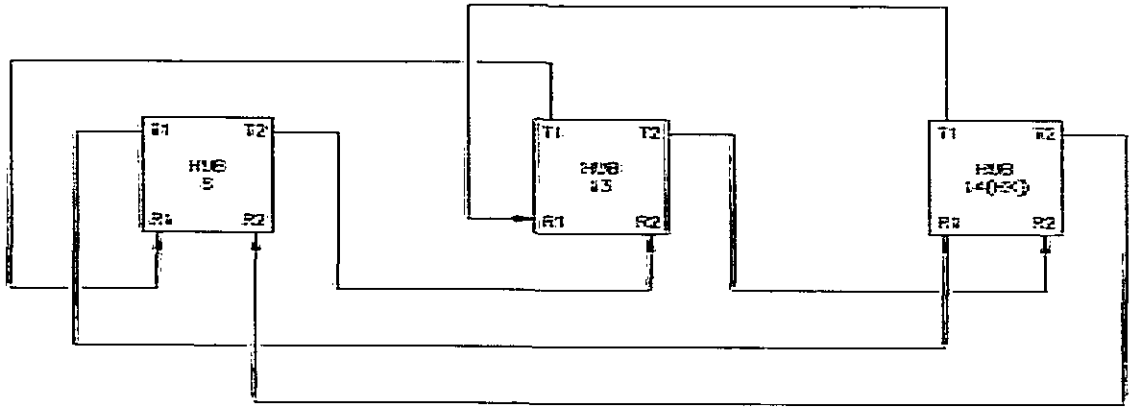
Table 4: Available Space at the Hubs

Hub No.	From Hub Location	Available 19" Rack Space	Available Power
1	Halawa OB Approach, station 342+60	24 inches	Yes
2	Halawa IB Approach, station 475+60	24 inches	Yes
3	Halawa OB Portal Bldg. Level 2	None	Yes
4	Cross Passage XP-1	24 inches	Yes
5	Cross Passage XP-5	24 inches	Yes
6	Cross Passage XP-9	24 inches	Yes
7	Haiku OB Portal Bldg. Level 2	None	Yes
8	Haiku OB Approach, station 11+60	24 inches	Yes
9	Halawa IB Portal Bldg. Level 2	None	Yes
10	Cross Passage XP-3	24 inches	Yes
11	Cross Passage XP-7	24 inches	Yes
12	Haiku IB Portal Bldg. Level 2	None	Yes
13	Haiku IB Approach, station 1110+30	24 inches	Yes
14	TOC Equipment Room	Yes	Yes
15	O & M Building	None	Yes

Halawa Ring



Haiku Ring



Tunnel Ring

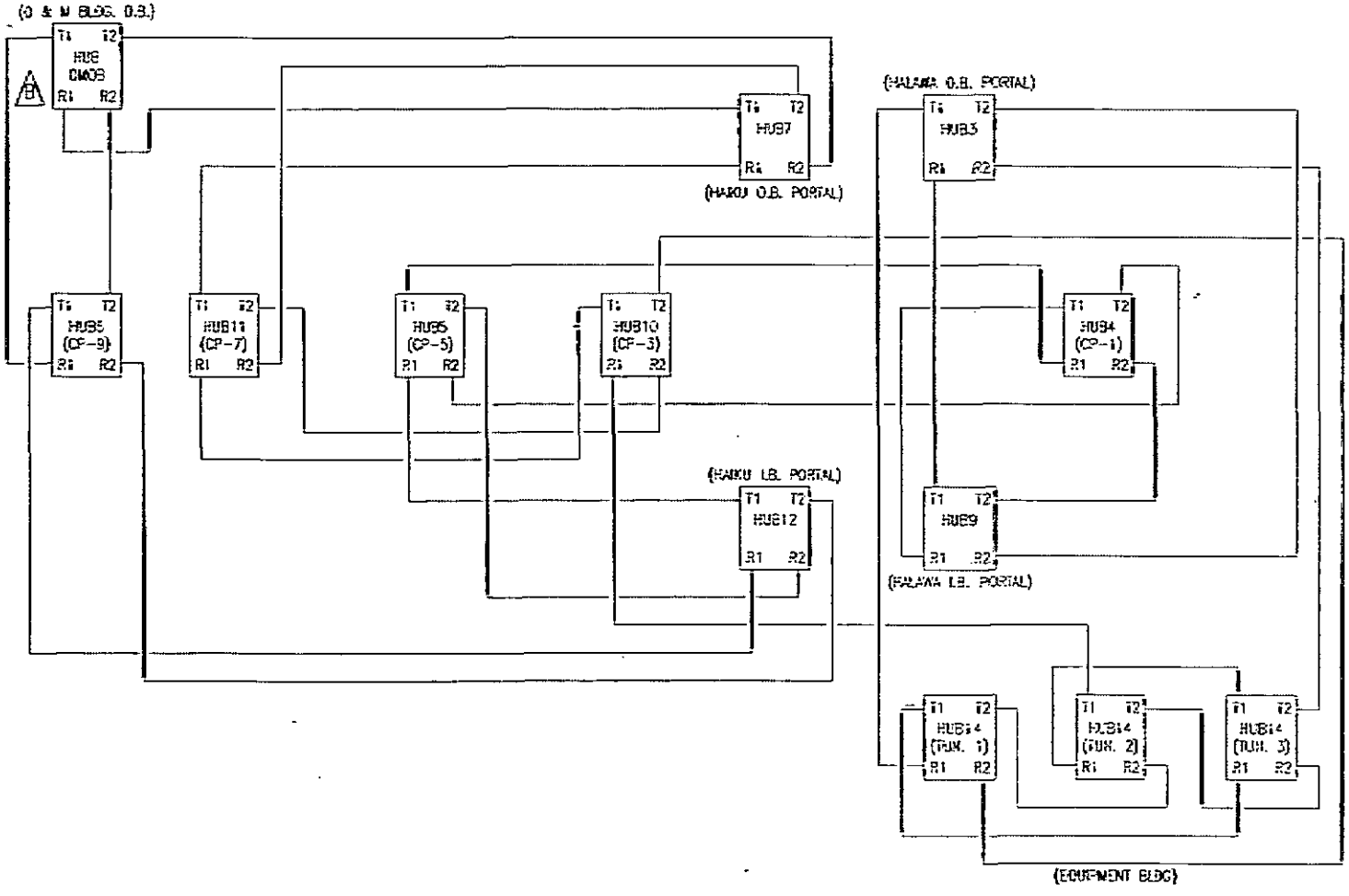

(O & M BLDG. O.B.)
T1 T2
HUB
OM09
R1 R2
T1 T2
HUB7
R1 R2
(HAIKU O.B. PORTAL)
(HALAWA O.B. PORTAL)
T1 T2
HUB3
R1 R2
T1 T2
HUB8
(CP-9)
R1 R2
T1 T2
HUB11
(CP-7)
R1 R2
T1 T2
HUB6
(CP-5)
R1 R2
T1 T2
HUB10
(CP-3)
R1 R2
T1 T2
HUB4
(CP-1)
R1 R2
(HAIKU I.B. PORTAL)
T1 T2
HUB12
R1 R2
T1 T2
HUB9
R1 R2
(HALAWA I.B. PORTAL)
T1 T2
HUB14
(FUN. 1)
R1 R2
T1 T2
HUB14
(FUN. 2)
R1 R2
T1 T2
HUB14
(FUN. 3)
R1 R2
(EQUIPMENT BLDG)

Table 5: Hub to Hub FO Backbone

From Hub to Hub	From Hub Location	To Hub Location	Type of FO Cable	FO cabling between hubs (ft.)
1 to 2	Halawa OB Approach, station 342+60	Halawa IB Approach, station 475+60	48 Fibers SMFO	13,300
2 to 14	Halawa IB Approach, station 475+60	TOC Equipment Room	48 Fibers SMFO	12,740
14 to 9	TOC Equipment Room	Halawa IB Portal Bldg. Level 2	24 Fibers MMFO	500
14 to 3	TOC Equipment Room	Halawa OB Portal Bldg. Level 2	24 Fibers MMFO	840
9 to 10	Halawa IB Portal Bldg. Level 2	Cross Passage XP-3	24 Fibers MMFO	1,440
3 to 10	Halawa OB Portal Bldg. Level 2	Cross Passage XP-3	24 Fibers MMFO	1,440
10 to 5 (1)	Cross Passage XP-3 (cable 1)	Cross Passage XP-5 (cable 1)	24 Fibers MMFO	1,440
10 to 5 (2)	Cross Passage XP-3 (cable 2)	Cross Passage XP-5 (cable 2)	12 Fibers MMFO	1,440
5 to 11 (1)	Cross Passage XP-5 (cable 1)	Cross Passage XP-7 (cable 1)	12 Fibers MMFO	1,440
5 to 11 (2)	Cross Passage XP-5 (cable 2)	Cross Passage XP-7 (cable 2)	12 Fibers MMFO	1,440
11 to 6 (1)	Cross Passage XP-7 (cable 1)	Cross Passage XP-9 (cable 1)	12 Fibers MMFO	1,440
11 to 6 (2)	Cross Passage XP-7 (cable 2)	Cross Passage XP-9 (cable 2)	12 Fibers MMFO	1,440
6 to 12	Cross Passage XP-9	Haiku IB Portal Bldg. Level 2	12 Fibers MMFO	1,440
6 to 7	Cross Passage XP-9	Haiku OB Portal Bldg. Level 2	12 Fibers MMFO	1,440
12 to 7	Haiku IB Portal Bldg. Level 2	Haiku OB Portal Bldg. Level 2	12 Fibers MMFO	700
14 to 13 (1)	TOC Equipment Room (cable 1)	Haiku IB Approach, station 1110+30 (cable 1)	48 Fibers SMFO	15,037
14 to 13 (2)	TOC Equipment Room (cable 2)	Haiku IB Approach, station 1110+30 (cable 2)	48 Fibers SMFO	15,037
13 to 8 (1)	Haiku IB Approach, station 1110+30 (cable 1)	Haiku OB Approach, station 11+60 (cable 1)	48 Fibers SMFO	13,000
13 to 8 (2)	Haiku IB Approach, station 1110+30 (cable 2)	Haiku OB Approach, station 11+60 (cable 2)	48 Fibers SMFO	13,000
			Total =	**98,554**

H-3 Hub to Hub Fiber Optic Terminations and Spare Fibers

Table 6: Hub Fibers & Spares Assigned

Section #	From Hub to Hub	Type of FO Cable	FO cabling between hubs (ft.)	Cable No.	Buffer Color	Fiber Color	Function	Functional Origin	Functional Destination	No. of unassigned spare fibers
1	2 to 1	48 Fibers SMFO	13,300	FO2-007-FO1	BLU	BLU	Halawa SEC Ring	OPCOM Node HW2	OPCOM Node HW3	43
					BLU	ORG	Halawa SEC Ring	OPCOM Node HW3	OPCOM Node HW1	
					ORG	BLU	Halawa SEC Ring (Spare)	FO Hub #2	FO Hub #1	
					ORG	ORG	Halawa SEC Ring (Spare)	FO Hub #1	FO Hub #14	
2	1 to 2	48 Fibers SMFO	13,300	FO1-001-FO2	BLU	BLU	Halawa PRI Ring	OPCOM Node HW2	OPCOM Node HW3	43
					BLU	ORG	Halawa PRI Ring	OPCOM Node HW3	OPCOM Node HW1	
					ORG	BLU	Halawa PRI Ring (Spare)	FO Hub #2	FO Hub #1	
					ORG	ORG	Halawa PRI Ring (Spare)	FO Hub #1	FO Hub #14	
3	14 to 2	48 Fibers SMFO	12,740	FO14-003-FO2	BLU	BLU	Halawa SEC Ring	OPCOM Node HW1	OPCOM Node HW2	43
					BLU	ORG	Halawa SEC Ring	OPCOM Node HW3	OPCOM Node HW1	
					ORG	BLU	Halawa SEC Ring (Spare)	FO Hub #2	FO Hub #14	
					ORG	ORG	Halawa SEC Ring (Spare)	FO Hub #1	FO Hub #14	
4	2 to 14	48 Fibers SMFO	12,740	FO2-002-FO14	BLU	BLU	Halawa PRI Ring	OPCOM Node HW1	OPCOM Node HW2	43
					BLU	ORG	Halawa PRI Ring	OPCOM Node HW3	OPCOM Node HW1	
					ORG	BLU	Halawa PRI Ring (Spare)	FO Hub #14	FO Hub #2	
					ORG	ORG	Halawa PRI Ring (Spare)	FO Hub #1	FO Hub #14	
5	3 to 14	24 Fibers MMFO	840	FO14-006-FO3	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 9	OPCOM Node 8	2
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 2	OPCOM Node 1	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 9	OPCOM Node 8	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 2	OPCOM Node 1	
					GRN	SLT	TUN DNS SEC Ring	OPCOM Node 10	OPCOM Node 9	
					GRN	WHT	TUN DNS SEC Ring	OPCOM Node 1	OPCOM Node 10	
					BRN	SLT	TUN DNS SEC Ring (Spare)	OPCOM Node 9	OPCOM Node 8	
					BRN	WHT	TUN DNS SEC Ring (Spare)	OPCOM Node 2	OPCOM Node 1	
6	4 to 3	24 Fibers MMFO	840	FO4-002-FO3	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 9	OPCOM Node 8	2
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 2	OPCOM Node 1	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 9	OPCOM Node 8	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 2	OPCOM Node 1	
					GRN	SLT	TUN DNS SEC Ring	OPCOM Node 9	OPCOM Node 10	
					GRN	WHT	TUN DNS SEC Ring	OPCOM Node 10	OPCOM Node 1	
					BRN	SLT	TUN DNS SEC Ring (Spare)	OPCOM Node 9	OPCOM Node 10	
					BRN	WHT	TUN DNS SEC Ring (Spare)	OPCOM Node 10	OPCOM Node 1	
7	10 to 4	24 Fibers MMFO	1,440	FO10-002-FO4	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 8	OPCOM Node 7	10
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 2	OPCOM Node 1	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 8	OPCOM Node 7	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 2	OPCOM Node 1	
8	4 to 10	24 Fibers MMFO	1,440	FO4-001-FO10	BLU	GRN	TUN DNS PRI Ring	OPCOM Node 7	OPCOM Node 8	8
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 1	OPCOM Node 2	
					ORG	GRN	TUN DNS PRI Ring (Spare)	OPCOM Node 7	OPCOM Node 8	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 1	OPCOM Node 2	
9	5 to 10	24 Fibers MMFO	1,440	FO5-002-FO10	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 8	OPCOM Node 7	10
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 3	OPCOM Node 2	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 8	OPCOM Node 7	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 3	OPCOM Node 2	
10	10 to 5	12 Fibers MMFO	1,440	FO10-001-FO5	BLU	GRN	TUN DNS PRI Ring	OPCOM Node 7	OPCOM Node 8	0
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 2	OPCOM Node 3	
					ORG	GRN	TUN DNS PRI Ring (Spare)	OPCOM Node 7	OPCOM Node 8	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 2	OPCOM Node 3	

H-3 Hub to Hub Fiber Optic Terminations and Spare Fibers

Table 6: Hub Fibers & Spares Assigned

Section #	From Hub to Hub	Type of FO Cable	FO cabling between hubs (ft.)	Cable No.	Buffer Color	Fiber Color	Function	Functional Origin	Functional Destination	No. of unassigned spare fibers
11	11 to 5	12 Fibers MMFO	1,440	FO11-002-FO5	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 7	OPCOM Node 6	2
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 3	OPCOM Node 2	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 7	OPCOM Node 6	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 3	OPCOM Node 2	
12	5 to 11	12 Fibers MMFO	1,440	FO5-001-FO11	BLU	GRN	TUN DNS PRI Ring	OPCOM Node 6	OPCOM Node 7	0
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 2	OPCOM Node 3	
					ORG	GRN	TUN DNS PRI Ring (Spare)	OPCOM Node 6	OPCOM Node 7	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 2	OPCOM Node 3	
13	6 to 11	12 Fibers MMFO	1,440	FO6-002-FO11	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 7	OPCOM Node 6	2
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 4	OPCOM Node 3	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 7	OPCOM Node 6	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 4	OPCOM Node 3	
14	11 to 6	12 Fibers MMFO	1,440	FO11-001-FO6	BLU	BRN	TUN DNS PRI Ring	OPCOM Node 6	OPCOM Node 7	4
					BLU	ORG	TUN DNS PRI Ring	OPCOM Node 3	OPCOM Node 4	
					ORG	GRN	TUN DNS PRI Ring (Spare)	OPCOM Node 6	OPCOM Node 7	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 3	OPCOM Node 4	
15	7 to 6	12 Fibers MMFO	1,440	FO7-001-FO6	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 7	OPCOM Node 6	2
					BLU	ORG	TUN DNS SEC Ring	OPCOM Node 4	OPCOM Node 3	
					BLU	GRN	TUN DNS SEC Ring	OPCOM Node 6	OPCOM Node 5	
					BLU	BRN	TUN DNS SEC Ring	OPCOM Node 5	OPCOM Node 4	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 7	OPCOM Node 6	
					ORG	ORG	TUN DNS SEC Ring (Spare)	OPCOM Node 4	OPCOM Node 3	
					ORG	GRN	TUN DNS SEC Ring (Spare)	OPCOM Node 6	OPCOM Node 5	
					ORG	BRN	TUN DNS SEC Ring (Spare)	OPCOM Node 5	OPCOM Node 4	
16	12 to 7	12 Fibers MMFO	700	FO12-001-FO7	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 7	OPCOM Node 6	4
					BLU	ORG	TUN DNS PRI Ring	OPCOM Node 4	OPCOM Node 5	
					BLU	GRN	TUN DNS SEC Ring	OPCOM Node 6	OPCOM Node 5	
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 3	OPCOM Node 4	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 7	OPCOM Node 6	
					ORG	ORG	TUN DNS PRI Ring (Spare)	OPCOM Node 4	OPCOM Node 5	
					ORG	GRN	TUN DNS SEC Ring (Spare)	OPCOM Node 6	OPCOM Node 5	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 3	OPCOM Node 4	
17	6 to 12	12 Fibers MMFO	1,440	FO6-001-FO12	BLU	BLU	TUN DNS PRI Ring	OPCOM Node 5	OPCOM Node 6	0
					BLU	ORG	TUN DNS PRI Ring	OPCOM Node 4	OPCOM Node 5	
					BLU	GRN	TUN DNS PRI Ring	OPCOM Node 6	OPCOM Node 7	
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 3	OPCOM Node 4	
					ORG	BLU	TUN DNS PRI Ring (Spare)	OPCOM Node 5	OPCOM Node 6	
					ORG	ORG	TUN DNS PRI Ring (Spare)	OPCOM Node 4	OPCOM Node 5	
					ORG	GRN	TUN DNS PRI Ring (Spare)	OPCOM Node 6	OPCOM Node 7	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 3	OPCOM Node 4	
18	9 to 4	24 Fibers MMFO	940	FO9-001-FO4	BLU	GRN	TUN DNS PRI Ring	OPCOM Node 8	OPCOM Node 9	4
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 1	OPCOM Node 2	
					ORG	GRN	TUN DNS PRI Ring (Spare)	OPCOM Node 8	OPCOM Node 9	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 1	OPCOM Node 2	
					GRN	SLT	TUN DNS PRI Ring	OPCOM Node 9	OPCOM Node 10	
					GRN	WHT	TUN DNS PRI Ring	OPCOM Node 10	OPCOM Node 1	
					BRN	SLT	TUN DNS PRI Ring (Spare)	OPCOM Node 9	OPCOM Node 10	
					BRN	WHT	TUN DNS PRI Ring (Spare)	OPCOM Node 10	OPCOM Node 1	

