INTERNET
USERS SOCIETY
Niue

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Niue's .nu

Creating a Wireless Nation

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Richard St. Clair is Chairman of the Pacific Islands Chapter of the Internet Society (PICISOC) and the technical manager for the Internet User's Society - Niue, the charitable foundation which administers .nu, the ISO-3166 country code Top Level Domain (ccTLD) associated with the island of Niue (pronounced New-way). When St. Clair first arrived in Niue in 1994, the telephone in his house had a crank on the side and his phone number was "two longs and a short" turn of the crank. Now, with funds provided by the global marketing of .nu, he has created a Niuean technological infrastructure and provides free dial-up and DSL Internet access for the Island's residents via a satellite connection to New Zealand.

The Island of Niue with a population of less than 2,000, is the world's smallest independent self-governed nation, and is a former dependency of New Zealand. And now, it's the world's smallest "wireless nation." Using funds generated by registrations of the .NU ccTLD, the Internet Users Society-Niue, a private, nonprofit, non-government charitable foundation, is building the world's first nation-wide WiFi Internet access service, all at no cost to the public or the local government.

Affectionately known as "the Rock," Niue is often cited as the largest upraised coral atoll in the world. A single land mass in the center of a triangle of Polynesian islands, made up of Tonga, Western Samoa and

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the Cook Islands, Niue is located 2400 km north-east of New Zealand, on the eastern side of the International dateline, and is 11 hours behind Greenwich Mean Time. The island's isolation and coral makeup create a rugged coastline and reef which provide intimate swimming coves as opposed to the typical long stretches of sandy beaches so predominant elsewhere in Polynesia. As a result it is a whale-watchers', snorkelers' and scuba divers' paradise. The landmass of Niue is 259 sq. km, and 13 villages are found along Niue's 67-km circle island road.

The Internet Users Society – Niue (IUS-N) was designated to administer the .NU top level domain (TLD), commonly known as the .NU Country Code TLD (ccTLD), by the Internet Assigned Numbers Authority (IANA), in early 1997. IUS-N was founded in 1997 by J. William Semich in the US and others in Niue with the aim of using .NU domain name registration fees to fund the high costs of satellite-based Internet connectivity in Niue.

SINCE IUS-N FIRST INTRODUCED free Email services to the nation of Niue in 1997 and subsequently launched free full Internet access services for all the people of Niue in 1999, exciting new technologies have been under development for Niue's local Internet community. Amazingly enough, in a very short time Niue has become an extremely diverse communications technology home. With continued investment by IUS-N, Niue will be the future home of even more diverse technologies. Its size makes research and development one of its more friendly environments, and the Internet Users Society-Niue has been testing innovative Internet technologies on the island for the past six years.

Globally there are many new communications technologies available. Some have been around for a few years now, and some are just coming of age even at R&D levels. As in the case of Niue, many of these new technologies have been tried, developed and placed in service, most within the past 5 years where Information Communications Technology is concerned. And of all the emerging communications technologies that Niue has seen, all have been extremely successful and useful, each in its own way.

WIRELESS IS THE MOST RECENT ON the scene in this small nation in the South Pacific. WiFi, 802.11 [or IEEE 802.11] is a type of radio technology used for wireless local area networks, based on a standard developed by the IEEE for local and wire networks within the 802.11 section. WiFi 802.11 is composed of several standards operating in different frequencies. 802.11b is a standard for wireless operating in the 2.4 Ghz spectrum, with a bandwidth of 11 Mbps. 802.11a operates in the 5Ghz range with a bandwidth of 54 Mbps. 802.11g is yet a third standard operating in the 2.4Ghz range but with a bandwidth of 54 Mbps. Hence "the ABGs" of WiFi.

SINCE 1997, IUS-N HAS provided free basic Internet services on Niue via modem dial-up only, using analog modems for all users over copper cable and POTs (plain old telephone systems). The local Internet community would dial in to IUS-N's servers located on Niue. These servers are connected to the Internet backbone by way of a costly satellite link to New Zealand.

