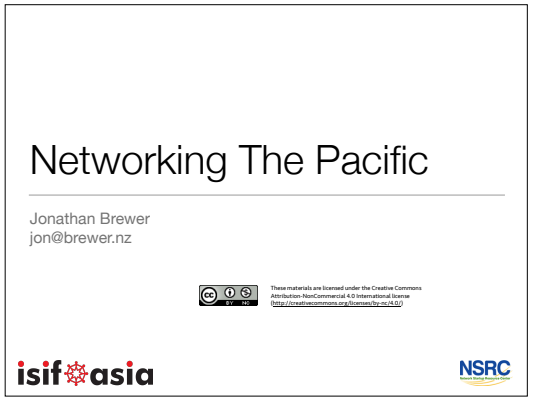


Kia ora koutou. I'm Jon Brewer, a network engineer based in Wellington New Zealand. This talk discusses preliminary findings from a larger body of work in progress around connectivity and Interconnectivity in the Pacific. I'd like to thank the Network Startup Resource Center for funding some of the early work discussed here today, and APNIC's ISIF fund for work since June 2015.

My involvement in the Pacific began two and a half years ago with a conference paper on dynamic radio spectrum and TV Whitespaces - the same one I have here in 2013.

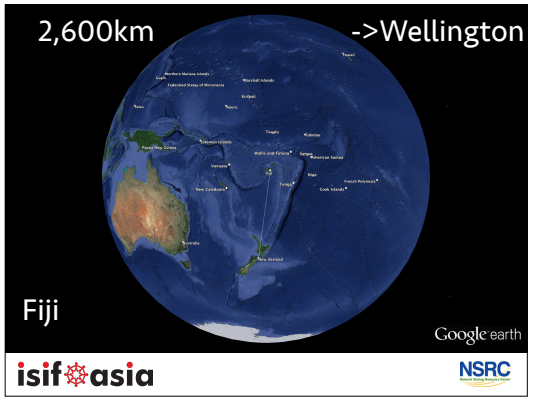
Since then I've been involved in PacNOGs as a trainer for NSRC, teaching network management & security workshops in Tonga, Fiji,

Today we'll consider the Pacific the set of these islands. Technically some are non-self-governing territories, but for this talk I might refer to these islands as countries. Even Guam, Hawaii, and American Samoa, which are all part the USA.

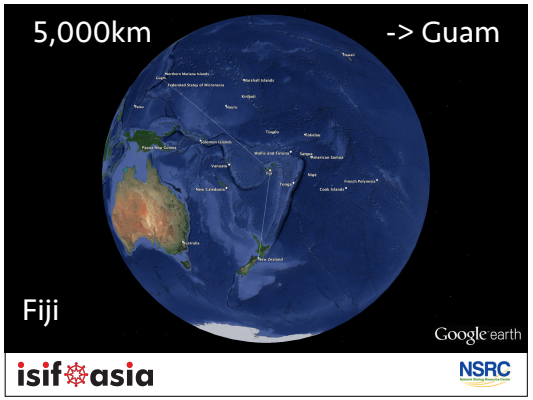
So this is the Pacific. It's a long way away from anywhere - and a lot

Remember the Truman Show? That was Jim Carey, seventeen years ago.

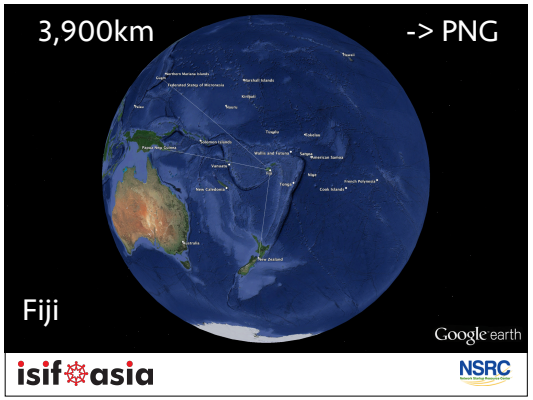
Carey plays Truman, a guy, who among a lot of other issues, dreams of getting out of his small town in America.
He wants to go as far away as you can possibly go.