H-3 Hub to Hub Fiber Optic Terminations and Spare Fibers

Table 6: Hub Fibers & Spares Assigned

Section #	From Hub to Hub	Type of FO Cable	FO cabling between hubs (ft.)	Cable No.	Buffer Color	Fiber Color	Function	Functional Origin	Functional Destination	No. of unassigned spare fibers
19	14 to 9	24 Fibers MMFO	500	FO14-001-FO9	BLU	BLU	TUN DNS SEC Ring	OPCOM Node 9	OPCOM Node 8	4
					BLU	BRN	TUN DNS PRI Ring	OPCOM Node 1	OPCOM Node 2	
					ORG	BLU	TUN DNS SEC Ring (Spare)	OPCOM Node 9	OPCOM Node 8	
					ORG	BRN	TUN DNS PRI Ring (Spare)	OPCOM Node 1	OPCOM Node 2	
					GRN	SLT	TUN DNS SEC Ring	OPCOM Node 10	OPCOM Node 9	
					GRN	WHT	TUN DNS PRI Ring	OPCOM Node 10	OPCOM Node 1	
					BRN	SLT	TUN DNS SEC Ring (Spare)	OPCOM Node 10	OPCOM Node 9	
					BRN	WHT	TUN DNS PRI Ring (Spare)	OPCOM Node 10	OPCOM Node 1	
20	14 to 13	48 Fibers SMFO	15,037	FO14-001-FO1	BLU	BLU	Haiku PRI Ring	OPCOM Node HK1	OPCOM Node HK3	43
					BLU	ORG	Haiku PRI Ring	OPCOM Node HK3	OPCOM Node HK1	
					ORG	BLU	Haiku PRI Ring (Spare)	FO Hub #14	FO Hub #13	
					ORG	ORG	Haiku PRI Ring (Spare)	FO Hub #8	FO Hub #14	
21	13 to 14	48 Fibers SMFO	15,037	FO13-006-FO1	BLU	BLU	Haiku SEC Ring	OPCOM Node HK2	OPCOM Node HK1	43
					BLU	ORG	Haiku SEC Ring	OPCOM Node HK3	OPCOM Node HK1	
					ORG	BLU	Haiku SEC Ring (Spare)	FO Hub #13	FO Hub #14	
					ORG	ORG	Haiku SEC Ring (Spare)	FO Hub #8	FO Hub #14	
22	13 to 18	48 Fibers SMFO	13,000	FO13-001-FO8	BLU	BLU	Haiku PRI Ring	OPCOM Node HK2	OPCOM Node HK3	43
					BLU	ORG	Haiku PRI Ring	OPCOM Node HK3	OPCOM Node HK1	
					ORG	BLU	Haiku PRI Ring (Spare)	FO Hub #14	FO Hub #8	
					ORG	ORG	Haiku PRI Ring (Spare)	FO Hub #14	FO Hub #8	
23	8 to 13	48 Fibers SMFO	13,000	FO8-005-FO13	BLU	BLU	Haiku SEC Ring	OPCOM Node HK3	OPCOM Node HK2	43
					BLU	ORG	Haiku SEC Ring	OPCOM Node HK1	OPCOM Node HK3	
					ORG	BLU	Haiku SEC Ring (Spare)	OPCOM Node HK3	OPCOM Node HK2	
					ORG	ORG	Haiku SEC Ring (Spare)	OPCOM Node HK1	OPCOM Node HK3	
			661,454							

H-3 Hub to Hub Fiber Optic Terminations and Spare Fibers

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Table 6:

		Origin							Destination						
Section #	From Hub to Hub	Cable No.	Buffer Color	Fiber Color	Splice Box	Splice / Tray	Patch Box	Patch Box Col/Row	Cable No.	Buffer Color	Fiber Color	Splice Box	Splice / Tray	Patch Box	Patch Box Col/Row
1	2 to 1	FO2-204-OPCOMSW2	NA	NA	SBFO2-3	1/13	PBFO2-1	4/1	FO1-203-OPCOMHW3	NA	NA	SBFO1-3	1/1	PBFO1-1	2/1
		FO14-003-FO2	BLU	ORG	SBFO2-3	1/2	NA	NA	FO1-204-OPCOMHW3	NA	NA	SBFO1-3	1/2	PBFO1-1	2/2
		NA	NA	NA	SBFO2-3	2/13	PBFO2-1	4/3	NA	NA	NA	SBFO1-3	2/1	PBFO1-1	2/4
		FO14-003-FO2	ORG	ORG	SBFO2-3	2/2	NA	2/4	NA	NA	NA	SBFO1-3	2/2	PBFO1-1	2/5
2	1 to 2	FO1-201-OPCOMHW3	NA	NA	SBFO1-2	1/1	PBFO2-1	1/1	FO1-203-OPCOMHW3	NA	NA	SBFO1-3	1/1	PBFO1-1	2/1
		FO1-202-OPCOMHW3	BLU	ORG	SBFO1-2	1/2	NA	1/2	FO1-204-OPCOMHW3	NA	NA	SBFO1-3	1/2	PBFO1-1	2/2
		NA	NA	NA	SBFO1-2	2/1	PBFO1-1	1/4	NA	NA	NA	SBFO1-3	2/1	PBFO1-1	2/4
		NA	NA	NA	SBFO1-2	2/2	PBFO1-1	1/5	NA	NA	NA	SBFO1-3	2/2	PBFO1-1	2/5
3	14 to 2	FO14-203-OPCOMHW1	NA	NA	SBFO14-3	1/1	PBFO14-2	2/1	FO2-203-OPCOMHW2	NA	NA	SBFO2-3	1/1	PBFO2-1	2/1
		FO14-204-OPCOMHW1	NA	NA	SBFO14-3	1/2	PBFO14-2	2/2	FO2-007-FO1	BLU	ORG	SBFO2-3	1/2	NA	NA
		NA	NA	NA	SBFO14-3	2/1	PBFO14-2	2/4	NA	NA	NA	SBFO2-3	2/1	PBFO2-1	2/3
		NA	NA	NA	SBFO14-3	2/2	PBFO14-2	2/5	FO2-007-FO1	ORG	ORG	SBFO2-3	2/2	NA	NA
4	2 to 14	FO2-202-OPCOMHW2	NA	NA	SBFO2-2	1/13	PBFO2-1	1/1	FO14-201-OPCOMHW1	NA	NA	SBFO14-2	1/1	PBFO14-2	1/1
		FO14-003-FO2	NA	NA	SBFO2-2	1/2	NA	NA	FO1-201-OPCOMHW1	NA	NA	SBFO14-2	1/2	PBFO14-2	1/2
		NA	NA	NA	SBFO2-2	2/13	PBFO2-1	1/3	NA	NA	NA	SBFO14-2	2/1	PBFO14-2	1/4
		FO1-001-FO2	ORG	ORG	SBFO2-2	2/2	NA	NA	NA	NA	NA	SBFO14-2	2/2	PBFO14-2	1/5
5	3 to 14	FO4-002-FO3	BLU	BLU	SBFO3-1	1/1	NA	NA	FO14-005-FO9	BLU	BLU	SBFO14-1	1/1	NA	NA
		FO4-002-FO3	BLU	ORG	SBFO3-1	1/2	NA	NA	FO14-115-OPCOM1	NA	NA	SBFO14-1	1/13	PBFO14-1	4/1
		FO4-002-FO3	ORG	BLU	SBFO3-1	1/7	NA	NA	FO14-005-FO9	ORG	BLU	SBFO14-1	1/7	NA	NA
		FO4-002-FO3	ORG	ORG	SBFO3-1	1/8	NA	NA	NA	NA	NA	SBFO14-1	1/18	PBFO14-1	4/6
		FO3-103-OPCOM10	NA	NA	SBFO3-1	2/13	PBFO3-1	2/3	FO14-005-FO9	GRN	SLT	SBFO14-1	2/5	NA	NA
		FO3-104-OPCOM10	NA	NA	SBFO3-1	2/14	PBFO3-1	2/4	FO14-128-OPCOM1	NA	NA	SBFO14-1	2/17	PBFO14-1	6/3
		NA	NA	NA	SBFO3-1	2/15	PBFO3-1	2/3	FO14-005-FO9	BRN	SLT	SBFO14-1	2/11	NA	NA
		NA	NA	NA	SBFO3-1	2/16	PBFO3-1	2/4	NA	NA	NA	SBFO14-1	2/22	PBFO14-1	3/6
6	4 to 3	FO4-104-OPCOM8	NA	NA	SBFO4-1	2/13	PBFO4-1	2/1	FO14-006-FO3	BLU	BLU	SBFO3-1	1/1	NA	NA
		FO10-002-FO4	BLU	ORG	SBFO4-1	3/2	NA	NA	FO14-006-FO3	BLU	ORG	SBFO3-1	1/2	NA	4/1
		NA	NA	NA	SBFO4-1	3/14	PBFO4-1	2/2	FO14-006-FO3	ORG	BLU	SBFO3-1	1/7	NA	NA
		FO10-002-FO4	ORG	ORG	SBFO4-1	3/8	NA	NA	FO14-006-FO3	ORG	ORG	SBFO3-1	1/8	NA	4/6
		FO9-101-FO4	GR	SLT	SBFO4-1	4/15	NA	NA	FO3-101-OPCOM10	NA	NA	SBFO3-1	2/5	PBFO3-1	1/2
		FO9-101-FO4	GR	WHT	SBFO4-1	4/16	NA	NA	FO3-101-OPCOM10	NA	NA	SBFO3-1	2/6	PBFO3-1	1/3
		FO9-101-FO4	BR	SLT	SBFO4-1	4/19	NA	NA	NA	NA	NA	SBFO3-1	2/11	PBFO3-1	1/4
		FO9-101-FO4	BR	WHT	SBFO4-1	4/20	NA	NA	NA	NA	NA	SBFO3-1	2/12	PBFO3-1	1/5
7	10 to 4	FO5-002-FO10	BLU	BLU	SBFO10-1	3/1	NA	NA	FO4-103-OPCOM8	NA	NA	SBFO4-1	3/1	SBFO4-1	2/5
		FO10-106-OPCOM2	NA	NA	SBFO10-1	3/13	PBFO10-1	1/4	FO4-002-FO3	BLU	ORG	SBFO4-1	3/2	NA	NA
		FO5-002-FO10	ORG	BLU	SBFO10-1	3/7	NA	NA	NA	NA	NA	SBFO4-1	3/7	SBFO4-1	2/6
		NA	NA	NA	SBFO10-1	3/8	PBFO10-1	1/5	FO4-002-FO3	ORG	ORG	SBFO4-1	3/8	NA	NA
8	4 to 10	FO4-102-OPCOM8	NA	NA	SBFO4-1	1/13	PBFO4-1	1/5	FO10-001-FO5	BLU	GRN	SBFO10-1	1/3	NA	NA
		FO9-001-FO4	BLU	BRN	SBFO4-1	1/4	NA	NA	FO10-101-OPCOM2	NA	NA	SBFO10-1	1/4	PBF10-1	1/1
		NA	NA	NA	SBFO4-1	1/14	PBFO4-1	1/6	FO10-001-FO5	ORG	GRN	SBFO10-1	1/9	NA	NA
		FO9-001-FO4	ORG	BRN	SBFO4-1	1/10	NA	NA	NA	NA	NA	SBFO10-1	1/10	PBF10-1	1/2
9	5 to 10	FO5-104-OPCOM7	NA	NA	SBFO5-1	2/13	PBFO5-1	2/1	FO10-002-FO4	BLU	BLU	SBFO10-1	3/1	NA	NA
		FO11-002-FO5	BLU	ORG	SBFO5-1	2/2	NA	NA	FO10-105-OPCOM2	NA	NA	SBFO10-1	3/2	PBF10-1	2/4
		NA	NA	NA	SBFO5-1	2/14	PBFO5-1	2/2	FO10-002-FO4	BLU	BLU	SBFO10-1	3/7	NA	NA
		FO11-002-FO5	ORG	ORG	SBFO5-1	2/8	NA	NA	NA	NA	NA	SBFO10-1	3/8	PBF10-1	2/5
10	10 to 5	FO4-001-FO10	BLU	GRN	SBFO10-1	1/3	NA	NA	FO5-101-OPCOM7	NA	NA	SBFO5-1	1/3	PBFO5-1	1/1
		FO10-104-OPCOM2	NA	NA	SBFO10-1	1/13	PBF10-1	2/1	FO5-001-FO11	BLU	BRN	SBFO5-1	1/4	NA	NA
		FO4-001-FO10	ORG	GRN	SBFO10-1	1/9	NA	NA	NA	NA	NA	SBFO5-1	1/9	PBFO5-1	1/2
		NA	NA	NA	SBFO10-1	1/14	PBF10-1	2/2	FO5-001-FO11	ORG	BRN	SBFO5-1	1/10	NA	NA

H-3 Hub to Hub Fiber Optic Terminations and Spare Fibers

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Table 6:		Origin							Destination						
Section #	From Hub to Hub	Cable No.	Buffer Color	Fiber Color	Splice Box	Splice / Tray	Patch Box	Patch Box Col/Row	Cable No.	Buffer Color	Fiber Color	Splice Box	Splice / Tray	Patch Box	Patch Box Col/Row
11	11 to 5	FO6-002-FO11	BLU	BLU	SBFO11-1	2/1	NA	NA	FO5-103-OPCOM7	NA	NA	SBFO05-1	2/1	PBFO11-1	2/5
		FO11-106-OPCOM3	NA	NA	SBFO11-1	2/13	PBFO11-1	1/5	FO5-002-FO10	BLU	ORG	SBFO05-1	2/2	NA	NA
		FO6-002-FO11	ORG	BLU	SBFO11-1	2/7	NA	NA	NA	NA	NA	SBFO05-1	2/7	PBFO5-1	2/6
		NA	NA	NA	SBFO11-1	2/14	PBFO11-1	1/4	FO5-002-FO10	ORG	ORG	SBFO05-1	2/8	NA	NA
12	5 to 11	FO5-102-OPCOM7	NA	NA	SBFO05-1	1/13	PBFO5-1	1/5	FO11-001-FO6	BLU	GRN	SBFO11-1	1/3	NA	NA
		FO10-001-FO5	BLU	BRN	SBFO05-1	1/4	NA	NA	FO11-103-OPCOM3	NA	NA	SBFO11-1	1/4	PBFO11-1	1/3
		NA	NA	NA	SBFO05-1	1/14	PBFO5-1	1/6	FO11-001-FO6	ORG	GRN	SBFO11-1	1/9	NA	NA
		FO10-001-FO5	ORG	BRN	SBFO05-1	1/10	NA	NA	NA	NA	NA	SBFO11-1	1/10	PBFO11-1	1/6
13	6 to 11	FO7-001-FO6	BLU	BLU	SBFO6-1	2/1	NA	NA	FO11-002-FO5	BLU	BLU	SBFO11-1	2/1	NA	NA
		FO7-001-FO6	BLU	ORG	SBFO6-1	2/2	NA	NA	FO11-105-OPCOM3	NA	NA	SBFO11-1	2/2	PBFO11-1	1/1
		FO7-001-FO6	ORG	BLU	SBFO6-1	2/7	NA	NA	FO11-002-FO5	ORG	BLU	SBFO11-1	2/7	NA	NA
		FO7-001-FO6	ORG	ORG	SBFO6-1	2/8	NA	NA	NA	NA	NA	SBFO11-1	2/8	PBFO11-1	1/2
14	11 to 6	FO5-001-FO11	BLU	GRN	SBFO11-1	1/3	NA	NA	FO6-001-FO12	BLU	GRN	SBFO6-1	1/3	NA	NA
		FO11-104-OPCOM3	NA	NA	SBFO11-1	1/16	PBFO11-1	2/1	FO6-001-FO12	BLU	BRN	SBFO6-1	1/4	NA	NA
		FO5-001-FO11	ORG	GRN	SBFO11-1	1/9	NA	NA	FO6-001-FO12	ORG	GRN	SBFO6-1	1/9	NA	NA
		NA	NA	NA	SBFO11-1	1/10	PBFO11-1	2/2	FO6-001-FO12	ORG	BRN	SBFO6-1	1/10	NA	NA
15	7 to 6	FO12-001-FO7	BLU	BLU	SBFO7-1	1/1	NA	NA	FO6-002-FO11	BLU	BLU	SBFO6-1	2/1	NA	NA
		FO7-103-OPCOM4	NA	NA	SBFO7-1	1/13	PBFO7-1	2/1	FO6-002-FO11	BLU	ORG	SBFO6-1	2/2	NA	NA
		FO12-001-FO7	BLU	GRN	SBFO7-1	1/3	NA	NA	FO6-105-OPCOM5	NA	NA	SBFO6-1	2/3	PBFO6-1	2/1
		FO7-104-OPCOM4	NA	NA	SBFO7-1	1/14	PBFO7-1	2/2	FO6-106-OPCOM5	NA	NA	SBFO6-1	2/4	PBFO6-1	2/2
		FO12-001-FO7	ORG	BLU	SBFO7-1	1/7	NA	NA	FO6-002-FO11	ORG	BLU	SBFO6-1	2/7	NA	NA
		NA	NA	NA	SBFO7-1	1/17	PBFO7-1	2/3	FO6-002-FO11	ORG	ORG	SBFO6-1	2/8	NA	NA
		FO12-001-FO7	ORG	GRN	SBFO7-1	1/9	NA	NA	FO6-002-FO11	NA	NA	SBFO6-1	2/9	PBFO6-1	1/3
		NA	NA	NA	SBFO7-1	1/18	PBFO7-1	2/4	FO6-002-FO11	NA	NA	SBFO6-1	2/10	PBFO6-1	1/4
16	12 to 7	FO12-103-OPCOM6	NA	NA	SBFO12-1	1/13	PBFO12-1	2/1	FO7-001-FO6	BLU	BLU	SBFO7-1	1/1	NA	NA
		FO6-001-FO12	BLU	ORG	SBFO12-1	1/2	NA	NA	FO7-101-OPCOM4	NA	NA	SBFO7-1	1/2	PBFO7-1	1/1
		FO12-104-OPCOM6	NA	NA	SBFO12-1	1/14	PBFO12-1	2/2	FO7-001-FO6	BLU	GRN	SBFO7-1	1/3	NA	NA
		FO6-001-FO12	BLU	BRN	SBFO12-1	1/4	NA	NA	FO7-102-OPCOM4	NA	NA	SBFO7-1	1/4	PBFO7-1	1/2
		NA	NA	NA	SBFO12-1	1/17	PBFO12-1	2/3	FO7-001-FO6	ORG	BLU	SBFO7-1	1/7	NA	NA
		FO6-001-FO12	ORG	ORG	SBFO12-1	2/2	NA	NA	NA	NA	NA	SBFO7-1	1/8	PBFO7-1	1/3
		NA	NA	NA	SBFO12-1	1/18	PBFO12-1	2/4	FO7-001-FO6	ORG	GRN	SBFO7-1	1/9	NA	NA
		FO6-001-FO12	ORG	BRN	SBFO12-1	1/10	NA	NA	NA	NA	NA	SBFO7-1	1/10	PBFO7-1	1/4
17	6 to 12	FO6-101-OPCOM5	NA	NA	SBFO6-1	1/13	PBFO6-1	1/1	FO12-101-OPCOM6	NA	NA	SBFO12-1	1/1	PBFO12-1	1/1
		FO6-102-OPCOM5	NA	NA	SBFO6-1	1/14	PBFO6-1	1/2	FO12-001-FO7	BLU	ORG	SBFO12-1	1/2	NA	NA
		FO11-001-FO6	BLU	GRN	SBFO6-1	1/3	NA	NA	FO12-101-OPCOM6	NA	NA	SBFO12-1	1/3	PBFO12-1	1/2
		FO11-001-FO6	BLU	BRN	SBFO6-1	1/4	NA	NA	FO12-001-FO7	BLU	BRN	SBFO12-1	1/4	NA	NA
		NA	NA	NA	SBFO6-1	1/15	PBFO6-1	1/3	NA	NA	NA	SBFO12-1	1/7	PBFO12-1	1/3
		NA	NA	NA	SBFO6-1	1/16	PBFO6-1	1/4	FO12-001-FO7	ORG	ORG	SBFO12-1	1/8	NA	NA
		FO11-001-FO6	ORG	GRN	SBFO6-1	1/9	NA	NA	NA	NA	NA	SBFO12-1	1/9	PBFO12-1	1/4
		FO11-001-FO6	ORG	BRN	SBFO6-1	1/10	NA	NA	FO12-001-FO7	ORG	BRN	SBFO12-1	1/10	NA	NA
18	9 to 4	FO9-103-OPCOM9	NA	NA	SBFO9-1	1/13	PBFO9-1	2/1	FO4-101-OPCOM8	NA	NA	SBFO4-1	1/3	PBFO4-1	1/1
		FO14-005-FO9	BLU	BRN	SBFO9-1	1/4	NA	NA	FO4-001-FO10	BLU	BRN	SBFO4-1	1/4	NA	NA
		NA	NA	NA	SBFO9-1	2/13	PBFO9-1	2/2	NA	NA	NA	SBFO4-1	1/9	PBFO4-1	1/2
		FO14-005-FO9	ORG	BRN	SBFO9-1	2/4	NA	NA	FO4-001-FO10	ORG	BRN	SBFO4-1	1/10	NA	NA
		FO9-104-OPCOM9	NA	NA	SBFO9-1	2/16	PBFO9-1	2/3	FO4-002-FO3	GRN	SLT	SBFO4-1	2/5	NA	NA
		FO14-005-FO9	GRN	WHT	SBFO9-1	1/6	NA	NA	FO4-002-FO3	GRN	WHT	SBFO4-1	2/6	NA	NA
		NA	NA	NA	SBFO9-1	2/19	PBFO9-1	2/4	FO4-002-FO3	BRN	SLT	SBFO4-1	2/11	NA	NA
		FO14-005-FO9	BRN	WHT	SBFO9-1	2/20	NA	NA	FO4-002-FO3	BRN	WHT	SBFO4-1	2/12	NA	NA