The dialup process has worked reasonably well considering the hostile natural conditions on Niue. For example, tropical rainstorms often saturate the ground where copper lines are laid and have existed for decades without replacement. This causes

ALL PHOTOS BY: EMANI AND TANI LUI

noise level increases and high signal to noise ratios. Lightning strikes are common, and most damage to computer systems statistically comes from the phone line surges caused from strikes.

Niue has no natural Earth ground, and therefore actually appears to an energy source as a giant capacitor-resistor floating on the ocean floor some thousands of feet down. Add to that the dielectric constant of ocean water, with a fresh water lens floating in coral and it makes Niue a very interesting specimen of electrical properties. Instead of being called one of the largest coral atolls in the world, perhaps it should better be called the world's largest electronic component, a virtual "pie network tank" or "capacitive resistance tank."

SO WHEN LIGHTNING STRIKES OCCUR, the energy has a need to go someplace that it just can't go in Niue and generally ends up in the computer equipment. I've often said to visiting techies, "Somewhere around here we have a giant box full of melted modems, some of which actually caught fire while experiencing their demise."

Still, with all these and other harsh conditions in Niue, the country's few hundred users dial up and are online a total of 6,000 or more hours per month using the 24 incoming lines leased by IUS-N from the government-owned Telecom Niue. Between 20-30,000 email messages per week go in and out of Niue, and web traffic ranges in the 300-500 megabyte per day range.

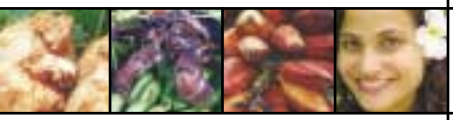
The Internet services on Niue have become a locally expected utility as common as running water or electricity. Since the traffic and demand have increased dramatically since the Internet services first came online with full services in 1999, the Internet Users Society-Niue has been looking ahead to keep up, and has been ready with new technologies as they have become available.

Recently, for instance, the IUS-N developed and installed DSL broadband services to its free Public Access point in Alofi ("Internet Café") using existing standard copper telephone lines leased from Telecom Niue. This has resulted in IUS-N being able to provide more machines for public use. Even though the conditions are hostile on Niue, the quality and robust nature of broadband short haul modems installed and maintained by IUS-N make the DSL services a welcome advance in communications capabilities for the local community.

The .NU Domain is Building a License-free 802.11 Infrastructure on the Tropical Island of Niue – It's as simple as "ABG".

IT HAS BEEN RUNNING ERROR FREE through good and bad weather as well as its share of lightning-filled days without a single problem. It has proved itself on Niue as a technology that is much more reliable and immune to failures than the analog modems. "We were very limited in the first two years of operation in the public access point. We had 6 computers running behind one single dial up analog modem in the office here", says Emani Lui, director of development and manager of the Alofi Public Access Point, IUS-N, "It worked very well, but was amazingly slow. Now we have more machines for the local Internet community to use, and they run at normal broadband speeds."

"IT'S IMPORTANT THAT THE PUBLIC access point runs well, since that means anyone in Niue who cannot afford a computer of their own at home can have



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Internet access", says Lui. "Broadband allows us to keep up with that demand in the local Internet community, especially among young students".

Since the availability of copper lines is limited mainly just to Niue's capital, Alofi, and since the commercial grade DSL equipment required at both ends is somewhat expensive, the broadband services have been reserved mainly for government departments' and commercial future use (and of course the presently operating public access point in downtown Alofi).

AT THE SAME TIME, LOCAL TELEPHONE lines have been (according to Telecom Niue) extremely overloaded due to the online duty cycles of calls being made. This has been attributed to IUS-N's introduction of free full Internet services in 1999, which required POTS users to be online for a higher duty cycle or duration of call in the last mile. Richard Hipa, director of Telecom Niue, has said that the local telephone systems were not designed to carry such a high duty cycle, but to carry light loads with only short calls, and far fewer users making calls simultaneously.