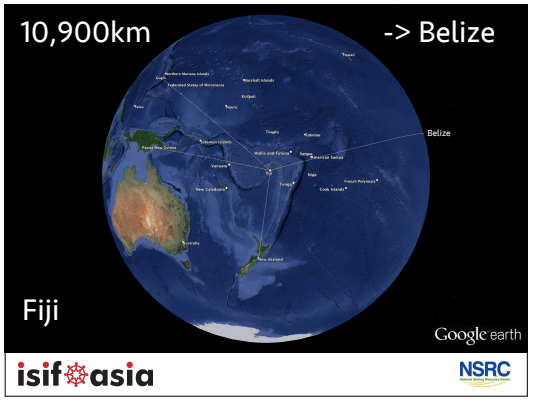
Suva is 2,600 km from Wellington. I looked it up.



It's 5,000 kilometres to Guam. I looked that up too.

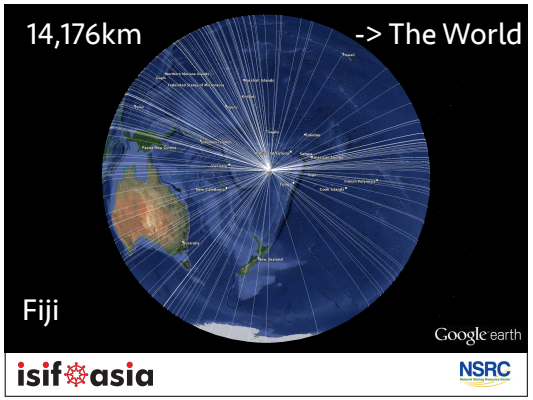


3,900 kilometres to Port Moresby.



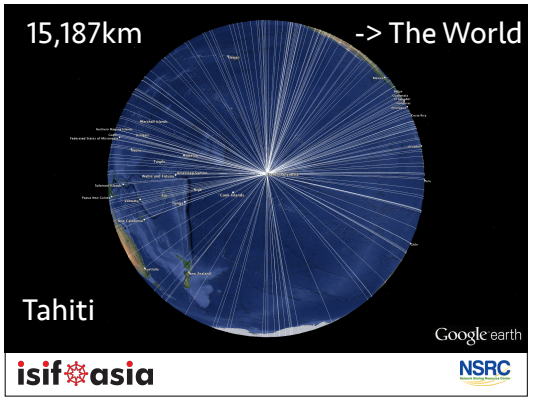
10,900 kilometres to Belize. And yeah, I looked it up.

The whole looking it up thing was getting tedious, so after about 20 goes at Google I grabbed a set of all the capital cities of the world, geocoded them, and wrote a few lines of Python to calculate all the distances from Fiji to everywhere.

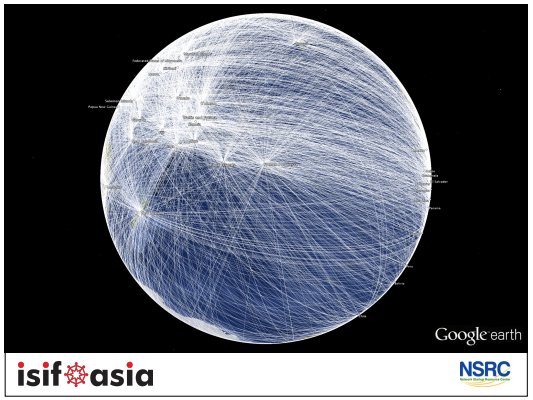


Pick a random country in the world. As it turns out, in most cases Fiji is a long way away. In fact, the median distance from Suva, Fiji to all the other capital cities in the world is 14,176 kilometres.

So was Truman Right? Is Fiji as far away as it gets?