H-3 Hub to Hub Fiber Optic Terminations and Spare Fibers

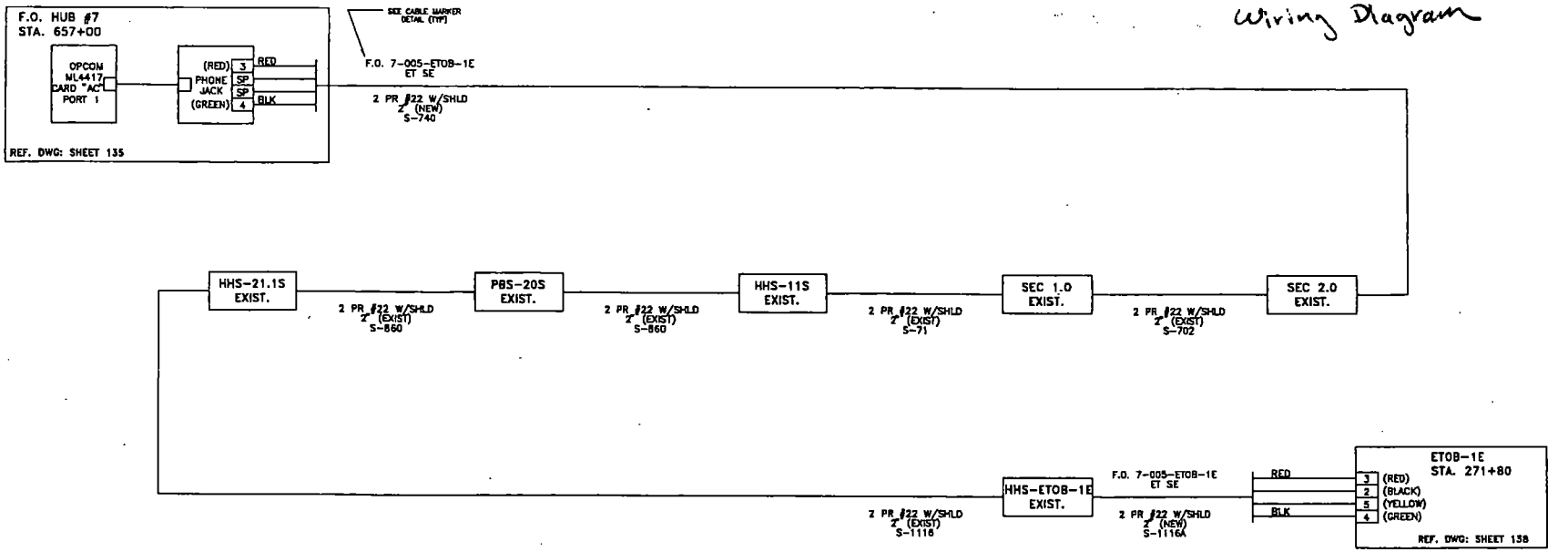
Table 6:		Origin							Destination						
Section #	From Hub to Hub	Cable No.	Buffer Color	Fiber Color	Splice Box	Splice / Tray	Patch Box	Patch Box Col/Row	Cable No.	Buffer Color	Fiber Color	Splice Box	Splice / Tray	Patch Box	Patch Box Col/Row
19	14 to 9	FO14-006-FO3	BLU	BLU	SBFO14-1	1/1	NA	NA	FO9-101-OPCOM9	NA	NA	SBFO9-1	1/1	PBFO9-1	1/1
		FO14-103-OPCOM1	NA	NA	SBFO14-1	1/4	PBFO14-1	1/3	FO9-001-FO4	BLU	BRN	SBFO9-1	1/4	NA	NA
		FO14-006-FO3	ORG	BLU	SBFO14-1	1/7	NA	NA	NA	NA	NA	SBFO9-1	1/7	PBFO9-1	1/2
		NA	NA	NA	SBFO14-1	1/10	PBFO14-1	2/2	FO9-001-FO4	ORG	BRN	SBFO9-1	1/10	NA	NA
		FO14-006-FO3	GRN	SLT	SBFO14-1	2/5	NA	NA	FO9-101-OPCOM9	NA	NA	SBFO9-1	2/5	PBFO9-1	1/3
		FO14-112-OPCOM1	NA	NA	SBFO14-1	2/6	PBFO14-1	3/1	FO9-001-FO4	GRN	WHT	SBFO9-1	2/6	NA	NA
		FO14-006-FO3	BRN	SLT	SBFO14-1	2/11	NA	NA	NA	NA	NA	SBFO9-1	2/11	PBFO9-1	1/4
		NA	NA	NA	SBFO14-1	2/12	PBFO14-1	3/4	FO9-001-FO4	BRN	WHT	SBFO9-1	2/12	NA	NA
20	14 to 13	FO14-201-OPCOMHK1	NA	NA	SBFO14-4	1/1	PBFO14-2	3/1	FO13-001-FO8	BLU	BLU	SBFO13-2	1/1	PBFO13-1	1/1
		FO14-202-OPCOMHK1	NA	NA	SBFO14-4	1/2	PBFO14-2	3/2	FO13-001-FO8	BLU	ORG	SBFO13-2	1/2	NA	NA
		NA	NA	NA	SBFO14-4	2/1	PBFO14-2	3/4	FO13-001-FO8	ORG	BLU	SBFO13-2	2/1	PBFO13-1	1/3
		NA	NA	NA	SBFO14-4	2/2	PBFO14-2	3/5	FO13-001-FO8	ORG	ORG	SBFO13-2	2/2	NA	NA
21	13 to 14	FO8-205-OPCOMHK2	NA	NA	SBFO13-3	1/13	PBFO13-1	3/1	FO14-203-OPCOMHK1	NA	NA	SBFO14-5	1/1	PBFO14-2	4/1
		FO8-005-FO13	BLU	ORG	SBFO13-3	1/2	NA	NA	FO14-204-OPCOMHK1	NA	NA	SBFO14-5	1/2	PBFO14-2	4/2
		NA	NA	NA	SBFO13-3	2/13	PBFO13-1	3/4	NA	NA	NA	SBFO14-5	2/1	PBFO14-2	4/4
		FO8-005-FO13	ORG	ORG	SBFO13-3	2/2	NA	NA	NA	NA	NA	SBFO14-5	2/2	PBFO14-2	4/5
22	13 to 18	FO13-202-OPCOMHK2	BLU	BLU	SBFO13-2	1/13	PBFO13-1	2/1	FO8-201-OPCOMHK3	NA	NA	SBFO8-1	1/1	PBFO8-1	1/1
		FO14-001-FO13	BLU	ORG	SBFO13-2	1/2	NA	NA	FO8-201-OPCOMHK3	NA	NA	SBFO8-1	1/2	PBFO8-1	1/2
		NA	ORG	BLU	SBFO13-2	2/13	PBFO13-1	2/3	NA	NA	NA	SBFO8-1	2/1	PBFO8-1	1/4
		FO14-001-FO3	ORG	ORG	SBFO13-2	2/2	NA	NA	NA	NA	NA	SBFO8-1	2/2	PBFO8-1	1/5
23	8 to 13	FO8-203-OPCOMHK3	NA	NA	SBFO8-2	1/1	PBFO8-1	2/1	FO13-203-OPCOMHK2	NA	NA	SBFO13-3	1/1	PBFO13-1	4/1
		FO8-204-OPCOMHK3	NA	NA	SBFO8-2	1/2	PBFO8-1	2/2	FO13-006-FO14	BLU	ORG	SBFO13-3	1/2	PBFO13-1	NA
		NA	NA	NA	SBFO8-2	2/1	PBFO8-1	2/4	NA	NA	NA	SBFO13-3	2/1	PBFO13-1	4/4
		NA	NA	NA	SBFO8-2	2/2	PBFO8-1	2/5	FO13-006-FO14	ORG	ORG	SBFO13-3	2/2	PBFO13-1	NA

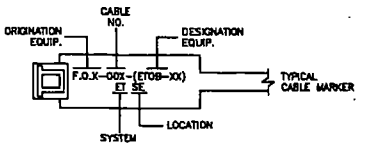
EXHIBIT B
NOT USED

EXHIBIT C
H-3 AS-BUILT DRAWINGS FOR
EXISTING OPCOM COMMMUNICATION SYSTEM

HAIKU OUTBOUND

Typical Telephone & Wiring Diagram





CABLE MARKER DETAIL

2-2 PR #22 W/SHLD — WIRE TYPE
2 INCH — CONDUIT SIZE
N/A — CONDUIT NUMBER

REV.	DATE	DESCRIPTION	BY	APP.
2	6-14-95	ADDED WIRE NO'S	R.C.	
1	08-23-94	ADDED OPCOM TERMINATION	J.Z.	
0	05-04-94	ISSUED FOR CONSTRUCTION	J.Z.	
B	04-08-94	REVISED PER ENGINEER'S COMMENTS	J.Z.	
3	6-23-95	ADDED TERMINAL NO'S	R.C.	

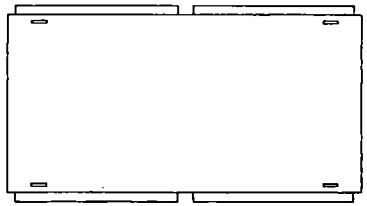
SCALE: AS SHOWN	DESIGNED	D. GETTY	APPROVED	
	DRAWN	J. SULLIVAN	8-15-93	P.O. 956-9000 / DATE: 06-23-95
	CHECKED	D. GETTY	APPROVED	

TRANSDYN CONTROLS, INC.

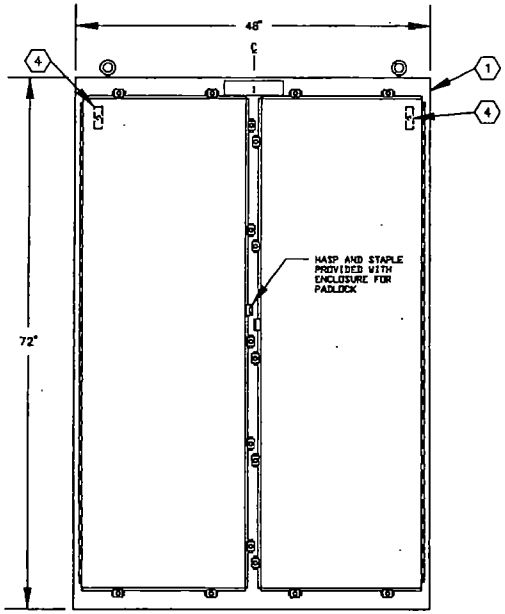
INTERSTATE ROUTE H-3
F.A.I. PROJECT NO. I-H3-1 (65)
TELEPHONE & INTERCOM SYSTEM WIRING DIAGRAM

JOB NO.	CLIENT JOB NO.	DRAWING NO.	REVISION
3125		3125-956-9000	3

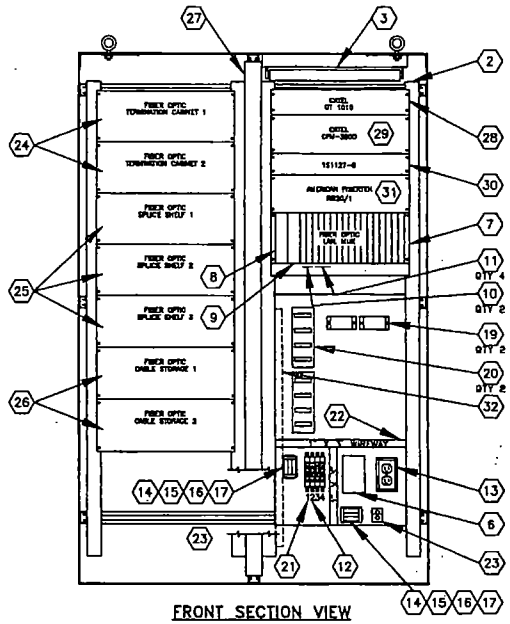
EQUIPMENT ELEVATION



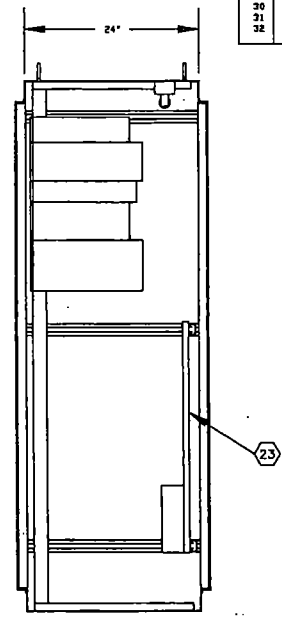
TOP VIEW



FRONT / BACK VIEW



FRONT SECTION VIEW



SIDE SECTION VIEW

NAMEPLATE SCHEDULE

NO.	QTY	1ST LINE INSCRIPTION	2ND LINE INSCRIPTION	TYPE	LETTER SIZE	SIZE
1	1	HAIKU FAR APPROACH	FIBER OPTIC HUB B/OCCV	BLK W/ WHT LETTER	1/4"	8" X 2"
2						
3						
4						
5						

LOCATION
11+40

BILL OF MATERIAL

ITEM	QTY	MFR.	PART NO.	DESCRIPTION
1	1	HOFFMAN	CUSTOM	ENCLOSURE, 72X48X24, NEMA 4
2	2	HOFFMAN	A-72RP24FS	RACK MTG ANGLES
3	1	HOFFMAN	X-LF16D1B	FLUORESCENT LIGHT STRIP, 18" LAMP
4	4	HOFFMAN	A-LF5VD	DOOR SWITCH
5	1	SIECOR	FSC-050	FIBER SPLICE CENTER
6	TBD	MCG	416	SURGE SUPPRESSOR
7	1	OPCOM	ML4400-1	CHASSIS, FIBER OPTIC LAN
8	1	OPCOM	ML4401	POWER SUPPLY
9	1	OPCOM	ML4403	FIBER OPTIC CONTROL CARD
10	1	OPCOM	ML4405	RS232 DROP CARD
11	TBD	OPCOM	ML4417	PHONE CARD
12	3	SQUARE D	QOU115	CIRCUIT BREAKER, 15 AMP
13	TBD	TBD	TBD	DUPLEX RECEPTACLE
14	A/R	ENTRELEC	168500.12	MTG RAIL
15	11	ENTRELEC	115116.07	TERM. BLOCK
16	2	ENTRELEC	118368.16	END SECTION
17	3	ENTRELEC	103002.26	END STOP
18	1	HOFFMAN	A-72P24F2	BACK PANEL, HALF
19	2	TRANSDYN	---	F.O.H. BRACKET
20	2	EAZY	MS-3	SPLITTER BOX
21	1	SQUARE D	QOU110	CIRCUIT BREAKER, 10 AMP
22	A/R	PANDUIT	TYPE E	PLASTIC WIREWAY
23	1	JVP	---	POWER GND BUS
24	2	BICC	481-000-000	72P TERMINATION CABINET
25	3	BICC	463-000-000	SPLICE SHELF
26	2	BICC	TBD	CABLE STORAGE
27	2	HOFFMAN	A-72FSCPS	CENTER PANEL SUPPORT
28	1	CATEL	DT 1010	OPTICAL TRANSMITTER
29	1	CATEL	CFM-3800	CONTROLLER
30	1	CATEL	151127-8	COMBINER
31	1	FIBERTEK	RR20/1	MULTIPLEXER AM
32	1	SOUND'R	ACS-1	6 DUPLEX OUTLET POWER STRIP

NOTES

1.) FOR POWER DISTRIBUTION WIRING DIAGRAM REFER TO DRAWING: 3125-964-2015

REV.	DATE:	DESCRIPTION	BY	APP.
1	10/5/94	SHOP AS-BUILT	J.Z.	CH.A.
C	5-27-93	SPLICE CABINETS	G.N.	J.E.
B	3/31/93	DOOR & TEMP. CONTROL SW.	G.N.	J.E.

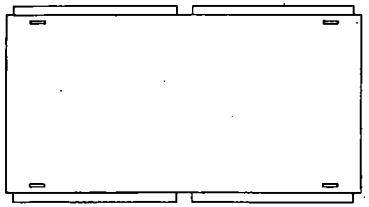
DRAWN BY: DAVID DREYER — APPR. BY:
DESIGN BY: JOHN EWERS — APPR. BY:
CHECK BY: JOHN EWERS — APPR. BY:
DATE: 2-23-1993 FILE: 964-3017 / DATE: 01-19-95

TRANSDYN CONTROLS, INC.