Until the past few months, users could experience busy lines or local circuits when trying to connect, partly because of the number of lines in service but mostly because of busy circuits in the Alofi area from extended use by Internet users. Even Telecom customers attempting to make regular voice calls have experienced busy signals due to the high number of in-use circuits. Recently, Telecom Niue was able to provide an extra block of dial up lines to the Internet Users Society-Niue, but adding dial up lines to the IUS-N machine room does not off load the local Telecom circuits. It actually increases the load.

"SINCE TELECOM MAKES METERED charges for local calls, the extra revenue that the online users are bringing in to Telecom is a very welcome profit, but no matter what, the lines can't be pushed beyond maximum capacity" said one telecom technician.

The problem or challenge then, has been to develop local methods of using technology that do not require the use of existing overloaded copper Telecom lines, but can still provide connectivity, of course using low cost equipment. By pure definition a tall order to fill, especially on such an isolated Island as Niue.

One of the innovative systems tested on Niue by the Internet Users Society-Niue in the past year was the PLC (power line carrier) network systems which can run data over standard AC utility wall outlets [mains]. While these networks performed very well and were virtually error free in all of the tests, even through lightning storms and other hostile conditions, they are confined to mostly "in building" networks. They have no low cost ability to jump across transformers in the high-tension lines. Equipment to make such a jump is still in the range of thousands of dollars per unit, and therefore can be ignored as too costly for local multiple network implementation.

THAT FACT IS A TESTAMENT to a limitation, which makes it a very useful technology for small network jumps inside offices and any other topography, powered by common AC circuits. But going hop distances of several kilometers will simply not work in most places, and Niue's power grid configuration

places Niue in that category. What Niue needed was an appropriate technology for a small, minimally-powered, isolated developing nation comprised of isolated villages with no copper cable connecting them to the communications infrastructure.

Fortunately, license free standards for WiFi have been on the horizon for a time, and the low cost of equipment associated with those standards finally present themselves as a cost effective bandwidth opportunity for countries like Niue. There are currently scores of manufactures producing low cost WiFi equipment, internationally accepted as license free, that is essentially readily available and not much more expensive (from the end user's point of view) than a standard 56K modem. Some new computers are already equipped with WiFi as part of a standard factory package, or as an add-on much in the way that modems were when they first hit the markets some years ago.

THIS IS GOOD NEWS FOR SMALL emerging Island countries like Niue. The harsh conditions of rain, lightning, salt water, and high humidity cause major problems with underground copper lines. Additionally, such lines are often so scarce, that an end user could wait some period of weeks or months to get a new line installed. Where the equation resembles this scenario, WiFi is the answer.

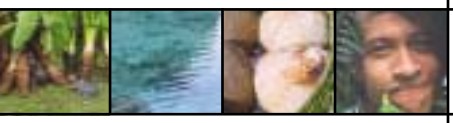
Wireless of course requires no copper lines for data transmission. The number of concurrent connections can be configured or implemented in any number of network topographies according to demand. Even the license free models running extremely low power (often in the 17dbm range or less depending on the manufacturer) can implement nodes as much as 5 kilometers apart using line of site and high quality antenna systems. Speed of up to 54 Mbps are now possible over short distances with the current WiFi standards, and since the release of those new higher speeds, the lesser cutting edge 11 Mbps equipment can be purchased and put in service relatively inexpensively.

As for Niue, this small island is only 259 square kilometers, and is well suited for short hops of microwaves. The Internet Users Society-Niue has begun the development of this WiFi technology which is already running and online in some parts of Alofi (Niue's capital city) as a free open node in the vicinity of the Public Access point. Additionally, the task of assisting telecom Niue in offloading the overloaded lines is under way in the Alofi Commercial Center area with direct saturation links under construction, some already online.