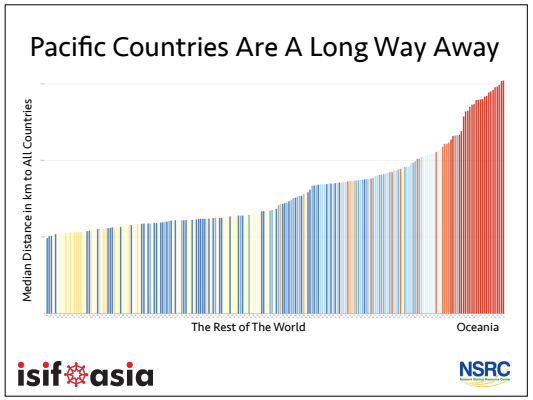
Actually Tahiti is even further away than Fiji.



And if you look at all the options (some more Python here)

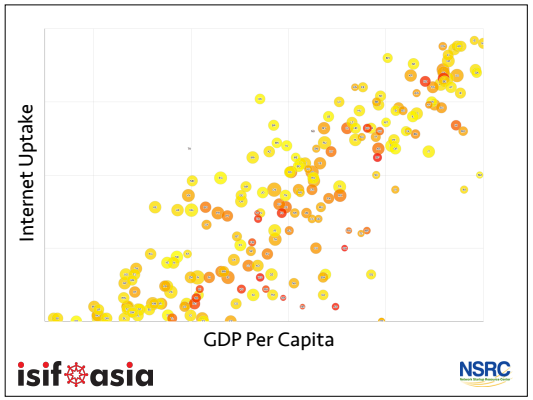
You want to get away from it all? Go to Rarotonga.

Rarotonga has the honour of being the furthest country away from everywhere else in the world.



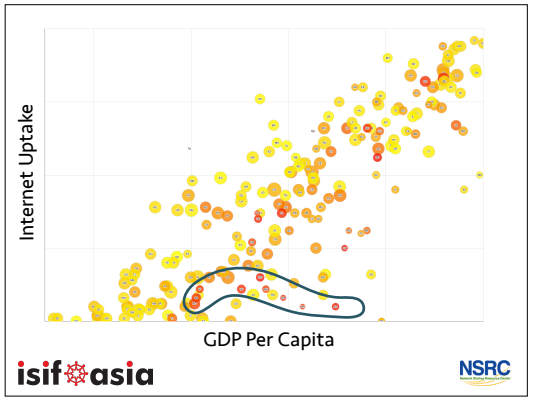
I've plotted all the median distances above, and shaded countries on a regional basis. Red is Oceania. What do we see? Pacific Countries Are A Long Way Away.

But it's not a very interesting view of the data, and I wanted to know if distance really makes a difference when it came to the use of the



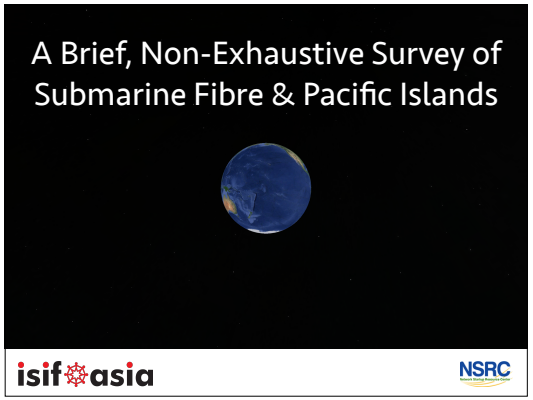
Now this is a bit more useful.

The chart up on the screen has all the same countries plotted with a bit more data I grabbed from the World Bank. Here the Y axis representing Internet Uptake, and the X representing GDP per Capita.



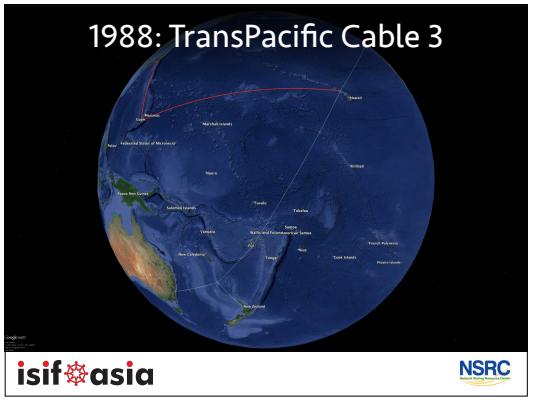
It turns out that when you look at Internet Uptake compared to GDP, distance could be a factor in some cases.