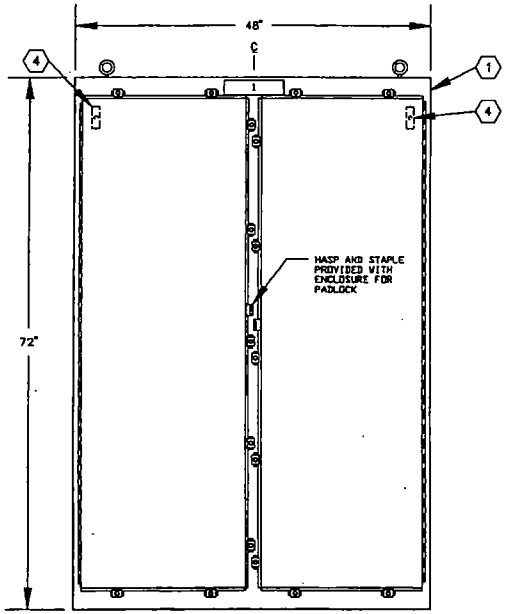
H-3 TRANS-KOOLAU TUNNEL
OPCOM
EQUIPMENT ELEVATION
HAIKU FAR APPROACH

JOB NO. 3125
CLIENT JOB NO.
SCALE 1/16" = 1" — SHT 1 OF 1
DRAWING NO. 3125-964-3017

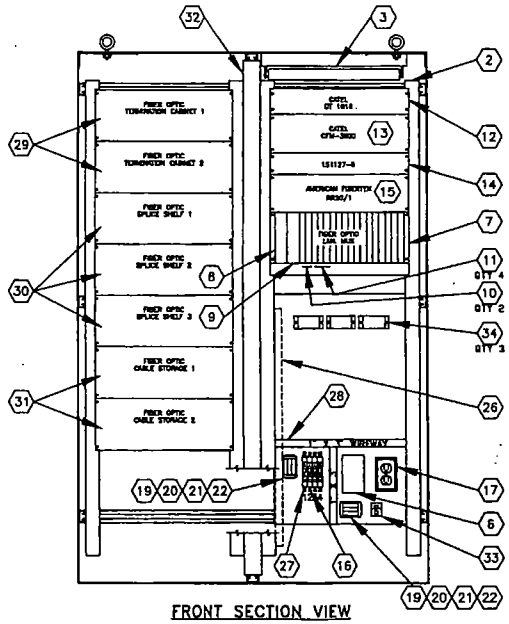
EQUIPMENT ELEVATION



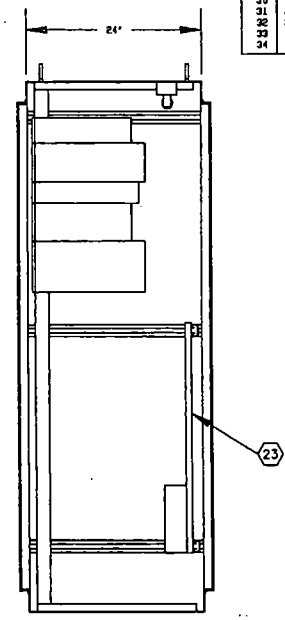
TOP VIEW



FRONT / BACK VIEW



FRONT SECTION VIEW



SIDE SECTION VIEW

NAMEPLATE SCHEDULE

NO.	QTY	1ST LINE INSCRIPTION	2ND LINE INSCRIPTION	TYPE	LETTER SIZE	SIZE
1	1	HALAWA NEAR APPROACH	FIBER OPTIC HUB I/OCTV	BLK W/ WHT LETTERS	1/4"	8" X 5"
2						
3						
4						
5						

LOCATION
475+00
"

BILL OF MATERIAL

ITEM	QTY	MFR.	PART NO.	DESCRIPTION
1	1	HOFFMAN	CUSTOM	ENCLOSURE, 72X48X24, NEMA 4
2	1	HOFFMAN	A-72RP24FS	RACK MTG ANGLES
3	1	HOFFMAN	X-LF16D18	FLUORESCENT LIGHT STRIP, 18" LAMP
4	4	HOFFMAN	A-LFSWD	DOOR SWITCH
5	1	SIECOR	FSC-059	FIBER SPLICE CENTER
6	1	MCG	416	SURGE SUPPRESSOR
7	1	OPCOM	ML4400-1	CHASSIS, FIBER OPTIC LAN
8	1	OPCOM	ML4401	POWER SUPPLY
9	1	OPCOM	ML4403	FIBER OPTIC CONTROL CARD
10	2	OPCOM	ML4405	RS232 DROP CARD
11	4	OPCOM	ML4417	PHONE CARD
12	1	CATEL	DT 1818	OPTICAL TRANSMITTER
13	1	CATEL	CFM-3800	CONTROLLER
14	1	CATEL	151127-8	COMBINER
15	1	FIBERTEK	RR20/1	MULTIPLEXER AM
16	3	SQUARE D	QOU15	CIRCUIT BREAKER, 15 AMP
17	1	TBD	TBD	DUPLEX RECEPTACLE
18	1	MOREN	6001	HEAT EXCHANGER
19	A/R	ENTRELEC	168500.12	MTG RAIL
20	11	ENTRELEC	115116.07	TERM. BLOCK
21	2	ENTRELEC	11E369.16	END SECTION
22	6	ENTRELEC	193002.26	END STOP
23	1	HOFFMAN	A72P24F2	HALF BACK PANEL
24				
25				
26	1	SOUND'R	ACS-1	6 DUPLEX OUTLET POWER STRIP
27	1	SQUARE D	QOU110	CIRCUIT BREAKER, 10 AMP
28	A/R	PANDUIT	TYPE E	PLASTIC WIREWAY
29	2	BICC	481-000-000	72P TERMINATION CABINET
30	3	BICC	463-000-000	SPLICE SHELF
31	2	BICC	TBD	CABLE STORAGE
32	2	HOFFMAN	A-72FSCPS	CENTER PANEL SUPPORT
33	1	TRANSDYN	----	GND LUG
34	3	TRANSDYN	----	F.O.H. BRACKET

NOTES

1.) FOR POWER DISTRIBUTION WIRING DIAGRAM REFER TO DRAWING: 3125-964-2018

REV.	DATE:	DESCRIPTION	BY	APP.
1	10/5/94	SHOP AS-BUILT	J.Z.	CH.A.
C	5/27/93	SPLICE CABINETS	G.N.	J.E.
B	3/31/93	DOOR & TEMP. CONTROL SW.	G.N.	J.E.

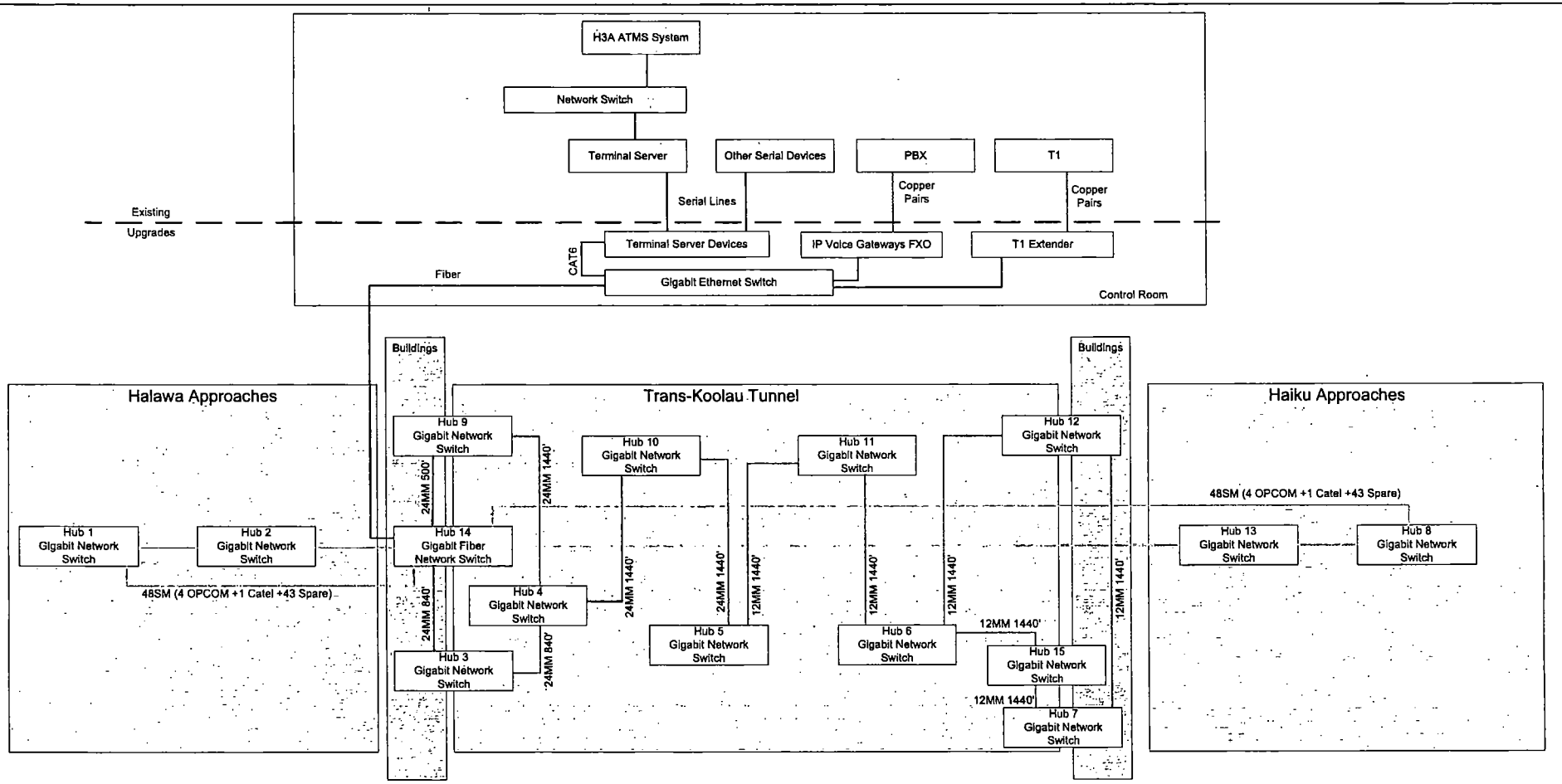
DRAWN BY	DAVID DREYER	APPR. BY	
DESIGN BY	JOHN EWERS	APPR. BY	
CHECK BY	JOHN EWERS	APPR. BY	

DATE: 2-23-1993 FILE: 984-3018 / DATE: 01-19-95

TRANSDYN CONTROLS, INC.

H-3 TRANS-KOOLAU TUNNEL
CCTV & OPCOM
EQUIPMENT ELEVATION
HALAWA NEAR APPROACH

JOB NO. 3125
CLIENT JOB NO.
SCALE 1/16" = 1"
SHT 1 OF 1
DRAWING NO. 3125-964-3018



No.	DATE	ISSUE / REVISION
1	4/29/2009	Initial Draft
2	6/25/2009	Modified Device Names
3	1/29/2010	HUB 15 Update
4	11/8/2011	Control Room Update

SUBMITTED BY:

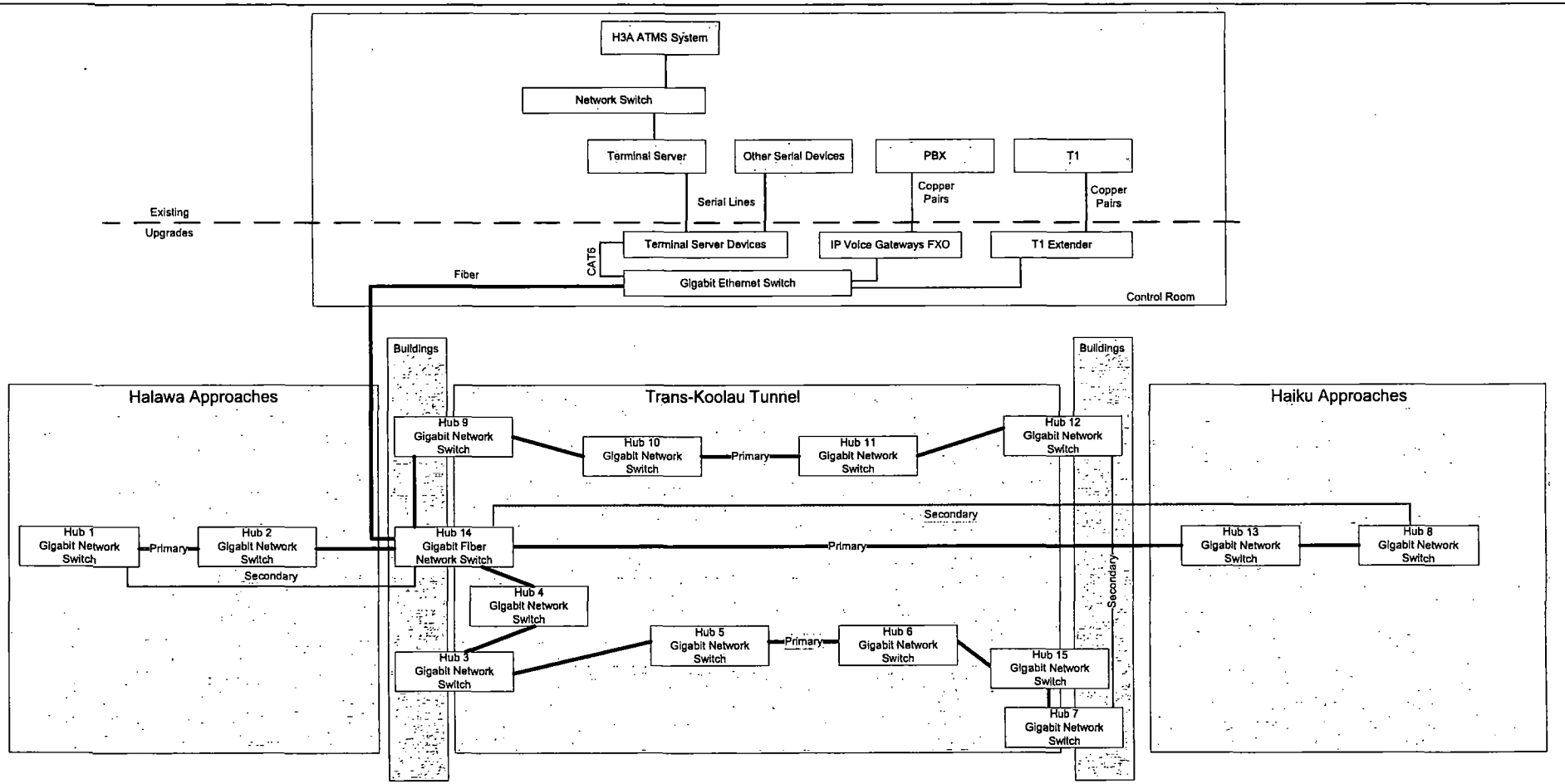
ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: Proposed System Physical Diagram

SCALE: None

PAGE: A1



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4	11/8/2011	Control Room Update

SUBMITTED BY:

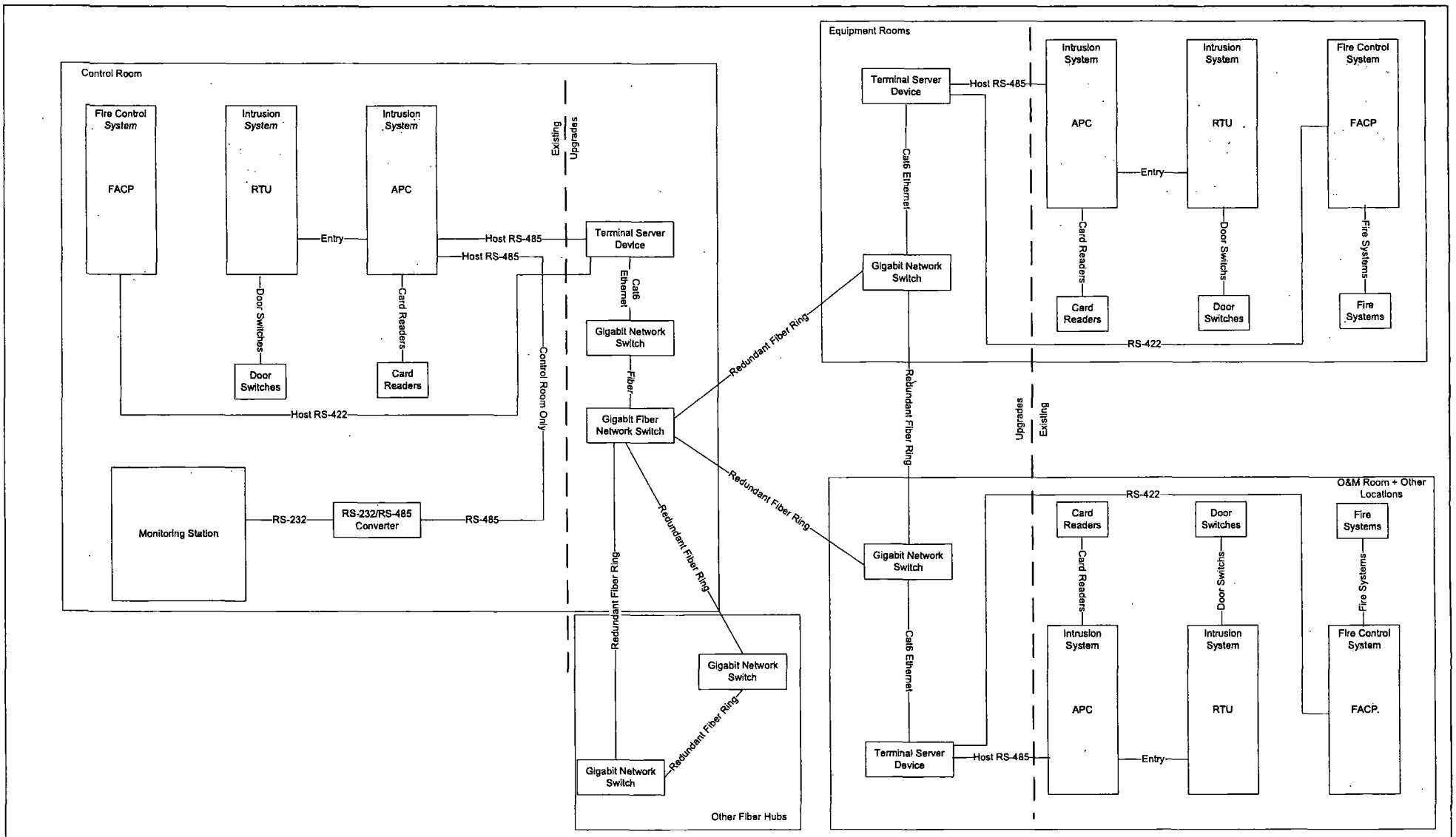
ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: Proposed System Logical Diagram

SCALE: None

PAGE: A2



No.	DATE	ISSUE / REVISION
1	4/29/2009	Initial Draft
2	5/22/2009	Updated to reflect comments from HDOT
3	6/25/2009	Modified Device Names

SUBMITTED BY:

