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	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

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.

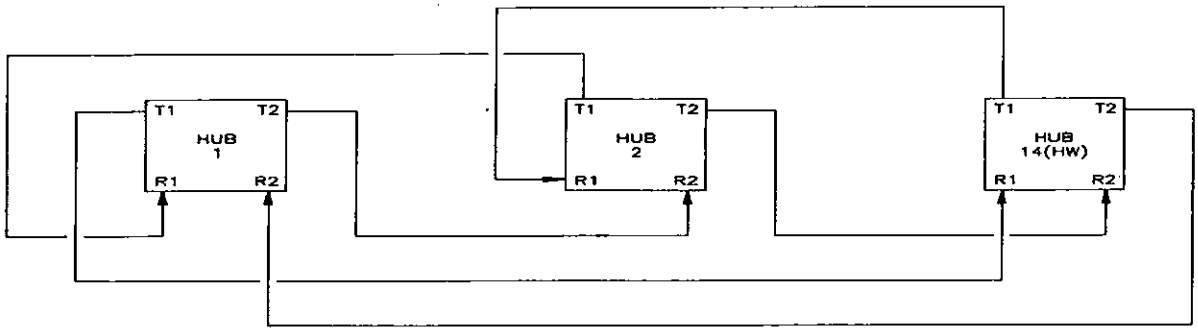

Figure 1. Halawa Ring

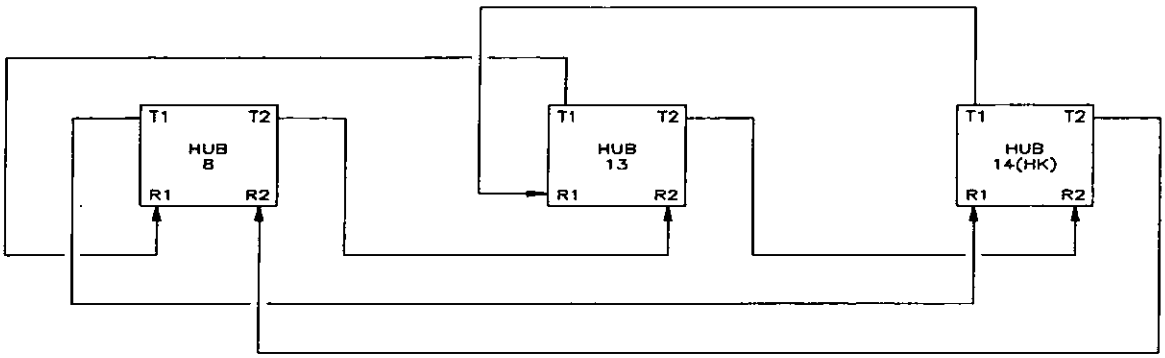

Figure 2. Haiku Ring

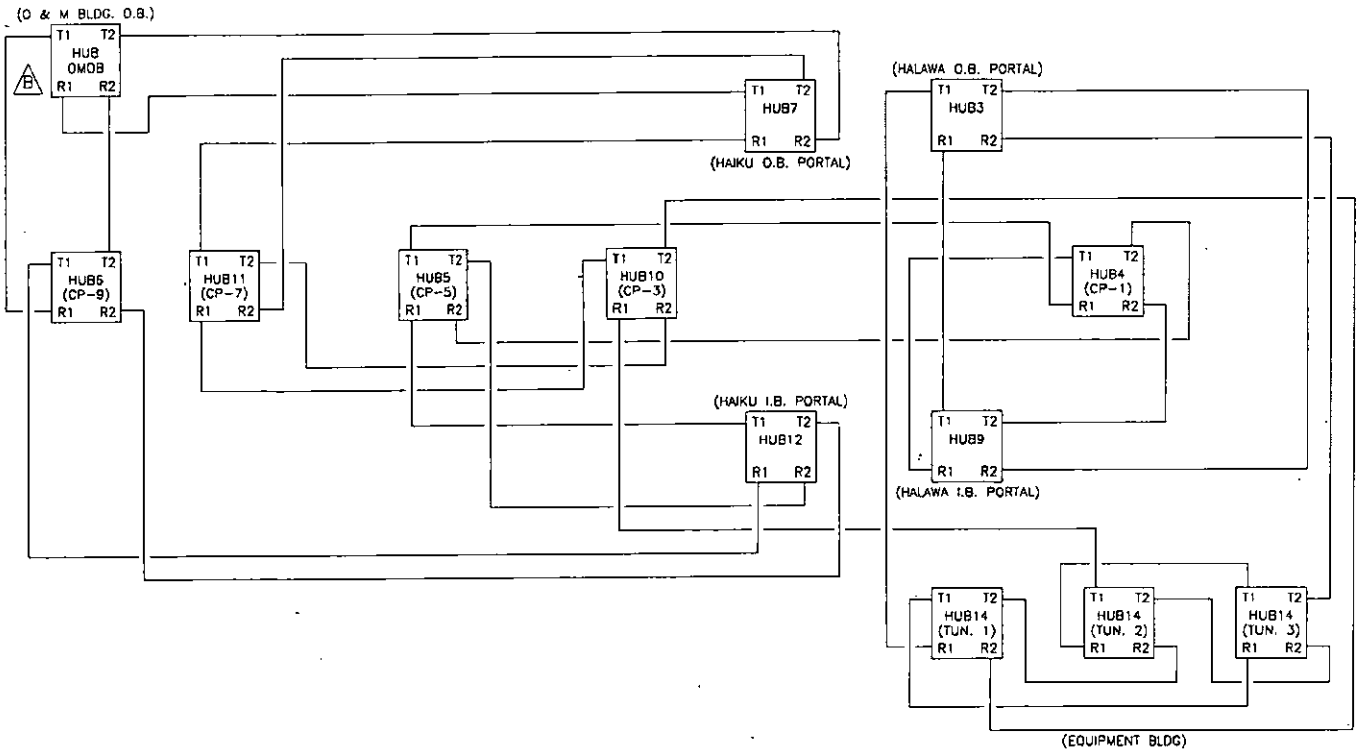

Figure 3. Tunnel Ring

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

		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)	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 (with the exception Hubs 1, 2, 8, and 13, which require cabinet replacement) 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: Replacement of Four Communications Hub Cabinets
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

The contract shall be for a total period of twenty two (22) months from the Notice to Proceed (NTP), including an installation and testing period of ten (10) months from NTP, and twelve (12) months for maintenance and warranty following the completion of the 30 Days Operational Acceptance Test.

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 Traffic Operations 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) copies and electronic PDF version in a CD-ROM.
2. Final Communications Migration Plan. Three (3) copies and electronic PDF version in a CD-ROM.

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	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
15	O & M Building	1	1	1		

Table 4A. Estimate of Required Hardware Per Ring

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

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

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 Communications Equipment, Halawa Ring
2. Procurement of Communications Equipment, Haiku Ring
3. Procurement of Communications Equipment, Tunnel Ring

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 5. 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 5. 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. The Contractor shall program the Network Switches, Terminal Servers 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.

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 - Network Monitoring Station
    f. 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. 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. Once the cabinet replacement task (Task 4) is complete the new equipment can be installed to operate the Ethernet based system in parallel with the OPCOM system. 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. 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 the HDOT Maintenance Manager 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 Communications Equipment, Halawa Ring
2. Installation of Communications Equipment, Haiku Ring
3. Installation of Communications Equipment, Tunnel Ring

2.06.04 Task 4: Replacement of Four (4) Communications Hub Cabinets

The Contractor shall provide and replace the four (4) existing hub communication cabinets identified below, reinstall the existing equipment, and test functionality of each device. These hub cabinets have deteriorated and must be replaced. The Contractor shall replace the existing cabinets with similar cabinets. Refer to Exhibit B for as-built cabinet details, photographs of existing equipment and equipment layout in each cabinet. These locations are outdoor hub cabinets located on the side of the H-3 roadway and are protected by guard rail.