In particular, PNG, the Solomons, Kiribati, Vanuatu, Samoa, the Marshall Islands, Wallace and Futuna, Nauru, and American Samoa have lower Internet uptake rates than less-distant peers of roughly



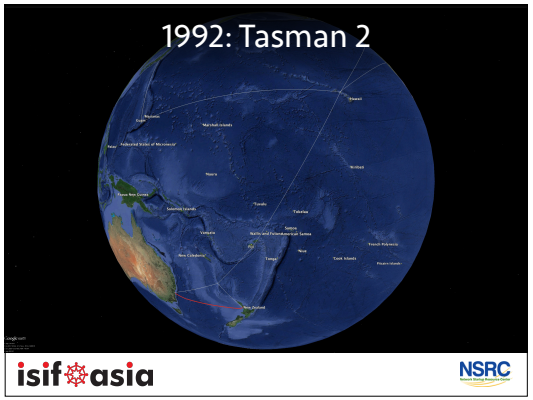
This talk is about networking the Pacific, so let's have a look at some networks.

This was the state of the Pacific in the late 1980s. ANZCAN linked Canada, Hawaii, Fiji, Norfolk Island, Australia, and New Zealand, with 1380 analogue channels, 480 of which branched off to New Zealand at Norfolk Island. ANZCAN wasn't fibre, but it carried the first Internet traffic to New Zealand.

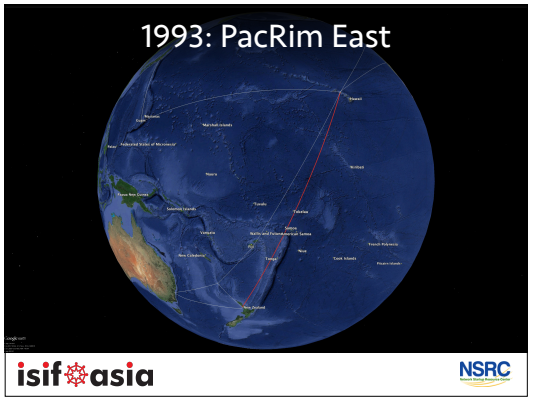


TPC3 has the honour of the first commercial submarine fibre optic cable in the Pacific.

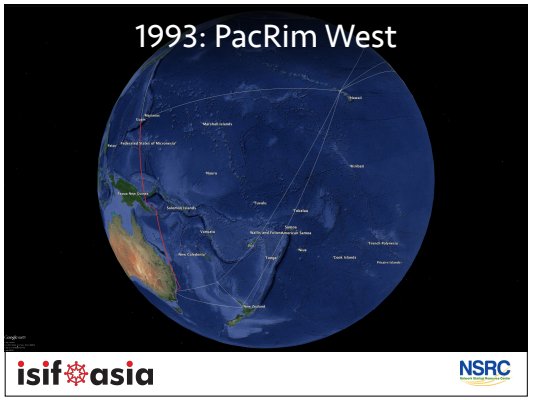
Two fibre pairs, each lit at 280 mbps. The US mainland was connected shortly after in 1989 by HAW-4, a single 280mbps pair from California, after which things quieted down for Pacific Islands for a bit.



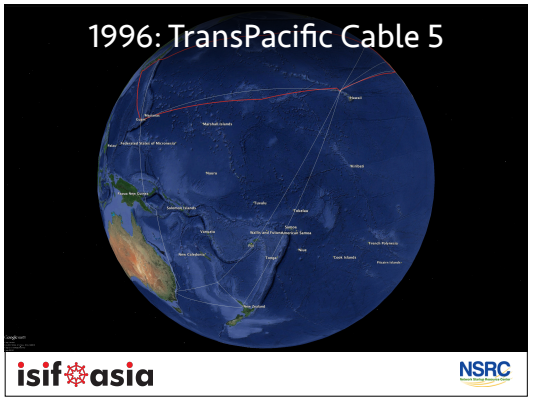
New Zealand's entry into submarine fibre came in 1992 with the lighting of Tasman 2 between Whenuapai and Sydney. Not exactly a standalone project, Tasman 2 was soon joined by…



PacRim East, joining Hawaii and Takapuna at 560mbps.