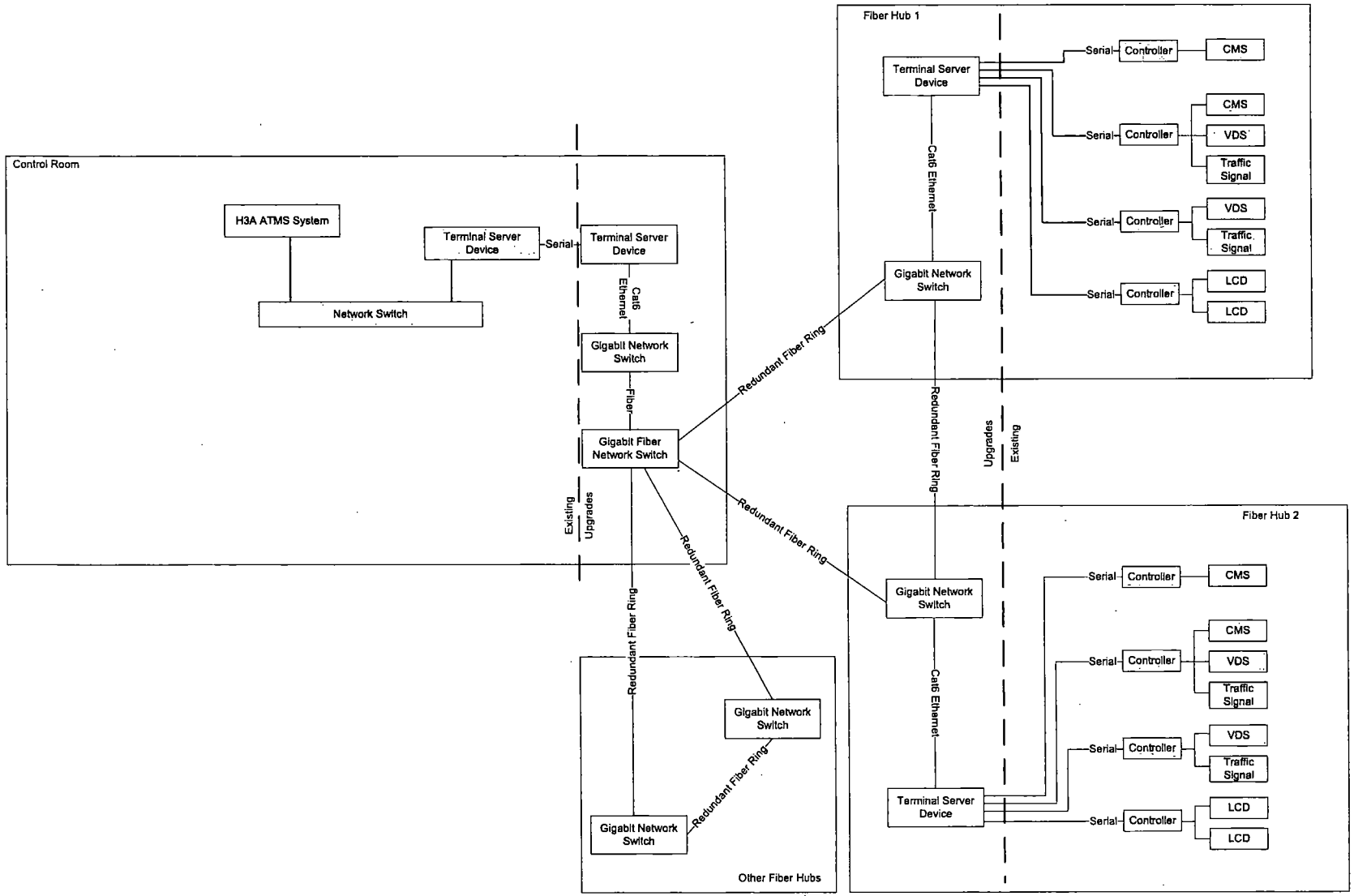
ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: Intrusion & Fire Systems

SCALE: None

PAGE: A3



No.	DATE	ISSUE / REVISION
1	4/29/2009	Initial Draft
2	5/22/2009	Updated to reflect comments from HDOT
3	6/25/2009	Modified Device Names
4	11/8/2011	Control Room Update

SUBMITTED BY:

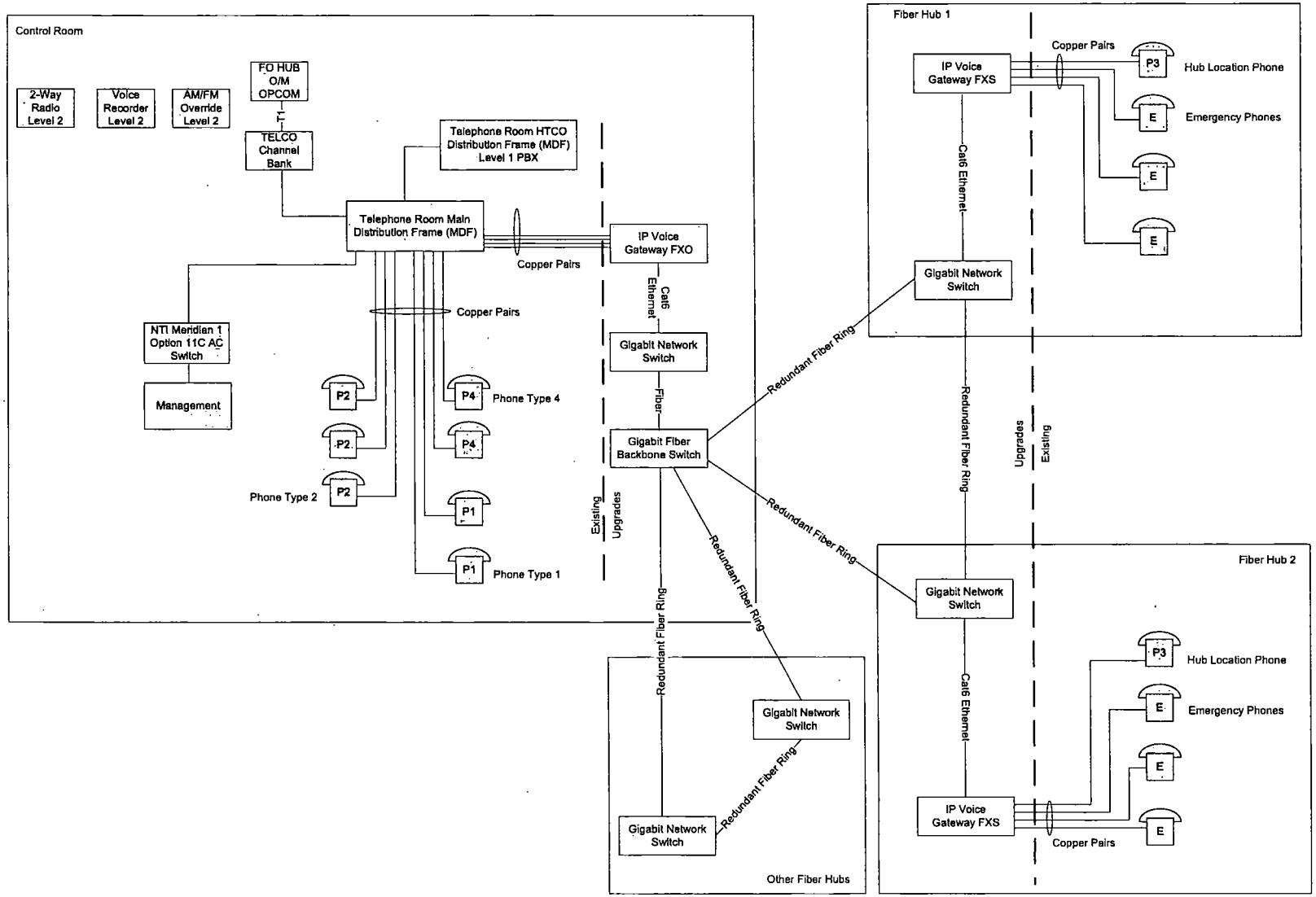
ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: Traffic Controller, VMS, CMS, VDS

SCALE: None

PAGE: A4



No.	DATE	ISSUE / REVISION
1	5/4/2009	Initial Draft
2	5/22/2009	Updated to reflect comments from HDOT
3	6/25/2009	Modified Device Names

SUBMITTED BY:

icx transportation

ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: Telephone & Intercom (Ethernet)

SCALE: None

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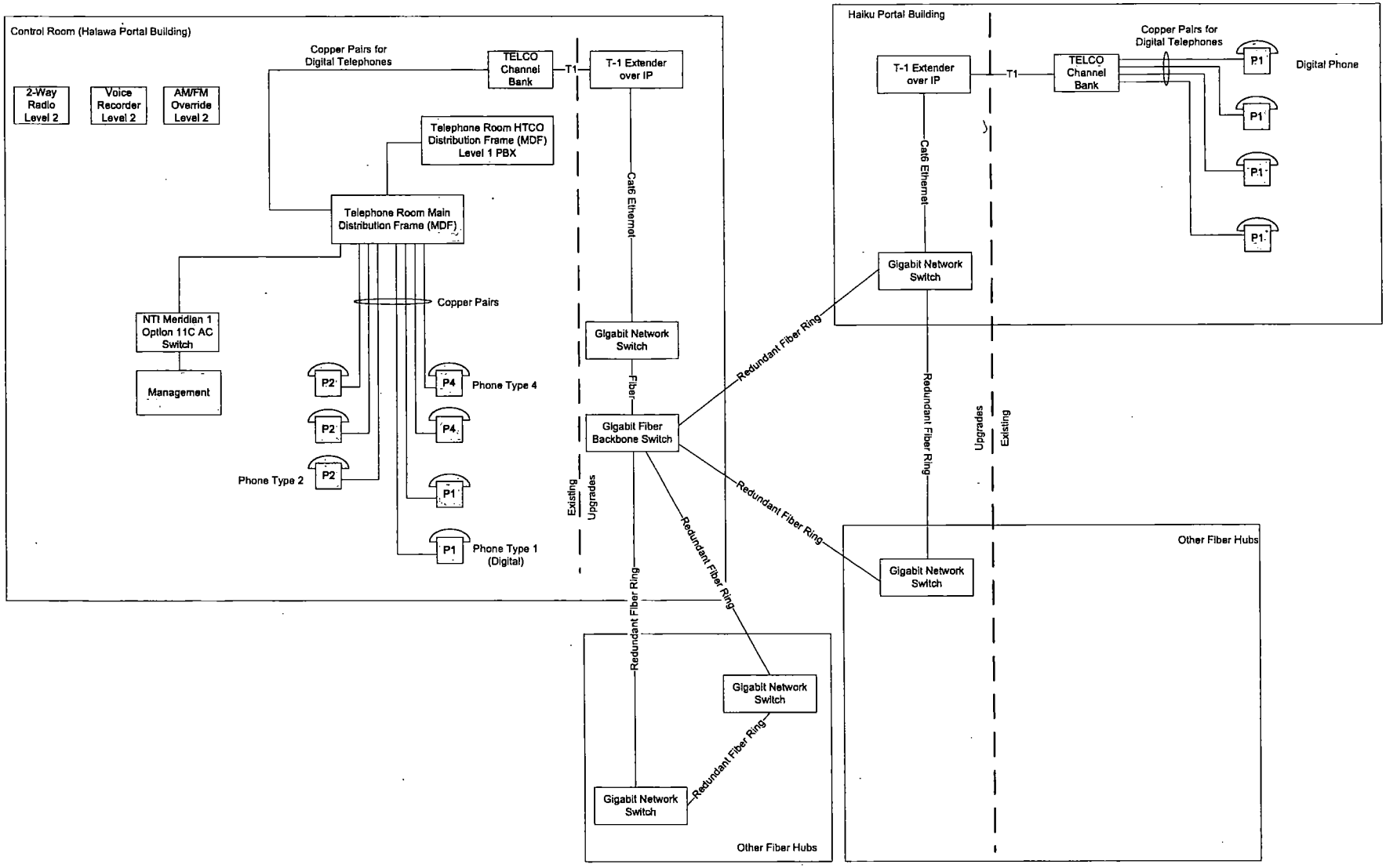

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1	1/26/2010	Initial Draft

SUBMITTED BY:

icx transportation

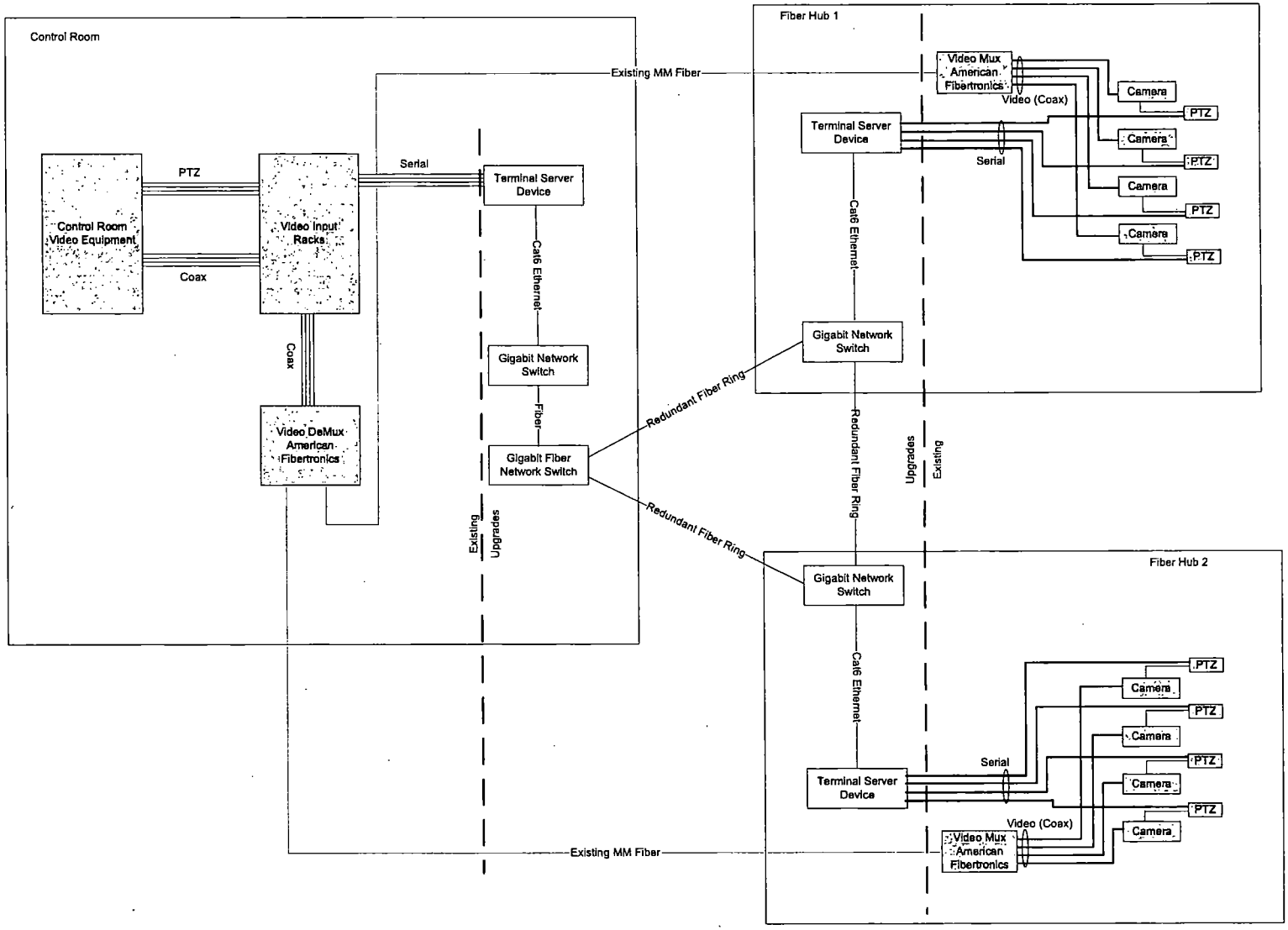
ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: Telephone T-1 Extender

SCALE: None

PAGE: A6



No.	DATE	ISSUE / REVISION
1	4/29/2009	Initial Draft
2	6/25/2009	Modified Device Names

SUBMITTED BY:

ICx Transportation Group
500 N. State College Blvd.,
Suite 1100
Orange, California 92868

PROJECT: Hawaii Department Of Transportation – Interstate Route H-3

TITLE: CCTV + PTZ Control

SCALE: None

PAGE: A7

EXHIBIT E
NOT USED

EXHIBIT F
OPCOM USER GUIDES

ML4405
Four Channel RS232

USER GUIDE

Document Number: 764-0171-001
Rev G (TI)
Date 5/17/00

OPCOM, INC.
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Table of Contents

INTRODUCTION

Overview

The ML4405 Channel Card provides four independent full duplex RS232 channels. Each channel may be user configured to operate in asynchronous mode, internal clock source, 110 to 19.2 Kbps data rates with local handshake lines. The ML4405 provides four RJ-45 modular eight-pin connectors for independent shielded cabling of each channel.

Each card uses one slot in a chassis and is position independent.
One of 128 addresses may be selected to allow up to 512 possible channels in a Muxlan system (128 addresses x 4 channels / cards).

The card can be user configurable to operate in one of two modes, either as a Point to Point system (Fig 1), or in a Point to Multi-Point operation (Fig 2). The P.M.P. system would operate in a poll/response format with a host computer broadcasting an address to multiple remote sites with the appropriate addressed site responding.

Fig 1 Point to Point Operation

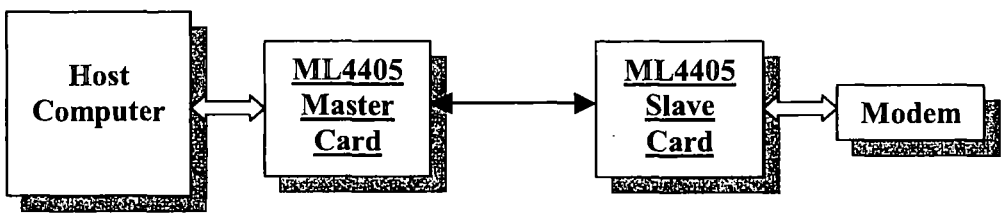
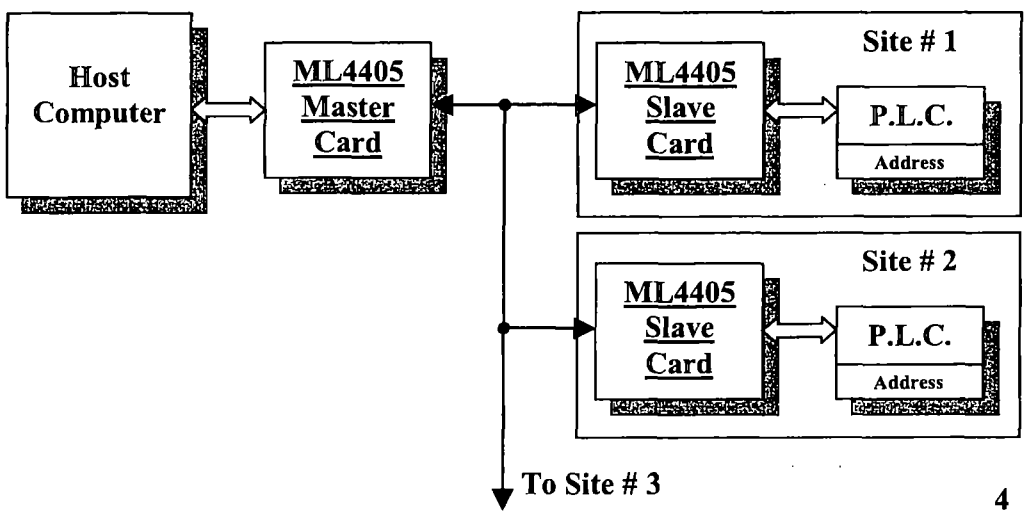


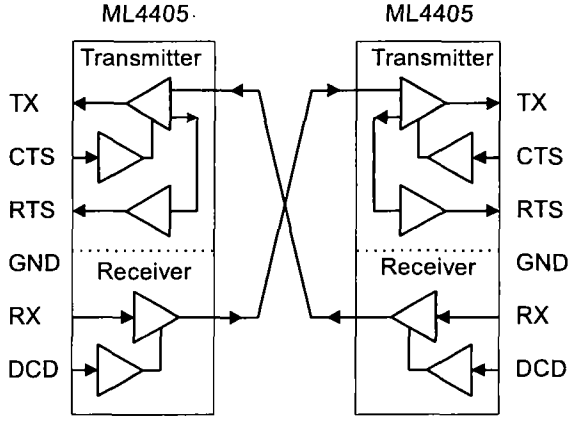
Fig 2 Point to Multi-Point Operation



Flow Diagram

The following is a logical representation of the signal flow and handshaking for the ML4405 in the Opcom system. Please note that the handshaking is done at the local ends, and is based on the presence of data to be transmitted or received at the local ends. The Opcom backbone passes data only, with all framing and handshaking done locally. The following diagram represents one data channel only on the ML4405 protocol card.

