



## Intelesense Technologies and University of Hawaii

### Develop Next Generation Monitoring Technologies

The Center for Conservation Research and Training at the University of Hawaii at Manoa was founded in 1993 to establish Hawaii as a “Model System” for environmental research and technology development. Center Director Ken Kaneshiro and Associate Director Mike Kido have championed the concept that Hawaiian Island environments provide ideal “test beds” for developing the models and technologies required to help achieve sustainability in coexisting human-environment systems. In these microcosms of “whole systems”, sustainability challenges such as biodiversity conservation, climate monitoring, ecosystem protection services and others could be studied at manageable spatial scales. Results from the Center are used in developing and testing products that are transitioned to the private sector for commercialization and society as a whole.

For thousands of years, native Hawaiians have relied on irrigating ponds obtained from fresh water streams and surface springs to grow *taro*, their primary food staple. As time progressed, operationalizing sustainable use of surface water ultimately became the basis for the fundamental unit of the Hawaiian land ownership system, known as the *ahupua'a*. Each *ahupua'a* had discrete geophysical boundaries that ran from mountain-to-sea and were governed by social rules and norms for managing their use. Water resources within an *ahupua'a* were such a critical resource to Hawaiians that each one was revered as the physical manifestation of their god *Kane*. Highly regarded individuals (*Konohiki*) were appointed to manage water allocation within- and between-land divisions. Carefully managed surface water became the basis of sustainable development within this ancient society. Quoting Hawaiian folklore, “*He hūewai ola ke kanaka na Kane* - Water is life and Kane is the keeper of water”.

#### Location:

Kauai, Hawaii

#### Challenge:

Determine impact of human activities in the Waipa Valley

#### Intelesense Solution:

- IntelCell
- Intelesense Data Exchange
- IntelView
- Intelesense Portals

One of the Center's primary research sites is the **Waipa Ahupua'a** located on the northern shore of Kauai. Encompassing an area of about 1000 acres, Waipa has been drastically altered by human uses including *taro* cultivation by native Hawaiian communities, closely followed by extensive periods of rice growing and cattle ranching. Except for remnant patches near the headwaters of Waipa Stream, human activities have nearly decimated all of the native forest in the valley replacing it with non-indigenous pasture grasses.

About thirty years ago, **The Waipa Foundation** was started by native Hawaiian residents to restore the biophysical resources of Waipa and to perpetuate Hawaiian culture by traditional *taro* cultivation techniques. According to the Foundation, it is estimated that about 20 acres of *taro* are cultivated in Waipa using approximately 75 % of the base flow of Waipa Stream used for their irrigation. However, there appear to be limitations in the surface water supply which is needed to support expansion of wetland *taro* farming. To complicate matters, historic changes to forest structure and composition in Waipa's upper watershed have changed the natural dynamics of surface water capture, retention and release in the system making the stream system more vulnerable to flooding. Despite great uncertainty for Waipa residents as to the quantity, quality, and movement of surface water in their *ahupua'a*, a number of ongoing management projects have started including restoration of Waipa's estuary and wetland, replanting of native *koa* trees in upper valley areas and the implementation of a long-term Agricultural Plan in the valley.

Further, several building projects are also in Waipa's Master Plan such as providing additional office space and a certified kitchen to process *taro* into *poi* for the extended community. Therefore, major physical changes to the existing watershed landscape have been proposed causing concern about their long-term impacts to water and other resources in the *ahupua'a*. This will become even more critical as projected climate change impacts unfold.

The rugged, wet Hawaiian environment required technology that could withstand the harsh conditions, communicate information reliably over long distances, and was able to incorporate a variety of environmental sensors at the same time. After reviewing options, the research team associated with the University of Hawaii selected Intelesense Technologies™ environmental monitoring equipment as its data gathering and analysis platform. In 2009, the University of Hawaii partnered with Intelesense to assist the Waipa Foundation with monitoring the climate in Waipa Valley and water quality flows in Waipa Stream. To facilitate this effort, Intelesense installed a wireless sensor network-based system comprised of three components to maximize intelligent, real time data acquisition: the IntelCell™, IntelNet™, and IntelView™.

The rugged IntelCell is designed to withstand extreme conditions such as the ones in the Waipa Valley, yet reliably transmit sensor data across long distances resolving many of the environmental challenges faced including:

- Support for multiple types of sensors simultaneously
- Locating units in unmapped terrain using built-in GPS
- Recharging high-capacity batteries using solar panels
- Versatility of units to act as repeaters, dataloggers and / or base stations

First, a network of IntelCell repeaters was established on high ridges in Waipa Valley to provide broad data transmission coverage from the valley floor and stream. These repeaters formed a smart mesh network and transmitted sensor data to an IntelCell base station



#### IntelCell Deployment

Intelesense's wireless sensor network transmits data from high ridges located in the Waipa Ahupua'a to the Waipa Foundation offices near the coast.

located in Waipa Foundation offices near the coast. Climate in the valley was monitored using IntelCell-based Vaisala-brand weather stations installed in both lower and upper valley locations. To monitor water quality and flows in Waipa Stream and the *taro* ditch system, stream stations were installed using YSI sondes and Troll 500 Level Sensors connected to IntelCells acting as datalogging repeaters.

Data from these devices are transmitted to an IntelCell base station where the results are uploaded to the IntelNet, a global network which transmits environmental data from all field-based systems. Data obtained by the IntelNet is sent to Intelesense's Data Exchange, a robust Internet-based geo-repository housed in a secure facility with multiple high-bandwidth network connections and partner networks located around the world. Once the data is processed by the Intelesense Data Exchange, the results can be displayed on Portals that display the results in various formats including interactive three dimensional maps which can be viewed on a computer, a tablet or even a smart phone. This architecture makes Intelesense Technologies highly adaptable for challenging deployments such as this.

Since then, the collaboration between The University of Hawaii and Intelesense Technologies has provided researchers with a powerful suite of integrated tools for environmental monitoring and research which has been leveraged in large proposals to organizations such as the National Science Foundation. In the Waipa *Ahupua'a* on Kauai, local residents are now better able to monitor climate variability in the valley as well as water resource states in their stream and agricultural irrigation system. This capability will be invaluable as this community develops plans and strategies to address the challenges of climate change impacts which are already affecting the Hawaiian Islands. According to one of the members of the Foundation, "Prior to Intelesense, we did not have any data related to monitoring environmental conditions from a mountain to sea scale. By using the Intelesense technology, not only were we were not only able to do that very quickly, we could gather, organize and share this information with others in real-time as well."

In the first half of 2013, Intelesense will release Collaborate.org, an online community that will facilitate global communication. This network will provide a robust platform for sharing data gathered by IntelCells as well as third party data from a variety of sources as well as provide a variety of other features to facilitate interaction with groups of any size. As a beta tester of this network, researchers at the Center for Conservation Research and Training have been very pleased and look forward to using it as part of their ongoing programs, sharing their findings, and collaborating with other organizations world-wide.

As we continue to face challenges on Earth such as global warming, the spread of infectious diseases, loss of biodiversity and overuse of natural resources such as water, we will need to pool resources from individuals, organizations, and companies worldwide to efficiently address these issues. Intelesense Technologies is already poised to be a valuable resource to integrate environmental monitoring technology with interdisciplinary collaboration for academic institutions, non-profit organizations and local communities as a whole.

[www.intelesense.net](http://www.intelesense.net)

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— *Waipa Foundation*



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