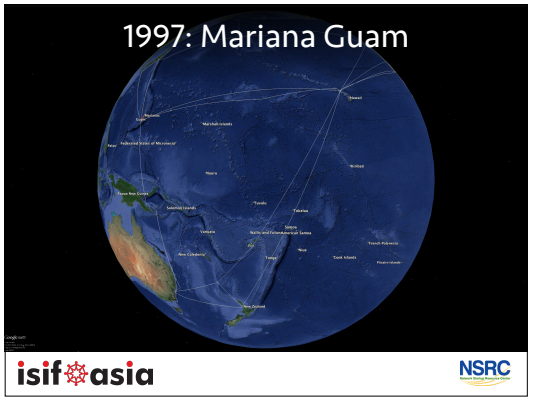


and PacRim West, joining Sydney to Guam, also at 560mbps. Not a lot of capacity, and as we'll see, these cables don't stick around all that long.

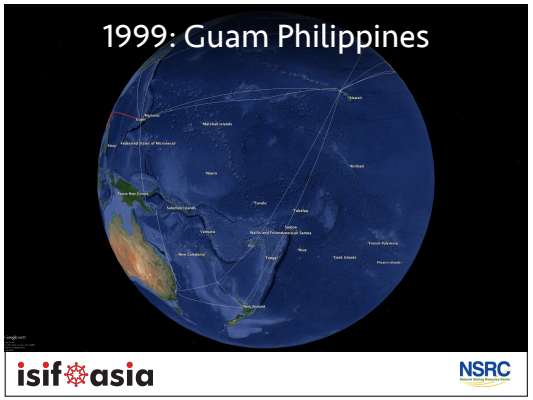


In 1996 TPC 5 lights up two pairs at 5gbps each (2x STM-16, with 32 155mbps circuits available) in a loop connecting the US, Hawaii, Guam, and Japan. That's starting to sound like real capacity, at least for the 90s. Note Hawaii and Guam both starting to become important waypoints.

I dropped by the TPC-5 landing site at Tumon Bay in Guam earlier this year. Not much to look at - a channel cut in the reef and a couple of manholes really. The landing station is up a hill around 4km away, but you have to know what you're looking for.

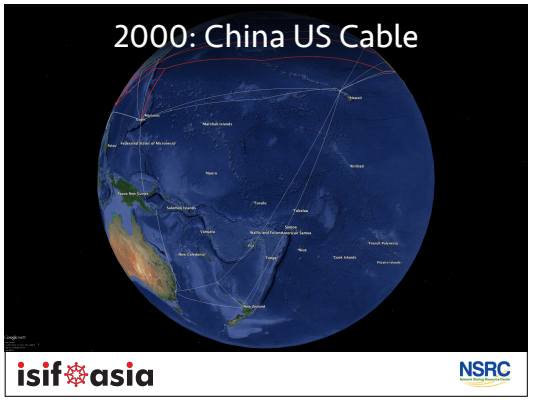


1997 brings our first island hopper cable in the Pacific, the Mariana Guam cable. 240km long, three islands of which Saipan is the biggest, and 6x 622mbps carriers. You're excused if you can't see the change on the map. Just a note, an ISP complained to me recently that they were quoted $20k a year for a T1 on this cable.

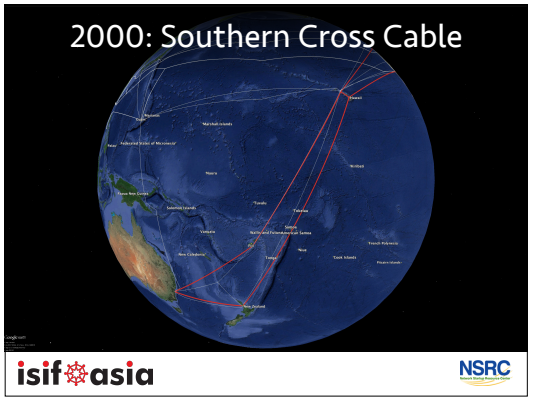


About the time Neil Stephenson was writing Cryptonomicon, a brilliant piece of fiction about cryptography, submarine fibre, and data havens, Hitachi Cable was laying a 3600km cable between Guam and the Philippines.

