Cloud Driven Multidisciplinary Changes to Computing Infrastructure at Canada France Hawaii Telescope

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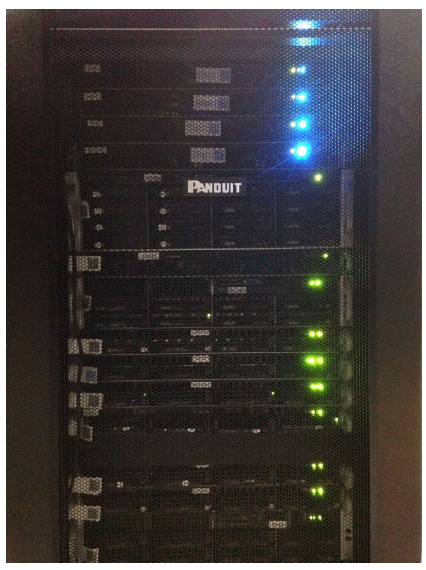
Fig. 1 - CFHT's Kamuela facility, with a 99,975 watts AC solar panel installation, performed by Renewable Energy Services. The system offsets 79.72 tons CO_2/yr.

INTRODUCTION

At CFHT, computing has mainly stayed under the roof and dome, but the cloud has had an undeniable effect on systems design. Increasingly our designs seek efficiency, green operations, continuity and future interoperability. To accomplish this, a multidisciplinary approach was needed targeting the physical environment as well as software design.



Physical Environment

Programming

CONCLUSION

Solutions to CFHT's computing design draws expertise from multiple disciplines. Within the company, input from the software, operations and admin groups contributed to the current problems and requirements. In the future computing may leave the roof and dome and some services have already been migrated to Software as a Service offerings such as the company's payroll and travel systems. Other projects like a migration to open source LDAP identity, policy and authentication are aimed at easing future transitions to the cloud.

1. Hawaii State Energy Office, *"Hawaii Energy Facts and Figures," (2015).*

2. http://www.homerenergy.com/HOMER_pro.html

3. Carbon Factor from RETScreen, Natural Resources Canada.

4. https://code.google.com/p/ganeti/

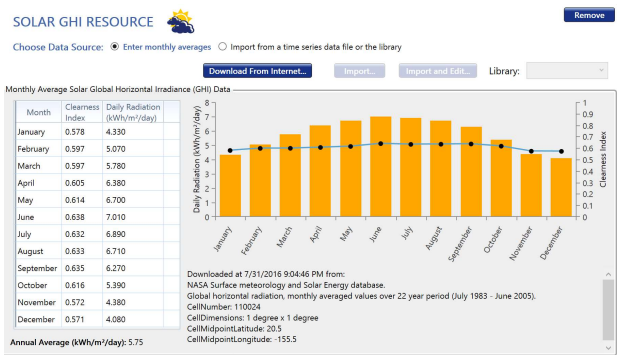
DATA CENTER

CHFT's location in Kamuela, HI provides a unique advantage as it is one of the coolest microclimates on the Big Island. In comparision, mean temperatures in Hilo, where most of the Maunakea observatory headquarters are located is 10-15 degrees higher and morning humidity ranges around 10% higher. Yet Kamula still enjoys a high degree of solar insolence.

Table 1 – Monthly Temperature and Humidity averages from myforecast.com for Kamula, HI.

	Avg High Temp F	Avg Low Temp F	Avg Mean Temp F	Avg Dew Point F	Avg Morning Humidity %	Avg Afternoon Humidity %
Jan	67	40	53	45	72	61
Feb	66	39	53	45	70	61
Mar	67	41	54	46	67	61
Apr	67	43	55	49	71	65
May	69	43	56	50	71	65
Jun	71	44	58	51	67	63
Jul	72	47	60	52	68	61
Aug	73	47	60	52	68	60
Sep	72	46	59	53	71	65
Oct	70	46	58	52	70	64
Nov	70	46	58	49	67	60
Dec	67	42	55	45	66	59

Fig. 4 Horizontal isolance and clearness from HomerPro[2].



This allows CFHT to cool it's main server room with outside air and without the aid of an air conditioner. The room is partitioned by modular PVC curtains into hot aisles and cold aisles and intake and exhaust are aided with constant speed fans. The room volume is 68.95 cubic meters. Using LED lighting and fans, Power Use Efficiency approaches 1.