INTERESTINGLY ENOUGH, SOME of the features that set Niue apart from most of the rest of the Pacific Island countries is its extremely small land mass, low population, isolation and terrain. Most of the population that has not emigrated to New Zealand or Australia (only 10% of the Niueans in the world live in Niue) lives near Alofi in a very small area. Niue's terrain is typically flat or slightly concave, with basically a single, raised elevation, giving it the claim to being a raised coral atoll.

Small population and isolation make Niue a place where communications systems, both local and global, become even more vital. Terrain however is another story. The terrain of Niue does present a few problems when it comes to radio transmissions in general.

MICROWAVES IN THE WIFI BAND are no exception. Commonly, microwaves in the WiFi band don't like to travel through live vegetation, and Niue is of course,



mostly tropical rain forest and flat. So finding adequate line of site pathways is a bit of a chore, but by using multiple inexpensive node placements (rather than a single high-powered unit, which would also require a license), this limitation can be overcome. Also Niue has no mountains whatsoever. It is in fact a coral atoll shaped very much like a pie plate, and also very much in the middle of the Pacific Ocean. Where radio transmissions are concerned, this has historically been a limitation on Niue, but in the case of short distance microwave transmission of the license free WiFi flavor, it is simply a limitation that no longer matters.

Aside from the geo-physical characteristics of WiFi, this new technology also lends itself very well to existing communications systems, community goals, and local lifestyles on Niue.

A SUBSTANTIAL PORTION of Niue's tourism comes from visiting Yacht traffic during the non-cyclone season. Yachts with onboard computer equipment with WiFi cards and external antennas will be able to park in the harbor and access full Internet services from their vessels as an open node, also free of charge. Other visitors, consultants and tourists to the island who carry laptops with either built in WiFi or as an add-on, will also have the ability to connect to the open node free of charge for the duration of their stay. Local Internet users with recent-vintage laptops will find the built in wireless features useful as more areas are covered with RF, and users who may be in the more congested telephone circuit locales such as Alofi central will also benefit from the new technology.

Also under current development with the first of three prototypes under construction is a small solar powered completely self-contained WiFi unit that can be installed in virtually any location to fill in dead spots or extend service distances. The unit consists of a sealed box containing a WiFi access Point that can be run in the client, WAP/Client, Bridge, or Peer to Peer Mode, together with a small sealed deep cycle battery, and a solar panel mounted on the top. Essentially hang it from a coconut tree, and it is certainly Coconut Wireless in every sense of the word!

THESE SPECIAL SOLAR UNITS, when placed in service, will most likely develop into an extremely useful piece of equipment that can be used in just about any environment (and certainly anywhere in the Pacific) where coverage needs to be extended or enhanced. Part of the development procedure has been to design and trial units, which can be as cheap and reliable, given the hostile conditions of heat, and humidity.

With many new possibilities to develop locally at the same time that the global technology community develops exciting new communications technologies, Niue [and places like her] can expect many positive changes in the near future. The development continues as Emani Lui, director of development, and Richard StClair, Technical manager, roam Niue mapping coverage with the "Barbie Doll Van" equipped with mobile Laptop WiFi, with 20 element Yagi, used for RF sniffing and mapping. It all takes time, and lots of it, and of course and as the saying goes, Rome wasn't built in a day. But then again, it might have been had they been equipped with WiFi technology.

Next comes the planned testing and research of running TCP/IP over redundant lasers. Is this too, a possible effective technology for Niue? Only the near future knows for sure.

Excerpted from Blue Latitudes, by Tony Horwitz, Henry Holt and Company, New York, 2002, pages 235 – 237.

While I'd been out, Roger had done some research of his own. "I found out there's a Palagi joint on the island that serves Australian beer," he said. "I need a break from rum and coconut."

We discovered the Wicked Wahoo Bar at the far end of the island. It was a pleasant open-air establishment overlooking the sea. A half-dozen patrons perched on stools with their backs to the water, facing a bar fridge adorned with bumper stickers: "You're Ugly and Your Mother Dresses You Funny" and "The Problem with Political Jokes is They Get Elected."