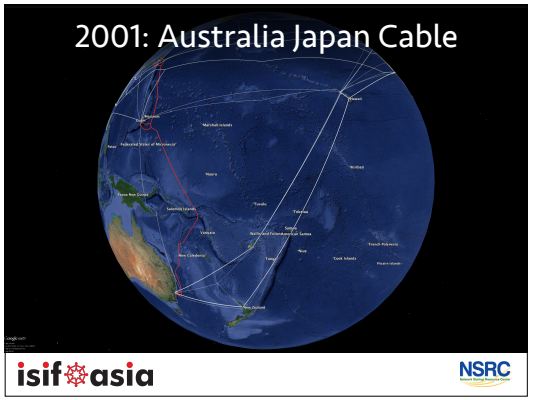
We're just getting into dotcom boom times, and fibre laying is



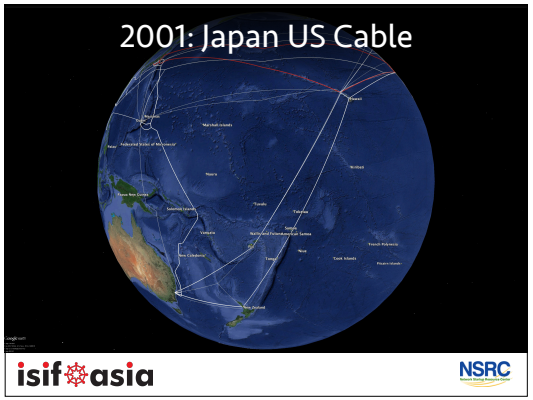
With Guam quickly becoming a hub, the China US cable drops 40gbps into Guam via a branching unit. As with Guam Philippines, Guam is now a destination, not just a waypoint.



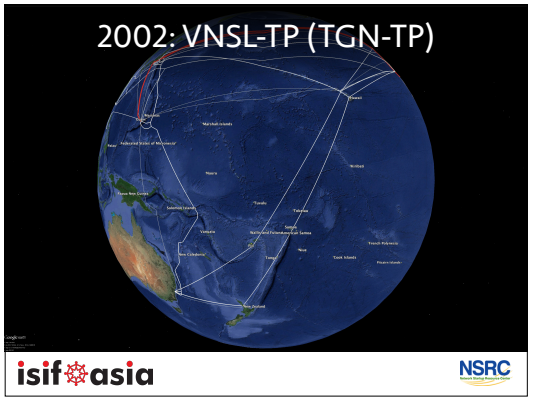
Finally New Zealand gets some love. Southern Cross is lit with 80gbps and an original design capacity of 250gbps. That's been pushed beyond a terabit by this point.



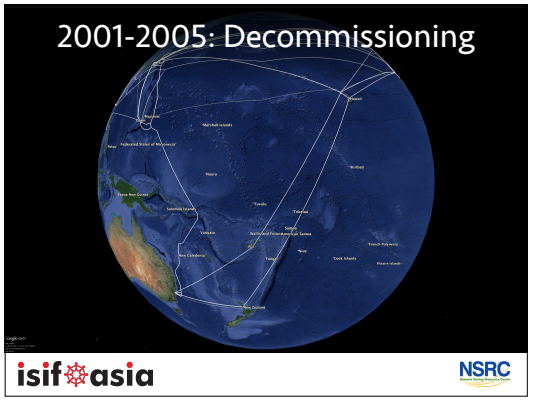
More love for Australia and for Guam with a 320gbps cable between Australia and Japan in 2001. And we see the decommissioning of PacRim East. Rest in peace PacRim East.