Fig 3 Flow Diagram



Not shown on the diagram are internal pull-up resistors on the CTS and DCD inputs, these will automatically enable the data to flow when no handshake lines are connected.

Data flow is as follows:

DCD controls the input to the board; it must be pulled to an RS232 low to disable the input, or high to enable it. Once enabled, data will flow to the opposite ML4405 board. When the transmitter has data in its buffer, RTS is asserted. No data will be transmitted until CTS is received.

Please note again that DCD and CTS have pull-ups on them that will *automatically enable the data flow* unless they are actively pulled to an RS232 low.

Fig 4 Practical Example of a Poll Response System, Point to Point / Multi-point

The following example shows one possible connection scheme between the ML4405 Protocol Cards and the attached equipment. Wiring schemes may change depending upon user application.

Fig 4 Application Diagram

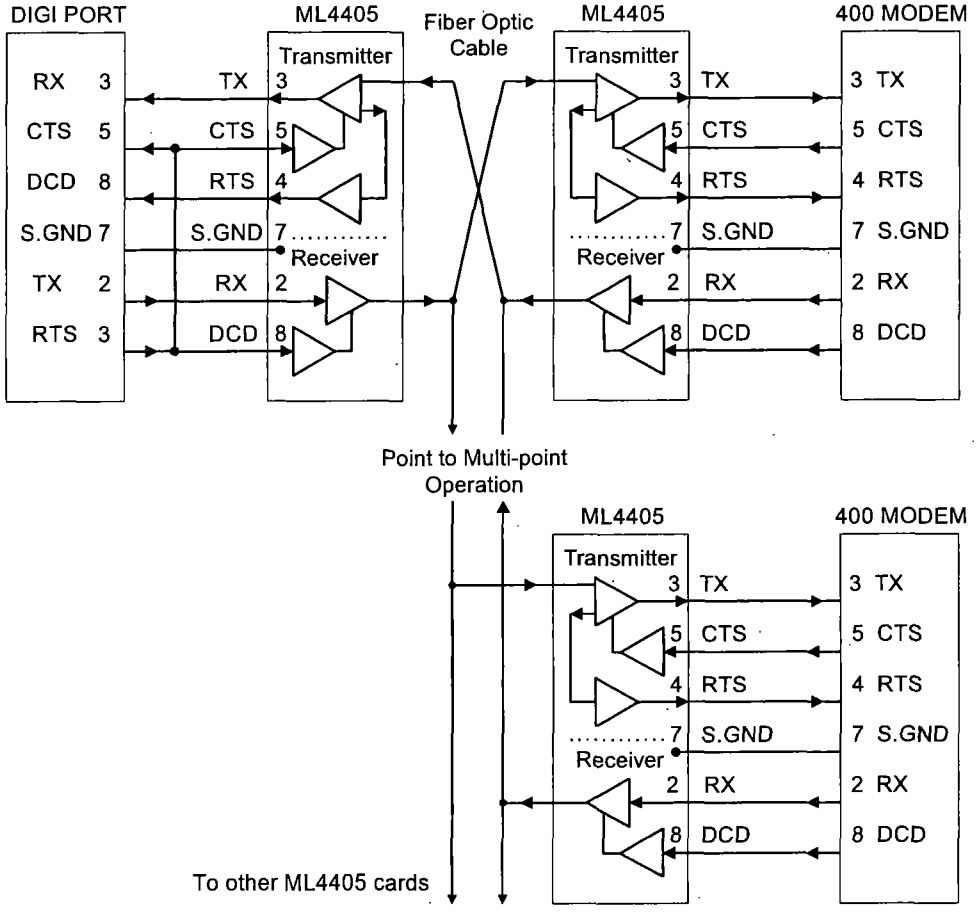
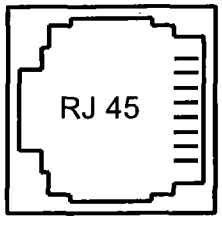


Fig 5 RJ 45 Pin Connections



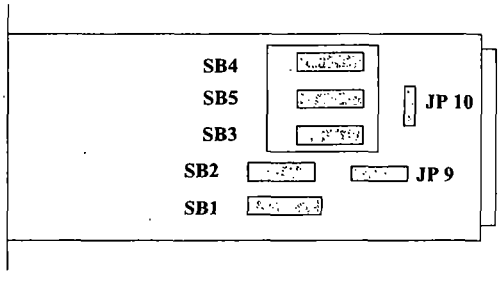
Pin 1	Chassis Ground	
2	RX Data	(Output)
3	TX Data	(Input)
4	RTS	(Output)
5	CTS	(Input)
6	N.C.	
7	Signal Ground	
8	DCD	(Input)

INSTALLATION

CAUTION! Card is not hot plug-able. Power down chassis before inserting or removing card.

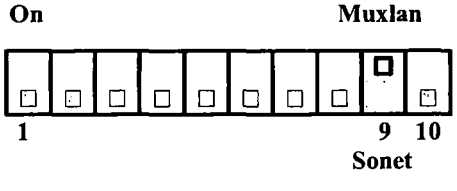
Before installing and powering on, configure the ML4405 for proper operation.

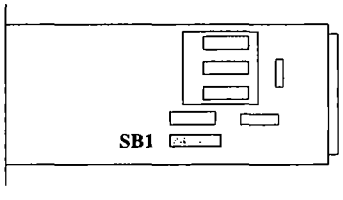
User Adjustments Locations



SB1 Switch

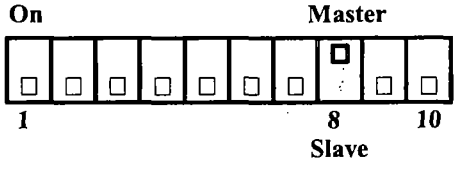
Muxlan or Sonet

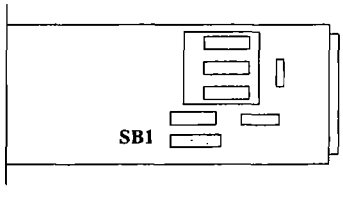




- This switch defines the operating system for the card.

Master or Slave – SB1 Switch



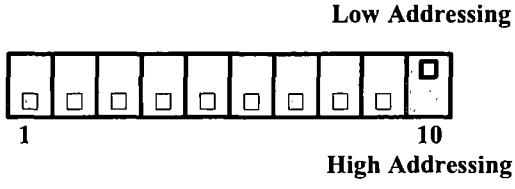


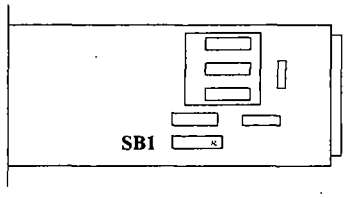
This switch allows a Master or Slave choice, one card is selected to be a master, and the other card must then be selected as a slave.

In Point to Multi-point operation all remote cards are selected as slaves.

Addressing

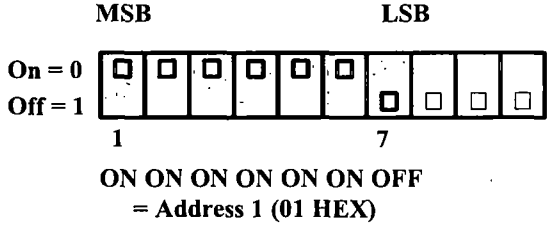
Sonet

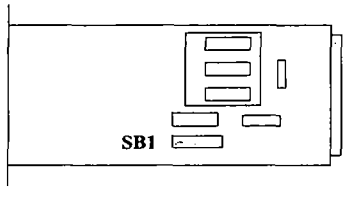




For Sonet only, set switch 10 — On for low addressing (0 –127)
Off for high addressing (128 – 255)

Muxlan & Sonet



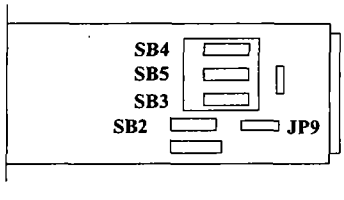


Select the card address, note that both cards must be set to the same address, in Point to Multi-Point all slaves must also have the same address.

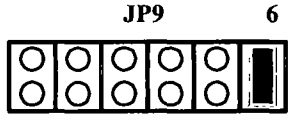
SW1 through 7 selects: 1 of 128 addresses (Muxlan)
1 of 256 addresses (Sonet-in conjunction with SW10)

SB2, 3, 4 & 5 Mode Switches

These four switches, one for each channel are identical in function and allow individual channels parameters to be set independent of the other channels.



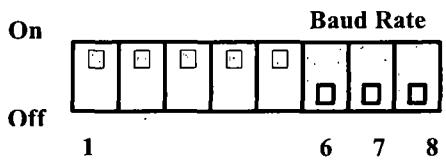
Note

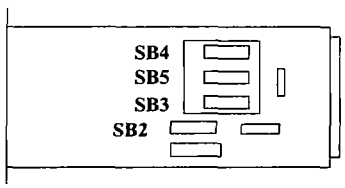


If all channels are to have the same configuration as channel one, install a jumper on JP9-6, this will then set channel one parameters for all four channels. Conversely if JP9-6 jumper is removed, then all four channels are independent of each other.

The allowable parameters that can be set are Baud rate, Bits per Character, Parity On/Off, Parity Odd/Even and Stop Bits. The following procedures are identical for all channels

Baud Rate



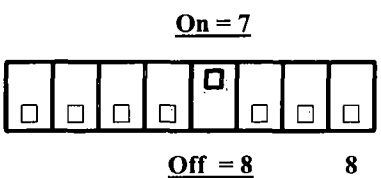


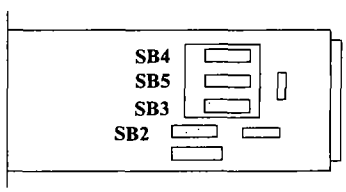
Switches 6, 7, & 8 are used to select the appropriate baud rate.

Use the adjacent table to select the appropriate baud rate.

Switch Settings			
Baud	**6**	**7**	**8**
19.2Kbps	**OFF**	**OFF**	**OFF**
9600	**OFF**	**OFF**	**ON**
4800	**OFF**	**ON**	**OFF**
2400	**OFF**	**ON**	**ON**
1200	**ON**	**OFF**	**OFF**
600	**ON**	**OFF**	**ON**
300	**ON**	**ON**	**OFF**
110	**ON**	**ON**	**ON**

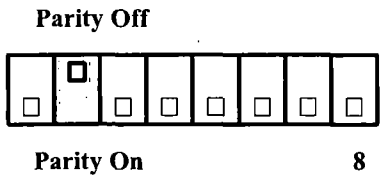
Bits per Character

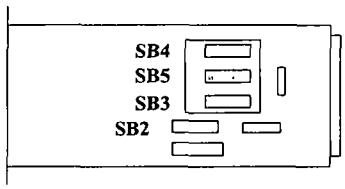




Select 7 or 8 Bits to match the character size.

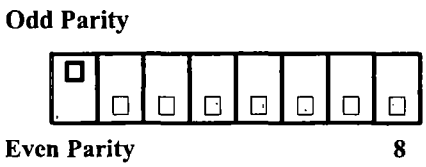
Parity

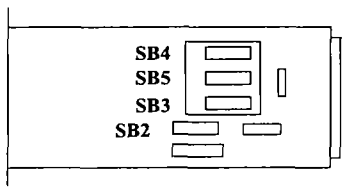




Turn Parity off if not required by external equipment.

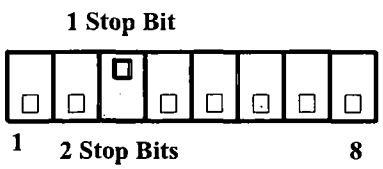
Parity Odd/Even

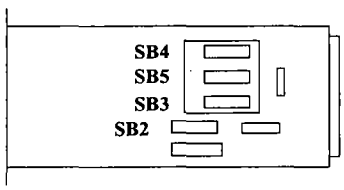




Select Odd or Even Parity to match external requirements.

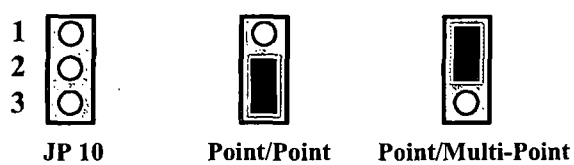
Stop Bits

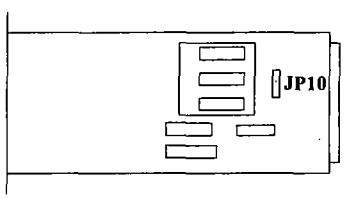




Select 1 or 2 Stop Bits to match external requirements

Point to Point/Multi-Point Operation





Select either Point/Point or Point/ Multi-Point operation, note that in PMP mode all Slaves must have the same address.

TROUBLESHOOTING

Troubleshooting

The following section lists some basic troubleshooting hints. The user should confirm that the basic system is working, i.e., the ML4400 chassis, the ML4401 power supply and the Fiber Optic Control Cards before proceeding to the protocol cards. The user should keep in mind that problem could be at either the local or remote end.

System Level

1. **Node not working.**

   a) Verify that the +5V, +12V and –12V LED's are illuminated.

   b) Is the Power Supply switched on?

   c) Verify that the Power Supply is securely seated in the chassis.

   d) Verify that the chassis is connected to AC power or optional 48VDC input.

   e) Replace Power Supply.

2. **FOCC LED's not on.**

   a) Check fiber cable.

   b) Check FOCC chassis seating.

   c) Replace FOCC.

3. **FOCC's LED's blinking.**

   a) Check receive optical power into R1 and R2. Does this match the recorded optical power?

b) If low, clean optical connectors with lint free cloth and IsoPropanol Alcohol (IPA) 97% pure or better. Use cotton swab moistened in IPA to clean out optical couplings on patch panels and blow out with clean canned air

c) If still low, check far end optical transmit power, if low replace far end FOCC, if correct check the fiber optic cables attenuation.

d) If receive level is ok, use a cotton swab moistened in IPA to clean out the R1 and R2 receptacles, blow out with clean canned air.

e) LED's still blinking, replace FOCC.

Note A can of *compressed clean air* must be used, not air from a compressed air line as this contains moisture and contaminants.

Protocol Card Level

1. **Check LED's.**

   a) At power on, LED(s) blink once for one second to signal initialization.

   b) Verify LED(s) are on continuously after initial one second blink, indicating a synchronized condition. This may take a few seconds.

   c) LED(s) do not blink at power on:

   d) Check seating of cards at both ends.

   e) Replace Card.

2. **LED(s) not on.**

   a) Check address setting (SW1) on both ends. These must match!

   b) Check that the ML4405 is set as a Master at the control end and all remotes are set as Slaves.

   c) Make sure channel parameters are duplicated at each end.

   d) Replace the card at one end, if this does not help, replace the card at the other end.

   e) Call Opcom if still not working.

3. **LED(s) on**

a) Use a BERT tester to verify data integrity over the network by transmitting and receiving valid data. When connecting to the ML4405 cards use a different hook-up cable to perform these tests.

Results:

Data is good, check original hook-up cable and then external equipment.

Data is bad, replace card at one end, if this does not help, replace the card at the other end.

b) Call Opcom if still not working.

SPECIFICATIONS

MECHANICAL

Size Single Slot.

ELECTRICAL

Connector Type RJ-49 Modular 8 Pin

Data Rates 110, 300, 600, 1200, 2400, 4800, 9600, 19.2Kbps.

Parity Odd, Even or None

Stop 1 or 2

Indicators Link Established, Green LED (1 per channel)

Interface

Pin 1	Chassis	GND
Pin 2	RX Data	Output
Pin 3	TX Data	Input
Pin 4	RTS	Output
Pin 5	CTS	Input
Pin 6	Unassigned	
Pin 7	Signal	GND
Pin 8	DCD	Input

Switches

Operating Mode	SB2	8 Position DIP Switch
Address	SB1	10 Position DIP Switch

Jumpers

JP 9-6	Single/Four Channel Mode Selector
JP 10	Point to Point or Point to Multi-point

(All others factory assigned)

ENVIRONMENTAL

Temperature 0 to 60 Degrees Celsius.
Humidity 5 to 90% Non-Condensing.

ML4417/18

Three Channel Telephone Card

User Guide

OPCOM

Document Number: 764-0017-001
Rev D
Date 5/15/95

Table of Contents

INTRODUCTION

The ML4417 and ML4418 channel cards provide three independent voice grade telephone channels per card set. The ML4417 provides a 2-wire interface for connection to an analog telephone. The ML4418 accepts a 2-wire interface from a PBX or the central office (C.O.). Each card uses three RJ-11 modular 6 pin connectors for independent cabling to each channel.

The ML4417 functionally emulates the station interface side of a PBX, providing an analog 2-wire tip and ring signal. An on-board ringing generator provides the ringing signal for each of the three channels. The ML4417 communicates through the MUXLAN/ SONET system with the ML4418.

The ML4418 functionally emulates a standard analog telephone. Two-wire tip and ring is accepted from the C.O. or PBX. Ringing and voice signals are passed via the system to the ML4417.

Each card uses one slot position in a chassis and is position independent.

Each card uses two of the possible 128 addresses, allowing 192 possible voice channels in a system.

Optionally, two ML4417s can be connected allowing a "hotline" telephone to telephone connection between systems.

CAUTION! Turn the front panel switch OFF on the ML4417 when inserting or removing the card from the chassis. Failure to do so could destroy the ML4417 card.

SPECIFICATIONS

Mechanical

Size	3.94" X 8.66" (100mm X 220mm)
Front Panel	.788" (20mm) 1 chassis slot
Connector Type	RJ-11 (6 position modular, 3 per card)

Electrical

Tip and Ring	ML4417: 2-wire analog, -48 VDC 80 VAC superimposed ringing signal connection to a standard analog telephone.	
	ML4418: 2-wire analog input accepts -48 VDC input with superimposed AC ring voltage. Input protected against lead reversal.	
LED	(3) Green	(1) for each channel
Interface	Pin 3 T Pin 4 R	

Environmental

Temperature	0 to 60 Degrees Celsius (other temperature ranges available)
Humidity	5 to 90% Non-Condensing

INSTALLATION

CAUTION! Card is not hot pluggable. Power down chassis before inserting or removing card.