The Contractor shall take extreme care when performing this work as to not damage any of the existing equipment. The Contractor shall complete each cabinet replacement within twenty four (24) hours after disabling the hub location. The Contractor shall remove and dispose of the existing cabinets.

Table 6 lists the hub locations that require cabinet replacements:

Table 6. Hub Cabinets to be Replaced

Hub No.	H-3 Hub Location	Rdwy, Tunnel, Bldg, Portal
1	Halawa OB Approach, station 342+60	Rdwy
2	Halawa IB Approach, station 475+60	Rdwy
8	Haiku OB Approach, station 11+60	Rdwy
13	Haiku IB Approach, station 1110+30	Rdwy

The Contractor shall submit the following for review and approval by HDOT prior to replacing the existing cabinets:

1. Cabinet shop drawings and specifications of the cabinet to be utilized
2. Anticipated down time of the Hub while performing the cabinet replacement
3. Test procedure to ensure the existing equipment in the new cabinet is operational after the new cabinet has been installed
4. Identify the staff performing the work
5. Brief description of the approach to complete the work
6. Special equipment to install the cabinet

7. Maintenance and protection of traffic plans while performing the work (See Exhibit E for minimum requirements)
8. Date and time to start and complete the work

The Contractor shall notify HDOT when the Hub location is ready for inspection and system verification.

Equipment Cabinet

The cabinet shall meet the following minimum requirements:

Dimensions

The cabinet dimensions shall be 72 inch H x 48 inch W x 24 inch D. The Contractor may choose a different size cabinet as long as the cabinet fits on the footprint of the existing concrete foundation and can accommodate the existing equipment and the proposed communications equipment appropriately. The Contractor shall not excavate and install new concrete foundations.

Material

The cabinet shall be constructed of 1/4 inch aluminum, in accordance with ASTM Designation B 209 for 5052-H32 aluminum sheet.

External Finish

The cabinet exterior shall be bare, unpainted aluminum per federal specification QQA-250/8.

Access

The cabinet shall have double doors in the front and rear of the cabinet. The doors shall be securely gasketed to prevent the entrance of dust and moisture. The gasket shall meet the physical properties as found in UL508 table 21.1 and shall form a weather tight seal between the door and cabinet. The doors shall include substantially the full area of the front and rear of the cabinet; and shall be flush with the sides of the cabinet when closed. The door opening shall be double flanged on all four sides.

The doors shall be provided with a catch to hold the door open more than 90 degrees. The catch shall hold the door securely open until released. Doors shall be hinged by means of continuous hinges bolted to the cabinet and door with 1/4-20 stainless steel carriage bolts. The hinges shall be 3/32 inch thick aluminum and shall have a ¼ inch minimum diameter stainless steel hinge pin. The hinge pins shall be capped top and bottom by weld. Hinge leaves shall not be exposed externally when the door is closed.

Ventilation

The cabinet shall contain two 200 cubic feet per minute fans with thermostatic control. The Contractor can choose a different configuration and type of fans as long as the fan configuration can move at least 400 cubic feet of air per minute. The lower portion of the front door shall have a louver area of sufficient size to permit the free flow of air corresponding to the rated capacity of the associated cabinet fan. The louvers shall satisfy the NEMA rod entry test for 3R ventilated enclosures. Filters shall be provided on all louvers, and shall be securely bracketed to the door. The fan and cabinet ventilation louvers shall be located

with respect to each other so as to direct the bulk of the air flow throughout the entire cabinet and in particular over the field equipment units as approved by HDOT. The thermostat shall be adjustable to turn on between 90 degrees and 110 degrees Fahrenheit.

Sun Shields
All cabinets shall be provided with sun shields. Sun shields shall be provided on the top, back, the two sides and the doors of the cabinets to reduce the cabinet's internal ambient temperature. The shield shall be in the form of 1/8 inch (minimum) aluminum sheets installed on 1 inch spacers, mounted with tamper-proof hardware to the cabinets. The sun shields shall be supported with sufficient mounts to prevent warping or bending of the sun shields. The areas described above shall be covered, except for the handle and the padlock locations. The top sun shield shall be crowned, in a similar manner to the cabinet top to provide drainage.

