



**Comprehensive Community Infrastructure
Budget Narrative Template**

Applicant Name: University of Hawaii

EasyGrants Number: 5786

Organization Type: State or State Agency

Proposed Period of Performance: 3 year

Total Project Costs: \$ 42,466,000

Total Federal Grant Request: \$ 33,972,800

Total Matching Funds (Cash): \$ 8,493,200

Total Matching Funds (In-Kind): \$ 0

Total Matching Funds (Cash + In-Kind): \$ 8,493,200

Total Matching Funds (Cash + In-Kind) as Percentage of Total Project Costs: % 20.00

1. Administrative and legal expenses - \$0.00

There are no administrative or legal expenses associated with this project.

2. Land, structure, rights-of-way, appraisals, etc. - \$0.00

There are no Land, structure, rights-of-way or appraisal costs associated with this project.

3. Relocation expenses and payment - \$0.00

There are no relocation expenses or payments associated with this project.

4. Architectural and engineering fees - \$0.00

There are no architectural or engineering fees associated with this project.

5. Other architectural and engineering fees - \$0.00

There are no other architectural and engineering fees associated with this project.

6. Project inspection fees - \$0.00

There are no project inspection fees associated with this project

7. Site work - \$0.00

There is no site work associated with this project.

8. Demolition and removal - \$0.00

There is no demolition and remove associated with this project.

9. Construction - \$0.00

There is no construction associated with this project.



10. Equipment - \$14,738,000

Equipment	Unit Cost	Units	Term	Total Cost
Switches	\$16,666.66	6	Purchased	\$100,000
Routers	\$13,000	388	Purchased	\$5,044,000
WDM Equipment	\$18,000	388	Purchased	\$6,984,000
UPS	\$2,500	388	Purchased	\$970,000
Dist.Ed: HDTV	\$160,000	80	Purchased	\$160,000
Dist.Ed: HD Cameras	\$160,000	40	Purchased	\$160,000
Dist.Ed: CODECs	\$10,000	40	Purchased	\$400,000
Dist.Ed: Automation Eqpt	\$60,000	7	Purchased	\$420,000
Dist.Ed:MCU	\$500,000	1	Purchased	\$500,000
TOTAL:				\$14,738,000

\$100,000 of this category is estimated for Ethernet switches at the Interisland aggregation points – these switches will enable the ability to carry DOE, HSPLS and UH traffic over the shared 10Gbps Interisland ethernet circuits while maintaining traffic separation.

The Cisco 4900M series of switches have been selected to perform the aggregation function. The 4900M switches feature up to 16 wire-speed 10Gbps Ethernet and 16 wire-speed 1 Gbps Ethernet ports, and are capable of support the QinQ VLAN tunneling at Layer-2 to provide transparent services for the three entities across the shared interisland transport. Cisco switches were chosen to ease the management of this deployment – currently all parties use Cisco switches in their network there by easing deployment and management of the network. The QinQ VLAN tunneling is currently deployed on the existing 10Gbps interisland circuits that the DOE and UH use as part of the INET network using similar Cisco switches. Replicating the proven, working solution eases the management and maintenance. The average unit cost of the switch (\$16,666.66) includes the hardware, redundant power supply, IOS software and associated transceivers to interface into the fiber network. The unit cost reflects approximately [redacted] discount off list prices that the University routinely obtains when purchasing equipment.

\$5,044,000 of this category is estimated for routers for each site location on the network. The routers will perform the redundancy function around the ring at the Layer-3 level and segment the network into manageable segments.

Each site will have a router installed to provide Layer 3 services to the site and to the wide area network. The routers will provide the redundancy by routing between multiple paths on the fiber backbone to create a Layer 3 redundancy on a ring based Layer 2 network. On the average, the router at each site would be approximately \$13,000. Either a Cisco 3560E, 4900M, 3Com 5500 router, or new line cards for existing routers will be installed at each site, depending on the site’s specific requirements (DOE uses primarily 3Com routers at the schools where as HSPLS and UH primarily use Cisco). The unit cost of each router or router blade includes the hardware, software license and associated transceivers to interface into the fiber network. The unit cost reflects approximately [redacted] discount off list prices that the University and DOE routinely obtains when purchasing equipment.

\$6,984,000 of this category is estimated for Wave Division Multiplexors for each site location on the network. The WDM equipment allows multiple, separate circuits to be sent across the same pair of fiber independently of each other. Both DWDM and CWDM technologies will be used, depending on the engineering requirements of the paths.