Before installation and powering on, configure the ML4417/ ML4418 for proper operation. For switch SB1, ON is 1 and OFF is 0.

1. Locate SB1 (see Figure 1).

   SB1 is a 10 position switch located near the bottom of the board.

2. Set the base address of the card using SB1-1 through SB1-7 (see Figure 2 for switch settings).

   Switch positions SB1-1 through SB1-7 set the address of the card in a binary encoded format. Since the card uses two addresses, it will automatically use the next higher address. Care should be taken when addressing multiple cards in the system to allow for the next address.

   Example: Setting SB1-1 through SB1-7 to OFF, OFF, OFF, OFF, OFF, OFF, ON selects address 2. The card will also automatically use address 3.

   The corresponding card at the other end of the link or drop off point must have the same address.

3. Set SB1-8 to ON for slave and OFF for master.

   Set the ML4418 to master and ML4417 to slave.

4. Set SB1-9 for the ring cadence signal.

   SB1-9 should be OFF if an ML4417 is addressed to an ML4418 and ON if an ML4417 is addressed to another ML4417 (telephone to telephone, no connection to a PBX or C.O.).

5. Set SB1-10 to ON for MUXLAN and OFF for SONET.

6. Seat the card in the chassis and make the appropriate

6. Seat the card in the chassis and make the appropriate connections (Plug telephone link into ML4418; plug standard telephone into ML4417).

CAUTION! Place the front panel switch on the ML4417 in the OFF position when inserting or removing the card from the chassis. Failure to do so could destroy the ML4417card.

7. Apply chassis power.

Figure 1 Voice Switch Location

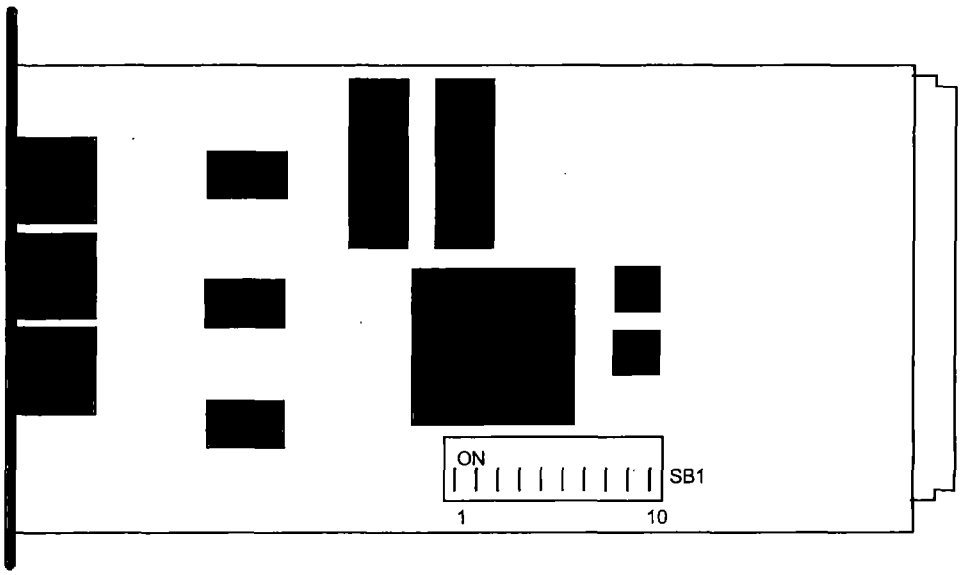
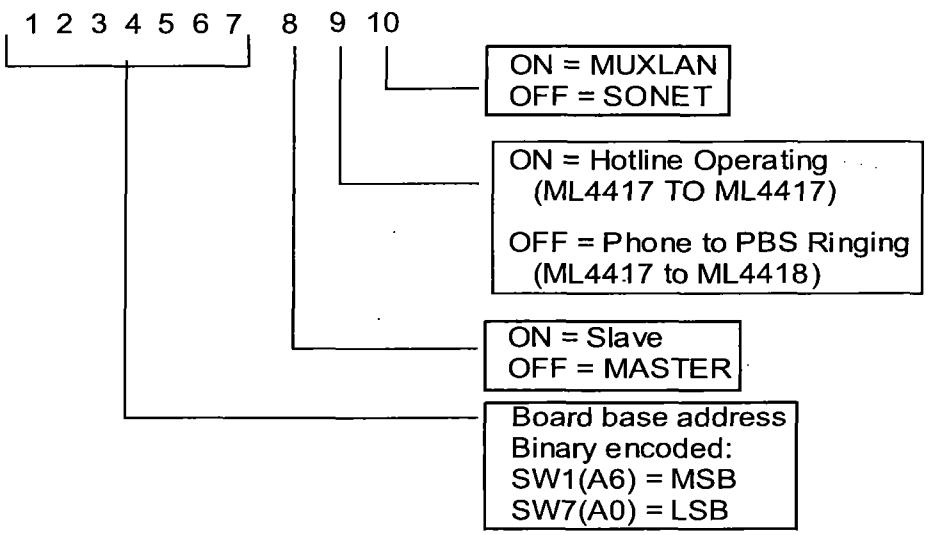


Figure 2 ML4417/4418 Switch Settings

SB1 Address/Mode Switch (10 Position Dip Switch)

ON = 1
OFF = 0



OFF OFF OFF OFF OFF OFF OFF = ADDRESS 0
OFF OFF OFF OFF OFF OFF ON = ADDRESS 2
ON ON ON ON ON ON ON = ADDRESS 255

Figure 3 Voice Interface Pinout

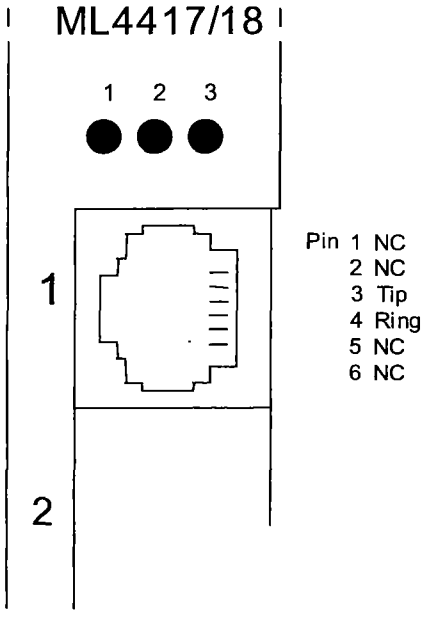
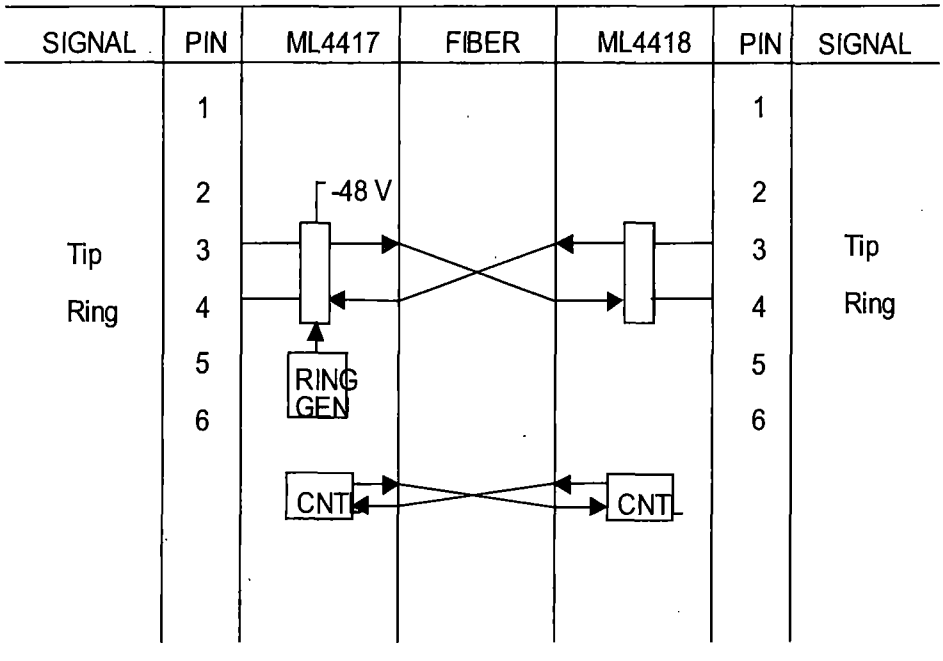


Figure 4 Voice Link Signal Flow



OPERATION

General Theory

The ML4417 uses a 16 bit microprocessor as the controlling function of the card. The subscriber line interface circuit provides line balancing and positive and negative input transient protection. The recovered low level audio is amplified, filtered and digitized. The microprocessor multiplexes the three audio channels and presents the data to the controller card bus for further multiplexing.
It also takes data from the bus and demultiplexes the three channels to become audio to the user.

The ML4418 is essentially the same in operation except the user interface emulates a telephone. Analog voice data from a PBX or central office is converted to an audio signal, amplified, digitized and multiplexed onto the system data bus. The process is reversed for data from the bus.

Figure 4 shows signal flow in and out of a typical voice link signal on an ML4417 and ML4418.

Status Indication

A few seconds after power on, all three LEDs will blink on for a second, then extinguish to indicate power on initialization complete (LEDs operate in unison).
The cards will then attempt to sync up with an appropriate card, if the address and master/slave bit switches have been correctly set. If there is a link or system problem, the LEDs will either stay off, or momentarily illuminate and go off. If synchronization has been achieved, the LEDs will stay lit. This may take approximately 10 seconds. An off-hook condition, i.e., active voice, is indicated by a steady 1Hz blink of the LED. After synchronization, operation is transparent to the user.

Redundancy

Each ML4417 and ML4418 voice card allows full redundant operation. With the system connected for redundant fiber paths, each card transmits user voice data over both the primary and secondary fiber loops.

When a card receives data from the remote end, it detects synchronization and selects the data from either the primary or secondary channel. The default channel at power-up is the primary channel.

If a fiber is cut or broken and the card was receiving data from that channel, the card loses synchronization (connection with the other end) and switches to the alternate channel.

The LEDs extinguish at loss of sync and illuminate when sync is reestablished. Momentary data loss may occur when switching from primary to secondary channel, or vice versa.

For SONET, the SO4202 control module handles redundancy.

MAINTENANCE

Cleaning

The ML4400 chassis requires no periodic maintenance. Clean the front panel labeled surfaces, as well as other unlabeled surfaces, using a soft cloth dampened with a mild cleanser or alcohol. Clean the fiber optic receptacles using a cotton-tipped applicator and alcohol if it appears that signal is being attenuated. Be careful to avoid sharp bends of less than 3" radius in the fiber optic cable, as this will attenuate the signal and/or break the glass fiber.

Troubleshooting

The following section lists some basic troubleshooting hints. The user should confirm that the basic system is working, i.e., the ML4400 chassis, the ML4401 power supply and the ML4402/ML4403 or SO4202 fiber optic control card, before proceeding to the protocol cards. The user should also keep in mind that the problem could be at either the local or remote end.

System Level

1. Verify that the chassis is connected to AC power or optional DC (-48V) input.
2. Verify power supply (ML4401) and fiber optic control card (FOCC) are securely seated in the chassis.
3. Switch on ML4401 power supply and verify that the +5V, +12V and -12V LEDs are illuminated.

   No Power: Check line fuses at rear panel.
4. Verify ML4402/ML4403 or SO4202 FOCC has fiber cable attached and the T1, T2, R1 and R2 LEDs are illuminated.

   LEDs not on:
   - A. Check fiber cable.
   - B. Check ML4402/ML4403 or SO4202 FOCC chassis seating.
   - C. Replace ML4402/ML4403 or SO4202 FOCC.

   LEDs blinking:
   - A. Check optical power into R1 and R2.
   - B. Check ML4402/ML4403 switch settings. (Ref.ML4402/ML4403 User Guide)
   - C. Check optical power out of T1 and T2.

Protocol Card Level

1. At power on, verify LED(s) blink once for one second to signal initialization.

   LED(s) do not blink at power on:

   A. Check seating of cards at both ends.
   B. Replace card.

2. Verify LED(s) are on continuously after an initial one second blink, indicating a synchronized condition. This may take a few seconds.

   LED(s) not on:

   A. Check address setting (SW1) on both ends. These must match.
   B. Check that one card is set to master and the other card is set to slave.
   C. Replace card at one end; if this does not help, replace the other.
   D. Call OPCOM.

3. Verify audio integrity by lifting handset.

   Audio not good:

   A. Check cable wiring to front panel connection.
   B. Replace card at one end; if no help, replace the other.
   C. Call OPCOM.

. An addressing problem exists at address 0 and 1 for the ML4417 and ML4418 cards. Current revision cards

ML4420

Four Channel RS422/RS485 Card

User Guide

OPCOM

Document Number: 764-0006-001
Rev D
Date 5/15/95

Table of Contents

INTRODUCTION

The ML4420 card provides four independent RS422/RS485 channels. Each channel may be user configured to operate in asynchronous, internal clock source mode at 110 to 19.2K bps data rates. The card provides four RJ-45 modular eight pin connectors for independent shielded cabling of each channel.

Each card uses one slot position in a chassis and is position independent. One of 128 addresses may be selected to allow up to 512 possible channels (128 addresses X 4 channels/card) in a MUXLAN system. In a SONET system, 256 addresses may be selected to allow up to 1024 possible channels.

The ML4420 uses command/response software that allows multiple RS422/RS485 cards to operate in parallel. One master talking with multiple remote slaves allows data to be broadcast to many remote sites, with the appropriate site responding.

SPECIFCATIONS

Mechanical

Size	3.94" X 8.66" (100mm X 220mm)
Front Panel	.788" (20mm) 1 chassis slot
Connector Type	RJ-45 (8 pin modular, 4 per card)

Electrical

Data Rates		110, 300, 600, 1200, 2400, 4800 9600, 19.2 Kbps
Parity		odd, even, or none
Indicators		Green LED (1 per channel) Link Established
Interface	Pin1	GND
	Pin2	Not Connected
	Pin3	Not Connected
	Pin4	Diff I/O 1(+)
	Pin5	Diff I/O 1(-)
	Pin6	Not Connected
	Pin7	Diff I/O 2(+)
	Pin8	Diff I/O 2(-)
Switches		
	SW1	Mode (8 position)
	SW2	Address (10 position)
	JP4	Sets I/O pins for drivers and receivers
	JP5-8	Sets 485 (Tristate)/422 driver output mode

Environmental

Temperature	0 to 60 Degrees Celsius (other temperature ranges available)
Humidity	5 to 90% Non-Condensing

INSTALLATION

CAUTION! Card is not hot pluggable. Power down the chassis before inserting and removing card.

Before installing and powering on, configure the ML4420 for proper operation.

1. Locate SW1 and SW2 and JP1-JP9 (See Figure 1).

   SW1 is a 10 position switch located above the assembly number. Its function is to select one of 128 addresses for MUXLAN and one of 256 addresses for SONET. It also sets the master/slave mode for the card.

   SW2 is an eight position switch located above SW1 address switch. SW2 sets the baud, bits/character, handshake type, number of stop bits and odd, even or no parity.

2. Select the card address by setting switches SW1-1 through SW1-7 (See Figure 2).

   Example: Settings SW1-1 through SW1-7 to ON, ON ON, ON, ON, OFF, OFF selects address 3.

3. Set the corresponding card(s) to the same address.

4. While setting the address switches, set SW1-8 ON or master or OFF for slave. (see Figure 2)

   This sets the cards to the same address and allows one card (master) to talk to the other card(s) (slave) at the same address. (With optional command/response firmware, multiple cards are set to the same address with one card set as master, and the rest set as slaves.)

5. Set SW1-9 to ON for MUXLAN and OFF for SONET.

6. For SONET, set SW1-10 to ON for low addressing (0-127) and OFF for high addressing (128-255). For MUXLAN, this switch setting does not matter.

7. If JP9-6 is jumpered, SW2 will set the mode (baud, bits/ character, etc.) for all four channels. With JP9-6 open, SW sets the mode for Channel 1 only. Channel 2, 3, 4 are set by SW3, SW4 and SW5, respectively. SW3 , SW4 and SW5 are located on the optional daughter card (see Figure 1).

   The following steps assume JP9-6 is jumpered, so SW2 will

8. Set the baud rate of the card using SW2-6 through SW2-8 (see Figure 2).

   Example: Setting SW2-6 through SW2-8 to OFF, OFF, ON selects a baud rate of 9600 bps.

9. Set SW2-5 to ON for 7 bits/character and OFF for for 8 bits/character.

10. Set SW2-4 is not used at this time.

11. Set SW2-3 to ON for 1 stop bit and OFF for 2 stop bits.

12. Set SW2-2 to ON for no parity and OFF to enable parity.

13. IF SW2-1 is OFF, set SW2-1 to ON for even parity and OFF for odd parity.

14. Set JP1-JP4 (see Figure 3).

    JP1-JP4 are two position jumpers, corresponding to each of the four channels, used in setting different input

    and output functions of pins 4,5,7, and 8 of each channel connector. Leaving all four jumpers open causes pins 4 and 5 to be outputs transmitting data and pins 7 and 8 to be inputs receiving data. Shunting the

15. Set JP5-JP8.

JP5-JP8 are three position jumpers used in selecting RS422 or RS485 mode for each of the four channels. Shunting A/B on each selects RS485 mode for each channel. Shunting B/C on each selects RS422 mode for each channel.

Note: Take notice of jumper lettering position in Figure 1. The lettering is not consistent for all jumpers.

Figure 4 shows the user interface connector along with pinout information. When looking at the front of the card, pin 1 is in the upper right corner. The connector is an RJ-45 modular connector for high density pin connections.

Figure 5 shows signal flow in and out of the ML4420 and across the fiber link. Data is fed into the ML4420 on pins 7 and 8 of the master end and appears at the slave end of the fiber link on pins 4 and 5. Likewise, data input at the slave end of the links on pins 7 and 8 is seen on pins 4 and 5 of master end.