The place had the stale, disaffected air of expat bars the world over.

I noticed a periodical on the counter headlined Niue Economic Review. Given what we'd seen of the island's economy, I assumed this was another feeble bar joke. Flipping through it, though, I found lengthy, well-written stories about the latest doings on "the Rock," as Niue's handful of expats called the coral island.

"Where can I find Stafford guest?" I asked, reading the editor's name from the back of the review. The others laughed. "You're looking at him," said the balding, mustachioed barman. Stafford turned out to be a journalist from New Zealand who had married a Niuean and lived here for decades, running the bar and an adjoining guesthouse as well as publishing his journal.

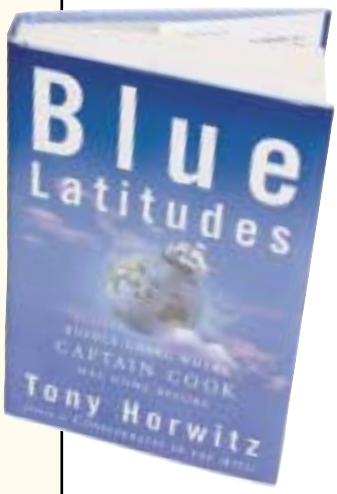
He deposited two years of back issues on the bar. They were filled with muckraking stories on astonishing scams. A small airline secured a loan from the Niue government and vanished without ever providing service to the island. A man wanted for fraud in three countries had convinced the government to give him land for a fanciful "Cyber-City" on the island, which was never built.

There were also stories on the curious enterprises we'd glimpsed in Alofi. The offshore company registry had earned Niue a place on regulatory blacklists, as one of fifteen countries accused of international money laundering. The grandiosely named Lord Liverpool University George Washington School of Medicine didn't actually qualify anyone to practice medicine. The Canadian Roger had met at the bar was the school's dean of medicine; though he was a chiropractor, not an M.D., he wore surgical scrubs to impress government ministers, who had showered the school with subsidies.

"You have these carpetbaggers flying all over the Pacific peddling get-rich-quick schemes," Stafford explained. "They come with a smile and a tie and an alligator briefcase and the government gives them everything — laws, land, loans. If these con men don't succeed at one island, they just fly on to the next."

Given all this, I was curious why Stafford chose to stay in Niue. It couldn't be easy to live in such a small place while exposing his neighbors' dubious dealings. But Stafford said he'd lived on other Pacific Islands and disliked their pervasive emphasis on clan and hierarchy. "Here, the attitude is, I come first, my family second, my village third, Niue last." People say, "Don't tell me what to do, I'm free to do what I want."

Niue had another advantage: its laws were modeled on New Zealand's, making it comparatively open and democratic, with a Westminster-style parliament and elections by secret ballot. "On a lot of islands they'd have shot me by now." He laughed, gathering up the pile of reviews. "Anyway, where else in the world would I find so much weirdness to write about?"



Stafford Guest has served as Administrative Contact for the Internet Users Society-Niue, the IANA-designated manager of the .NU domain under RFC-1591, since 1997.

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WWW.NIUE.NU

Niue Nuggets

WHAT: One of the smallest countries in the world, consisting of a 259 sq. km. island known as the "Rock of Polynesia"

WHERE: 2,400 km northeast of New Zealand in a triangle between Tonga, Samoa, and the Cook Islands