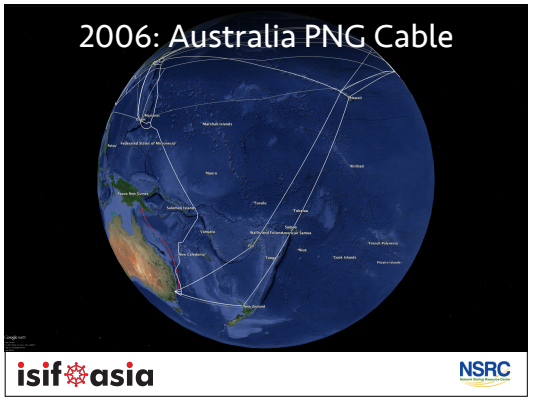
And a top-up for Hawaii in 2001, as a new cable from the US to Japan passes through with 320 gigabits per second. Hawaii - or at least O'ahu, is now as busy as Guam when it comes to cables. Capacity was doubled in 2008.



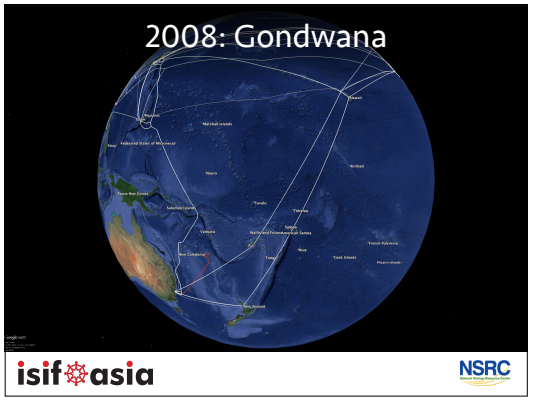
2002 brings the decommissioning of ANZCAN and the introduction of VNSL Transpacific (now known as TGN Pacific), nominally a US Japan cable, but with a branch down to Guam to meet the rest of the world there. Design capacity of 5 terabits per second - another step change for the Pacific.



With their limited capacity, the short-lived PacRim cables are decommissioned - NZ to Hawaii in 2001, and Australia to Japan in 2005. We lose TPC-3 in 2003, HAW-4 in 2004, and HAW-5 in 2005. But all is not lost.

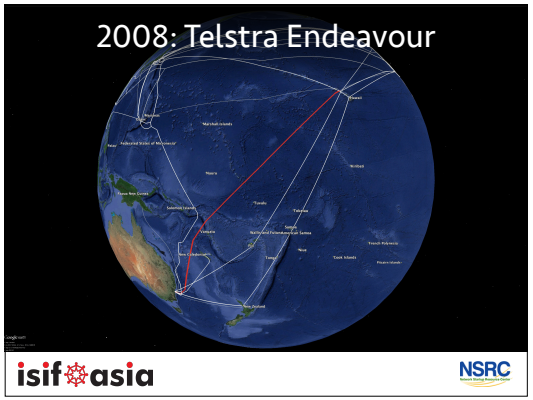


2006 has the cold, dead snake of PacRim West dragged off the seafloor and hauled to Port Moresby - recommissioned with a design bandwidth of just over a gigabit per second. From what I understand, regeneration in this cable is electronic, not optical, and E5 (565mbps) is as fast as electronic regeneration will work. So we've got two 565mbps pairs bringing a total of 1.1 gigabit per second into PNG.

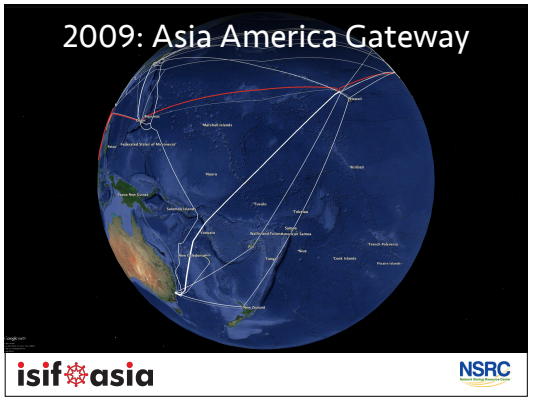


New Caledonia is the first major island infill project, with a new cable from Sydney lit at 20gbps in 2008. Likely taking advantage of idle Alcatel staff who would otherwise be waiting around to fix issues on Southern Cross.