16. With the appropriate connections made and the ML4420 configured, apply chassis power.

Figure 1 RS422/RS485 Switch and Jumper Location

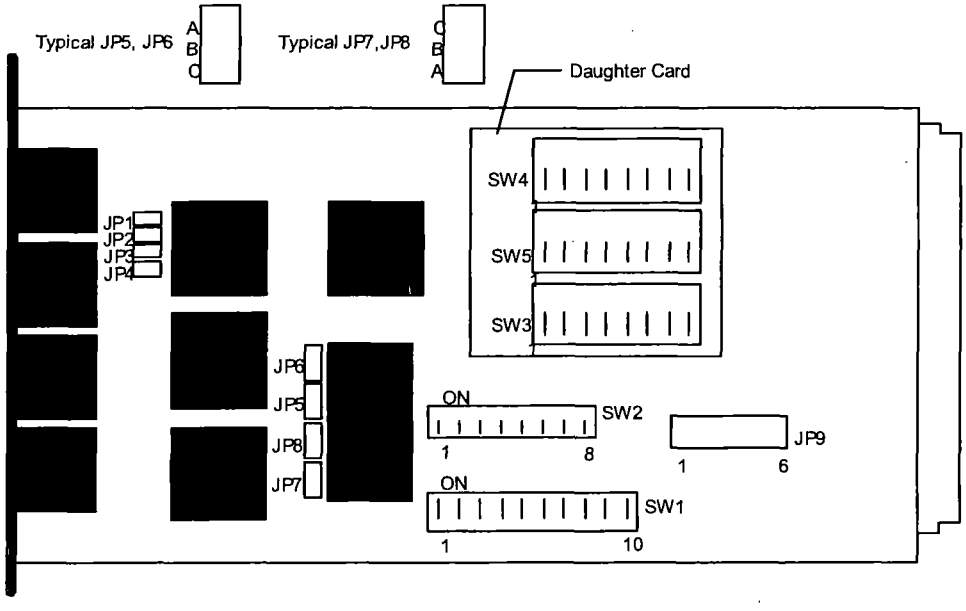
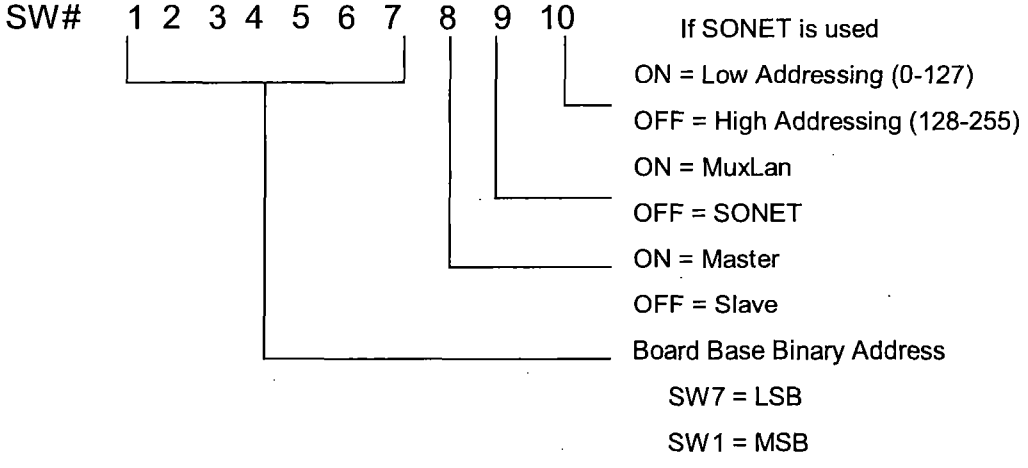


Figure 2 Switch Definition

SW1 Address Switch (10 Position Dip Switch)



ON ON ON ON ON ON ON	= Address 0
ON ON ON ON ON ON OFF	= Address 1
ON ON ON ON ON OFF ON	= Address 2
ON ON ON ON ON OFF OFF	= Address 3
OFF OFF OFF OFF OFF OFF OFF	= Address 127

SW2 Mode Switch (8 Position Dip Switch)

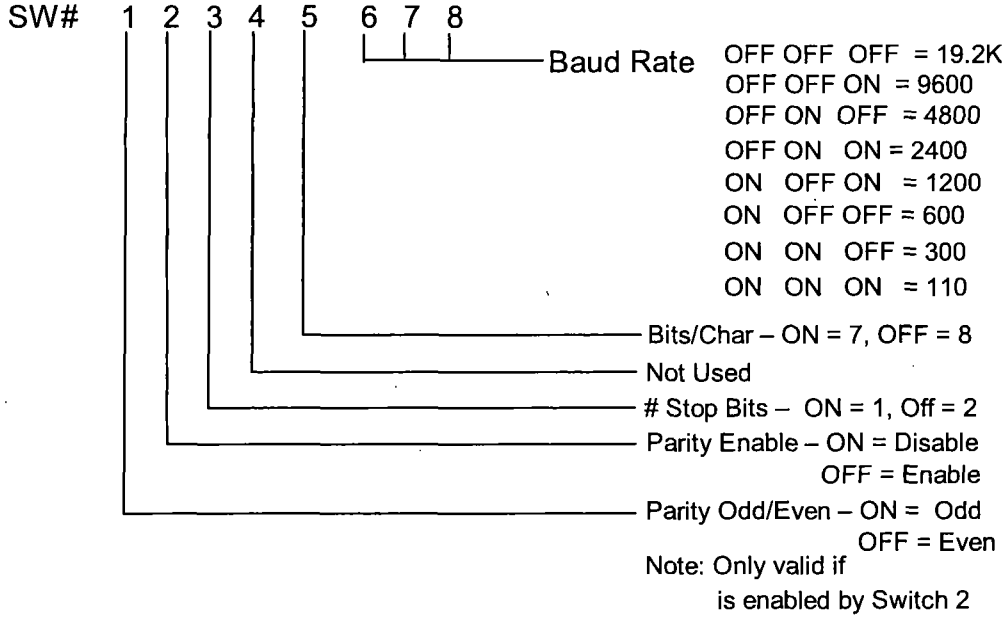


Figure 3 Jumper Definition

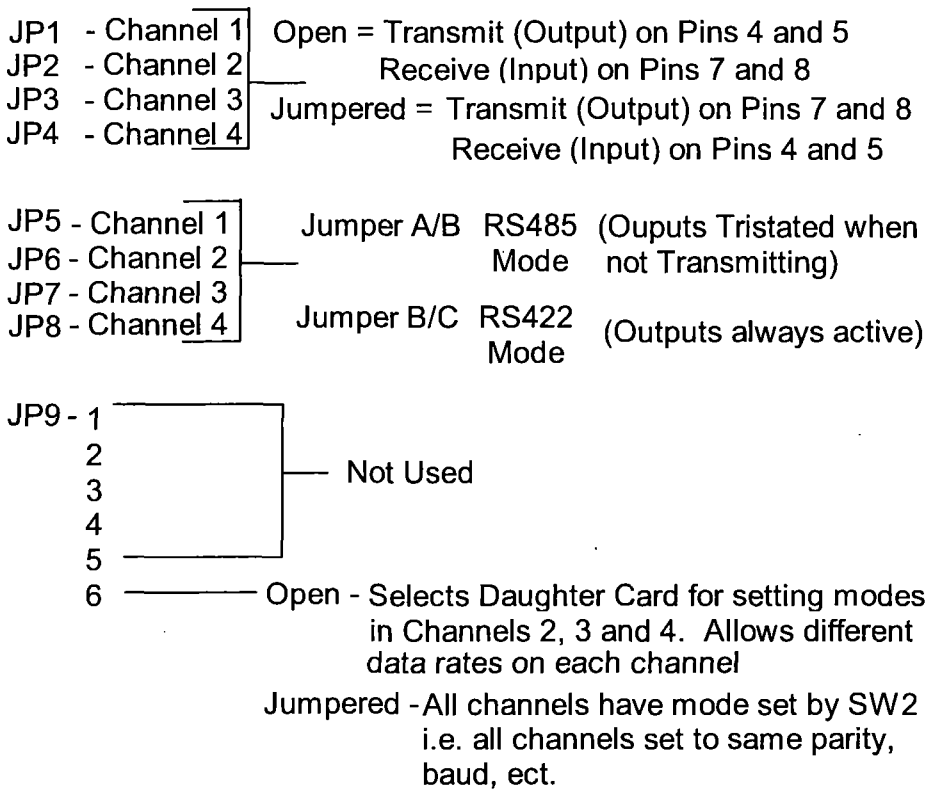


Figure 4 RS422/RS485 Interface Pinout

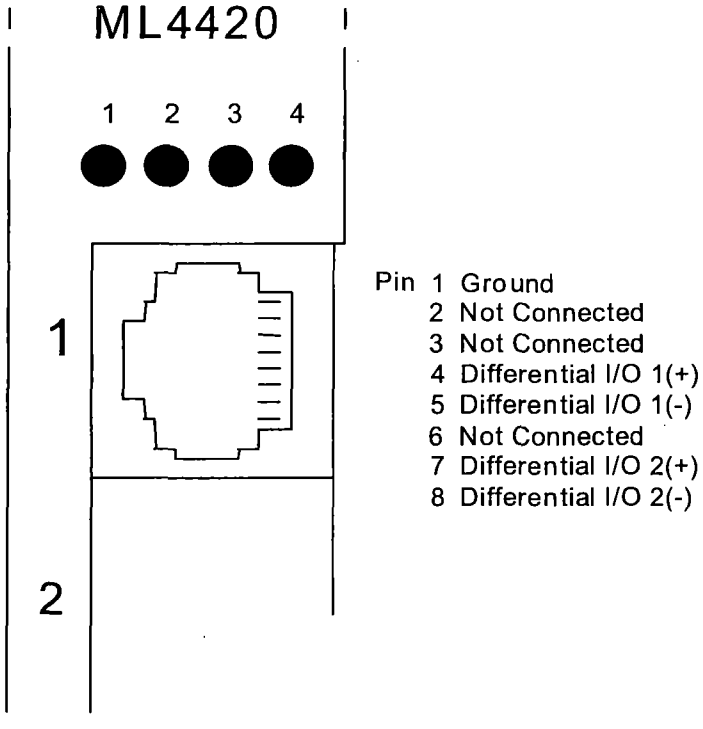
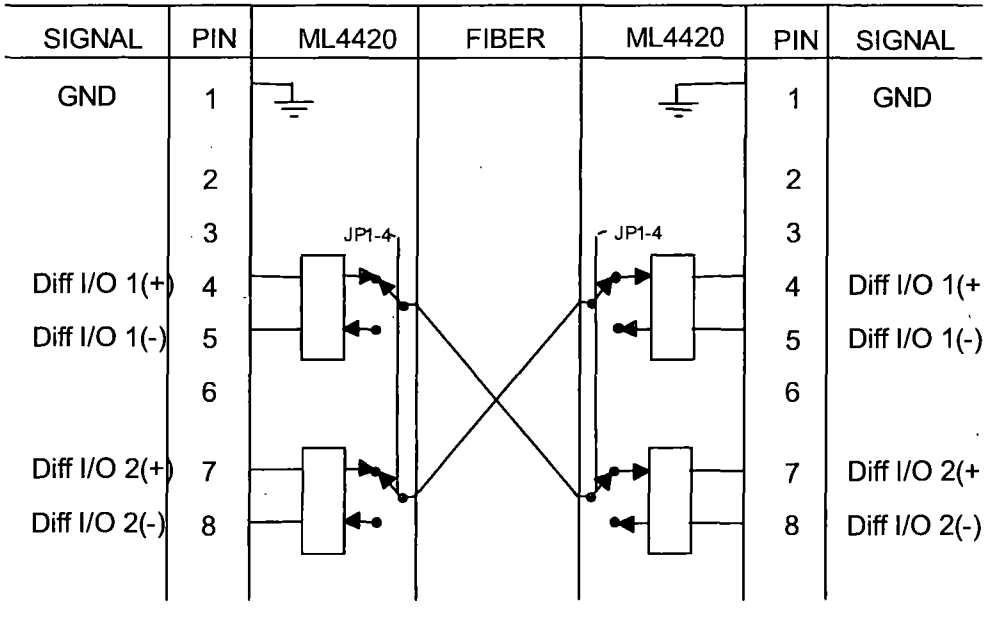


Figure 5 RS422/RS485 Link Signal Flow



OPERATION

General Theory

The ML4420 uses an eight bit microprocessor as the controlling function of the card. The microprocessor handles up to four 19.2Kbps channels per card. User data presented in a compatible async format, framed with start and stop bit(s), is decoded using a Universal Async Receiver Transmitter (UART) pre-set to the user's frame protocol. The microprocessor multiplexes the four channels and presents the data to the backplane bus for further multiplexing. Data from the system bus (slave end) is de-multiplexed in reverse order. Each channel contains a 256 byte buffer on the de-mux side that allows different speeds of operation at each end.

Once configured, operation of the ML4420 card is transparent to the user. All four channels are independent, with no restrictions on data format in the asynchronous mode.

Since data is received and transmitted in each end of the link, there is no jitter of the output signal that is typically associated with other types of multiplexers.

Status Indication

Once the ML4420s are configured, insert the cards in the chassis (cards are position independent) and apply power to the system. After a few seconds, all four LEDs will blink on for a second, then off to indicate power on initialization complete.

The cards attempt to sync up with an appropriate card, if the address and master/slave bit switches have been correctly set. If there is a link or system problem, the LEDs either stay off, or momentarily illuminate and go off. If synchronization is achieved, the LEDs stay lit. This indicates that the channels have the ability to transmit and receive data. This may take several seconds.

Note: Using command/response firmware, if there is a fiber path that allows the master to see its own status returned, all four LEDs on the master card illuminate whether a slave is there or not and, if a slave is there, whether it is in sync or not.

Redundancy

Each ML4420 RS422/RS485 card allows full redundant operation. For MUXLAN, with the system connected for redundant fiber paths, each card transmits identical user input data over both the primary and secondary fiber loops. When a card receives data from the remote end, it detects synchronization and selects the data from either the primary or secondary channel. The default channel at power-up is the primary channel.

If a fiber is cut or broken and the card was receiving data from that channel, the card loses synchronization and switches to the alternate channel. The LEDs extinguish at loss of sync and illuminate when sync is reestablished. Momentary data loss may occur when switching from primary to secondary, or vice versa.

For SONET, the SO4202 control module handles redundancy.

MAINTENANCE

Cleaning

The ML4400 chassis requires no periodic maintenance. Clean the front panel labeled surfaces, as well as other unlabeled surfaces, using a soft cloth dampened with a mild cleanser or alcohol. Clean the fiber optic receptacles using a cotton-tipped applicator and alcohol if it appears that signal is being attenuated. Be careful to avoid sharp bends of less than 3" radius in the fiber optic cable, as this will attenuate the signal and/or break the glass fiber.

Troubleshooting

The following section lists some basic troubleshooting hints. The user should confirm that the basic system is working, i.e., the ML4400 chassis, the ML4401 power supply and the ML4402/ML4403 or SO4202 fiber optic control card, before proceeding to the protocol cards. The user should also keep in mind that the problem could be at either the local or remote end.

System Level

1. Verify that the chassis is connected to AC power or optional DC (-48V) input.
2. Verify power supply (ML4401) and fiber optic control card (FOCC) are securely seated in the chassis.
3. Switch on ML4401 power supply and verify that the +5V, +12V and -12V LEDs are illuminated.

   No Power: Check line fuses at rear panel.

4. Verify ML4402/ML4403 or SO4202 FOCC has fiber cable attached and the T1, T2, R1 and R2 LEDs are illuminated.

LEDs not on:

A. Check fiber cable.
B. Check ML4402/ML4403 or SO4202 FOCC chassis seating.
C. Replace ML4402/ML4403 or SO4202 FOCC.

LEDs blinking:

A. Check optical power into R1 and R2.
B. Check ML4402/ML4403 switch settings. (Ref. ML4402/ML4403 User Guide)
C. Check optical power out of T1 and T2.

Protocol Card Level

1. At power on, verify LED(s) blink once for one second to signal initialization.

LED(s) do not blink at power on:

A. Check seating of cards at both ends.
B. Replace card.

2. Verify LED(s) are on continuously after an initial one second blink, indicating a synchronized condition. This may take a few seconds.

LED(s) not on:

A. Verify address setting (SW1) on both ends match.
B. Check that one card is set to master and the other card is set to slave.
C. Replace card at one end; if this does not help, replace the other.
D. Call OPCOM.

3. Verify data integrity by transmitting and receiving data.

Data not good:

A. Check data protocol switch settings (SW2 and/or jumpers)

B. Check cable wiring to front panel connection.

C. Replace card at one end; if no help, replace the other.

D. Call OPCOM.

WRITTEN QUESTIONS RECEIVED AND RESPONSES GIVEN

Question #	Ref Section	Question	Response
1	Exhibit C	Can the offeror obtain building (Halawa IB Portal, Control Center, Halawa OB Portal, Haiku IB Portal, and Haiku OB Portal) floor plans in Autocad format or converted pdf documents? If yes, whom will be the contact for this information?	As-built drawings are not available in Autocad format. Additional as-built sheets are being provided via addendum.
2		Can user and technical documentation (Specifications) be provided for the OPCOM ML 4436 (Singlemode Card) ML4401 PS, ML 4414 card, ML 4403 Multimode card, ML 4417 (Voice - 3 port) card, ML 4418 card, ML 4405 RS232 - 4 port card, ML 4420-1 RS485 - 4 port card, and the ML 4420-2 RS485 - 4 port card? If yes, whom will be the contact for this information?	HDOT has some OPCOM documentation, which will be issued via addendum. The Offerors are responsible for their own research on OPCOM documentation.
3	Technical Provisions 2.06.02, Task 2	2.06.02 Task 2: Procurement of Communications Equipment Terminal Server Device, Item 4 states "All cables shall be factory terminated and tested"; however, the last sentence in the item number also states "The Contractor must furnish tools and connectors to create and field test any necessary or proposed custom cables." Can you please clarify what cables must be factory terminated?	Will be addressed via addendum.
4	Technical Provisions 2.06.02, Task 2	2.06.02 Task 2: Procurement of Communications Equipment Gigabit Network Switch, Item 1 states that the device shall include a modular slot based network switch; Does the modularity include the chassis in its entirety (all required interfaces/ports/power, etc.)?	Modular interfaces refer to the Fiber ports. Modular interfaces will allow replacement and customization of fiber interfaces.

WRITTEN QUESTIONS RECEIVED AND RESPONSES GIVEN

Question #	Ref Section	Question	Response
5	Exhibit C	Exhibit C H-3 AS-Built Drawings for existing opcom communication system H-3 System Block Diagram depicts HW F.O. HUB 2 (Halawa Near End); however, there is no Equipment Elevation for HUB 2, is it possible to obtain the diagrams for the equipment elevation for HUB 2 or clarify which drawing no. is the appropriate drawing for Hub 2 if it is a matter of a labeling issue?	Additional as-built sheets are being provided via addendum.
6	Exhibit C	Exhibit C H-3 AS-Built Drawings for existing opcom communication system H-3 System Block Diagram depicts HW F.O. HUB 8 (Haiku Far End); however, there is no Equipment Elevation for HUB 8, is it possible to obtain the diagrams for the equipment elevation for HUB 8 or clarify which drawing no. is the appropriate drawing for Hub 2 if it is a matter of a labeling issue?	Additional as-built sheets are being provided via addendum.
7	Technical Provisions 2.06.02, Task 2	Would the State Of Hawaii DOT be interested with Open Source Software for the Network Management Station?	The network monitoring software must be commercial software licensed for enterprise use. Open source software will not be accepted.
8		Based on the majority of the statements in the RFP, it is apparent that the communication is directly multiplexed via Fiber and that no existing Ethernet (layer 2) infrastructure exists, is this a correct assumption? If there is an existing Ethernet network, are there any existing Layer 3 addresses? Are there any VLANs configured?	The existing system is multiplexed and no Ethernet network is available on the OPCOM system. The new equipment will create a Ethernet based network through the tunnel. Current tunnel upgrades continually impact the network configuration thus the winning offeror will be given IP address ranges for new devices and network configuration information.

WRITTEN QUESTIONS RECEIVED AND RESPONSES GIVEN

Question #	Ref Section	Question	Response
9		Will the new Ethernet-based communications infrastructure contain different broadcast domains for Management, Voice, RS232/485/T1 signals?	Current tunnel upgrades continually impact the network configuration thus the winning offeror will be given IP address ranges for new devices and network configuration information.
10		Most of the hardware/software requirements that outlined IP (layer 3) communications did not contain any version number, what version of IP is required?	IPV4