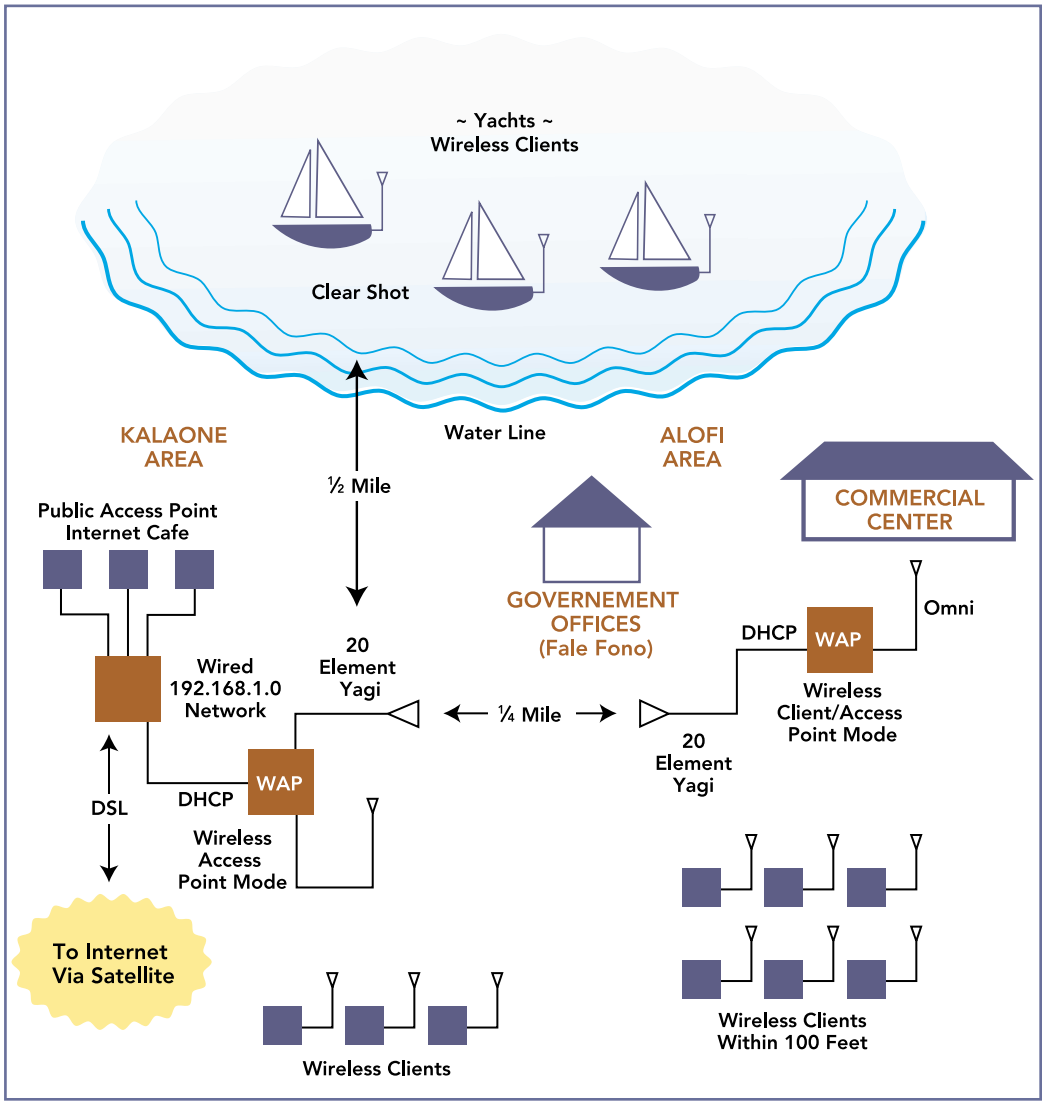
CLIMATE: Mean monthly temperatures are between 23 and 27 degrees Celsius with high humidity. From April to December, prevailing winds are the east-south-east trades; from January to March, winds are more variable. Rainfall averages 2,177 mm.

POPULATION: 1,800

GOVERNANCE: Niueans have dual citizenship as citizens of an independent nation in free association with New Zealand. Parliamentary form of government; MPs are elected, the Premier is elected by members of the Assembly

LANGUAGES: Niuean (a Polynesian tongue closely related to Tongan and Samoan) and English.

Network Topology for a WiFi Nation



Phase I: Alofi Area