Each site will have a DWDM chassis with associated fiber optic filters and CPE interface cards. On the average, the DWDM equipment at each site would be approximately \$18,000. Sorrento Networks Gigamux 3200 series of equipment will be installed at each location – card quantities and types will vary per location depending on the location of the site in the ring, its surrounding sites and distances as well as the line rate required (1Gbps or 10Gbps). Sorrento Networks equipment has been choosen as it is the currently installed equipment on the INET network – by installing the same type of equipment, the currently installed gear is completely compatible and can be



reused, thereby reducing costs. The unit cost of each DWDM chassis includes at minimum the chassis, mangement card and power supplies. CWDM or DWDM filters and counts vary per chassis, as do the CWDM and DWDM CPE line cards, amplifiers and dispersion compensation modules. The unit cost reflects the current [redacted] price that the University obtains when purchasing Sorrento Networks equipment.

\$970,000 of this category is estimated for Uninterruptable Power Supplies (UPS) to provide backup power for all the network equipment at all sites.

An APC SmartUPS RT 2000VA, which is a double conversion online type of system will be installed at each site to provide backup power to a minimum the DWDM chassis. As many of the sites on the network have amplifiers to allow for connectivity over long fiber runs, maintaining power to them is critical to ensure that the network remains functional. The APC SmartUPS RT has been deployed in the INET network and has proven itself to be reliable and easy to maintain. Maintaining a common UPS allows for easy maintenance and sparing. The unit cost of \$2,500.00 includes the 2000VA UPS along with the network management card. The unit cost reflects approximately [redacted] off list price that the University routinely obtains from vendors who resell the APC product.

\$1,640,000 of this category is estimated for the Distance Education video equipment for community colleges and other higher educational institutions and community centers to provide classes and interaction between their primary campuses and education centers across the state.

Each of the 25 sites across the community colleges, higher educational institutions and community centers will have distance education video equipment consisting of a HDTV, codecs and HD video cameras. A centralized multipoint conferencing unit (MCU) will also be purchased to provide many to many connections.

Of the \$1,640,000 cost for the distance education equipment, there will be 20 sites. Breakdown for specific equipment follows:

\$160,000 for 80 HDTVs at \$2,000 per unit. There will be 4 units at each site.

\$160,000 for 40 HD Cameras at \$4,000 per unit. There will be 2 units at each site.

\$400,000 for 40 CODECs at \$10,000 per unit. There will be 2 units at each site.

\$420,000 for Automation Integration Equipment at \$60,000 per unit. There will be 7 units installed – one for each of the primary locations at the community colleges and higher education institutions. Each AIE will be able to support the distance education classrooms for that campus.

\$500,000 for 1 Multipoint Control Unit. There will be 1 unit for the entire distance education network.

All unit costs reflect discounts that the University routinely obtains when purchasing video equipment.

Matching funds for this category comes from the Hawaii State Public Library System (\$823,200). Total matching funds for this category is \$823,200.

There is no in-kind matching funds for this project

11. Miscellaneous - \$27,728,000

Item	Unit Cost	Units	Term	Total Cost
Oahu – New	[redacted]	193	Purchased	[redacted]
Oahu – Ext	[redacted]	37	Purchased	[redacted]
Maui – New	[redacted]	35	Purchased	[redacted]
Big Island – New	[redacted]	67	Purchased	[redacted]
Kauai – New	[redacted]	22	Purchased	[redacted]



Expand Oahu East Ring		45	Purchased	
Expand Oahu North Shore Ring		40	Purchased	
Expand Oahu Leeward Ring		20	Purchased	
New – Big Island Saddle Road		60	Purchased	
New – Maui Hana		50	Purchased	
New – Maui Haleakala		25	Purchased	
Oceanic Interisland		6	Implemented	
Wavecom Interisland		2	Implemented	
Total				\$27,728,000

of this category is estimated for buildout of the fiber network on all islands as part of the Oceanic Cable Franchise agreement. The costs per unit for the buildout is based on an average cost to connect the site to the trunk cable. It should be noted that the number of sites do not equal 388 as there are 34 sites that are already “on net” on Kauai, Maui and the Big Island that will not be affected or incur any additional cost. The other 37 sites are “on net” on Oahu and will incur a cost to move their existing INET connections to the proposed new rings. Lanai and Molokai are included in the Maui site count as they are part of the County of Maui. All Oceanic Time Warner Cable costs reflect the “at cost” as required by the cable franchise agreement.