Locking System
Door locks shall be of solid brass rim Best Lock Series 516RL3XA7559-606 and include two keys.

Door Handles
The cabinet shall have stainless steel door handles with padlock feature on both front and back doors.

Galvanized Steel Hasps
Two heavy-duty galvanized steel safety hasps shall be furnished and installed on each equipment cabinet as shown on the plans. Padlocks will be furnished and installed by HDOT.

Light
A fluorescent lamp shall be provided at the front and back of each cabinet. The lights shall be configured to turn on upon door opening.

Rack Assembly
The cabinet shall have a standard EIA 19 inch removable, self-standing rack assembly, from top to bottom without hampering the operation of door or other items in the cabinet. The rack shall be capable of housing all existing equipment specified in Exhibit B for each existing hub.

Existing Equipment Reinstallation and Wiring

The Contractor shall re-install all existing equipment and wiring and ensure that the equipment is operational after the new cabinet has been replaced. Cabinet wiring shall be provided in a professional manner and all cabinet wiring where connected to terminal strips, flasher, relays, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving slipped over the wire before attachment of the lug or making the connection. The wire markers shall carry the legend in plain words with sufficient details so that a translating sheet will not be required. The work will include reinstalling the existing equipment including but not limited to cabinet grounding, interconnect cables and wires, fiber optic patch cables, fiber optic distribution panels,

surge protectors, fiber optic cable rack hardware, controllers, electronic peripherals and interface equipment.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly laced into cables with nylon lacing. Cables shall be secured with nylon cable clamps. The grounded side of the electric service shall be carried throughout the cabinet without a break. All electrical connections in the cabinet, including relays, flashers, terminal strips, etc., shall have sufficient clearance between each terminal and the cabinet to provide an adequate distance to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and independently to the ground bus. The lay of the interconnect cable between the components must be such that when the door is closed, it does not press against the cables or force the cables against the various components inside the cabinets.

All wiring containing line voltage A.C. shall be routed and bundled separately and/or shielded from all low voltage (i.e., control circuits). All conductors and live terminals or parts, which could be hazardous to maintenance personnel, shall be covered with suitable insulating material.

The A.C. return and equipment ground wiring shall be electrically isolated from each other and the A.C. + wiring by an insulation resistance of at least 10 Mega-ohms when measured at 250 VAC. Return and equipment grounding wiring shall be color coded white and green respectively.

Documentation

Each cabinet shall be supplied with three (3) hard copies of the Final Cabinet Wiring Diagram and one electronic copy on CD in PDF and AutoCAD formats. One (1) hard copy shall be placed in a clear plastic envelope and left in the cabinet. Two (2) hard copies shall be delivered to HDOT. The electronic copy of the cabinet wiring diagrams shall be delivered to HDOT.

Deliverables:

1. Furnish and replacement of Communications Hub Cabinet, Hub 1
2. Furnish and replacement of Communications Hub Cabinet, Hub 2
3. Furnish and replacement of Communications Hub Cabinet, Hub 8
4. Furnish and replacement of Communications Hub Cabinet, Hub 13

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 on a per unit basis as per the unit prices submitted by the Contractor in the Offeror's bid sheets 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. Three (3) copies and electronic copy on a CD-ROM.
2. Two (2) licenses of software to view OTDR test results, if applicable.

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 Offeror's bid sheets for "Splice Existing Fibers – Six Fibers" and "Terminate Existing Fiber – Six 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. Assume six fibers for each 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. Assume six fibers to be terminated. 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: OTDR test results. Three (3) copies and electronic copy on a CD-ROM.

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 Operation Acceptance Test Results

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) copies and electronic copy in PDF format on a CD-ROM.
4. User Manuals
5. System Administrator's Manual

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

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. Ten Percent (10%) spare of all factory or custom cables used to attach equipment, as per equipment specifications under Task 2.
7. One (1) complete Hub Cabinet, as per cabinet specifications under Task 4

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 HDOT Maintenance Manager 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

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

2.06.12 Quantities

Project quantities are as per Offer Form-2 in Attachment 2.