Fig. 2 - Kamuela Server Room with PVC curtains installed.

6 month energy savings from cooling project – 16.48 MWh

6 month grid energy reduction – 17.76 MWh

CO_2 reduced – 14.21 metric tons CO_2[3]

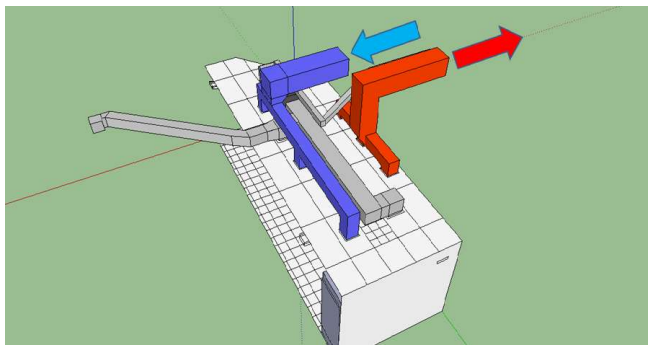


Fig. 3 – CAD drawing of server room with proposed air flow in Google SketchUp by 2012 Akamai Project Intern, Aaron Pigott.

SOFTWARE TECHNIQUES

Server are still predominantly under the roof and dome at CFHT to support controls, automation, data acquisition and the remote observing environment. But to be cloud competitive, higher utilization per server was needed. Servers running on bare metal had low CPU utilization, peaking at 7.5%, with the majority under 2.5%. Virtualization was used to increase utilization. It also allowed servers to be hardware independent, decreasing deployment time and increasing flexibility. Servers running under a Vmware hypervisor have been in place at CFHT for a few of years with better utilization of hardware.

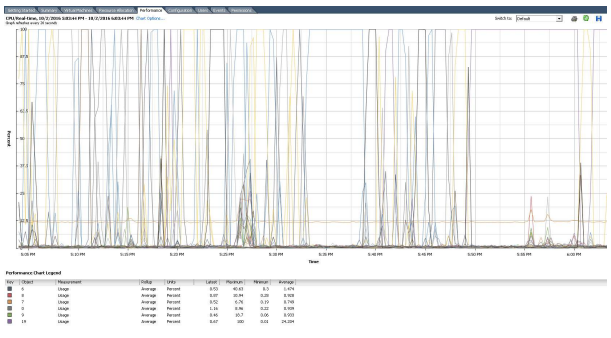


Fig. 7 – Vmware servers increased utilization, with individual cores on the hypervisor reaching 100% utilization of CPU.

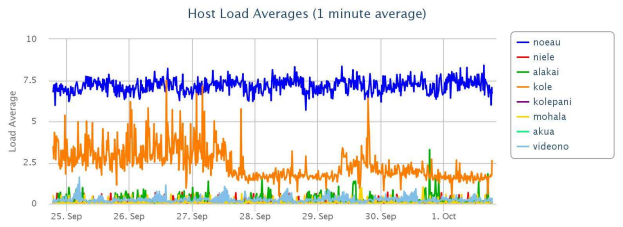
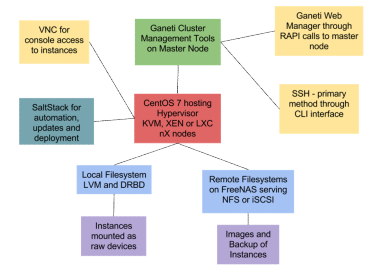


Fig. 5 – Load on various servers running on bare metal.

For expanding the system's virtualization, Ganeti Cluster Management Tool, a Google project, and Kernel-based Virtual Machine, standard in a CentOS distribution, were chosen over Vmware and OpenStack.[4] The advantages were no licensing requirements and lower overhead for the intended deployment size.



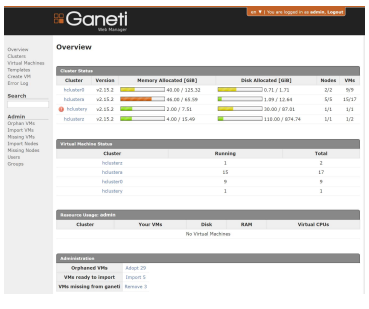


Fig. 6 & 8 – Block diagram of virtualization deployment. Screenshot of the web management interface from Oregon State OSL. The primary interface for administrators to manage the cluster is the command line interface.