Average costs for new connections vary per island based on geographical differences (i.e. long fiber runs from main trunk to site, cabling through underground conduits, etc). These numbers are based on approximately \$10/foot of fiber cable runs from the site to the closet splice closure on INET trunk fiber. The majority of sites would have less than 1 mile of fiber required, however there are a number of sites that require longer distances to trunk fiber. These costs average out to the unit costs reflected per island.

is the cost to connect 193 new sites on Oahu to the INET trunk cabling based on an average of per site.

is the cost to move 37 existing sites on Oahu to their respective new fiber rings based on an average per site.

is the cost to connect 35 new sites on Maui, Molokai and Lani to the INET trunk cabling based on an average of per site.

is the cost to connect 67 new sites on the Big Island to the INET trunk cabling based on an average of per site.

is the cost to connect 22 new sites on Kauai to the INET trunk cabling based on an average of per site.

Separate fiber rings will be built out on Oahu to ease the addition of the numerous sites on the Oahu INET network. As the majority of schools and libraries are on the island of Oahu, it would be difficult to connect all the schools and library to the existing single INET ring and maintain functionality. Two additional pairs will be built out to separate the DOE and UH from the existing INET ring as part of this project. The following costs represent the cost to run new trunk fiber runs in locations that are currently too congested to provide additional fiber strands. The cost per foot is a Time Warner corporate standard for Hawaii – which is higher than the continental United States due to increased labor cost (unionized workers) and materials (shipping). Cabling contractors that Oceanic Time Warner Cable uses are the same contractors that both the incumbent and competitive local exchange carriers use for fiber and copper cabling runs – thus the approximate cost per foot would be similar. Cabling costs include both cable laid and fiber terminations/splices in splice closures. Due to the large number of metro miles on Oahu, there are more terminations per mile than compared to the rural neighbor island locations.



██████████ is the cost for approximately 45 new miles of fiber to expand the East Oahu ring to provide additional pairs to separate the DOE and UH from the current INET ring based on ██████████ per mile ██████████. Much of the East Oahu ring is underground and/or through metro areas.

██████████ is the cost for approximately 40 miles of new fiber to expand the North Shore Oahu ring based on ██████████ per mile ██████████. Significant portions of the North Shore ring is underground and/or through metro areas.

██████████ is the cost for approximately 20 miles of new fiber to expand the Leeward Oahu ring based on ██████████ per mile ██████████. Significant portions of the Leeward ring is underground and/or through metro areas.

New fiber cabling will be run on Maui and the Big Island to locations currently not served by fiber. Costs are slightly lower on the neighbor islands as the runs are in rural areas and primarily aerial, thereby reducing the number of terminations/splices per mile.

██████████ is the cost for 60 miles of fiber to run across the Saddle Road of the Big Island based on ██████████ per mile ██████████.

██████████ is the cost for 50 miles of fiber to run to Hana based on ██████████ per mile ██████████.

██████████ is the cost for 25 miles of fiber to run up to the summit of Haleakala based on ██████████ per mile ██████████.

Interisland connectivity will be provided by two providers – Oceanic Time Warner Cable and Wavecom Solutions. Two providers were used as only Wavecom Solutions has the capability to provide fiber connectivity to Lanai and Molokai.

██████████ of this category is estimated for 6 10Gbps Ethernet circuits connecting the 4 major Hawaiian Islands from Oceanic Time Warner Cable at a unit cost of ██████████. The 10Gbps circuit runs are as follows:

Qty	From	To
1	Kauai	Oahu
2	Maui	Oahu
1	Big Island	Oahu
1	Maui	Big Island

██████████ of this category is estimated for 2 10Gbps Ethernet circuits connecting Lanai and Molokai to Oahu at a unit cost of ██████████ from Wavecom Solutions. This represents the initial buildout and new fiber runs to the University sites on Lanai and Molokai from the respective cable landing stations. The 10Gbps circuit runs are as follows.

Qty	From	To
1	Molokai	Oahu
1	Lanai	Oahu

In the terrestrial fiber network, there will a total of 165 miles of new backbone fiber and 75 miles of new lateral fiber (5 miles were added to the backbone from the original number provided in the Key Metrics Dashboard document). Total miles in the network are approximately 1005 miles, with 770 miles backbone and 235 being lateral. Existing fiber used is a total of 765 miles, with 605 miles of backbone fiber and 160 miles of lateral fiber.



The Interisland transport are light waves on the provider's fiber infrastructure. The project will not be obtaining dark fiber but will be provided wavelengths between the islands. Thus there is no undersea fiber build out component in the project. The total distance of the fiber network between all Hawaiian Islands is approximately 300 miles.

Matching funds for this category consists of \$3,670,000 in University of Hawaii Extramural funds and \$4,000,000 from the Department of Commerce and Consumer Affairs Cable Television Division. Total matching funds for this category is \$7,670,000.00.

There is no in-kind matching funds for this project

13. Contingencies - \$0

Contingencies are an unallowable expenditures under BTOP.

15. Project (program) income - \$0

No Program Income.