Just a couple more k and they'd have made it to Vanuatu, but that

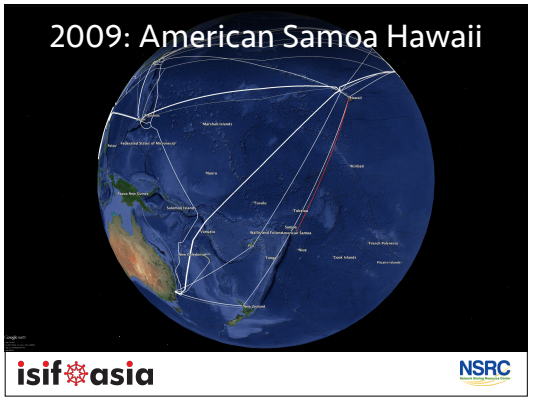


Also in 2008, Telstra lays a new cable directly from Sydney to Hawaii, bypassing Vanuatu, the Solomons, New Caledonia… You'd think they could have saved money combining efforts with Gondwana, but if there's anything I've learned about submarine cables it's that people don't cooperate. Endeavour is a 1.28 terabit per second cable.

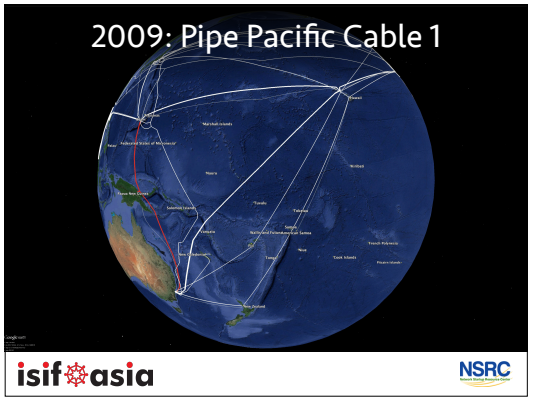


In 2009, we have the commissioning of the Asia America Gateway.

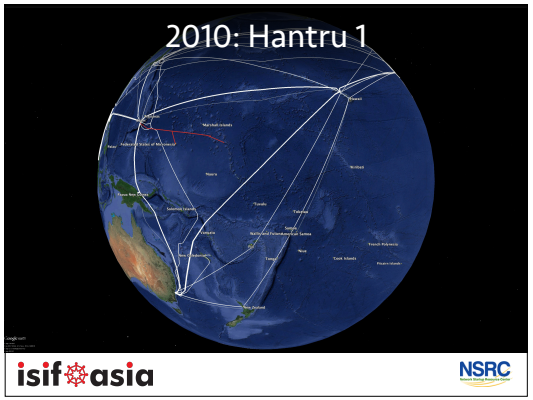
California, Hawaii, Guam, and then on to Asia. Initially half a terabit, but upgraded to 5 in 2011. At the same time , Tata's TGN Intra-Asia is installed from Singapore to Guam via Hong Kong and the Philippines. There's now an awful lot of bandwidth in and out of



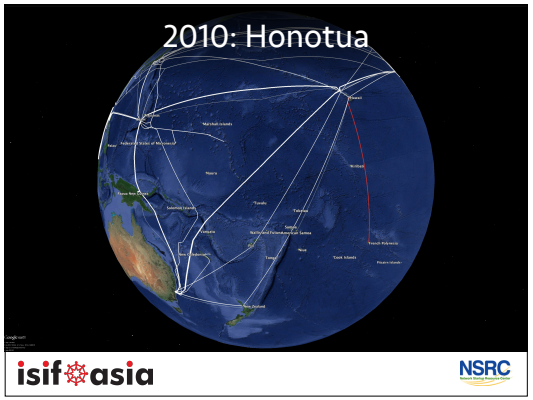
Also in 2009 we see another resurrection of the PacRim cable, this time the east section from Hawaii to Samoa. The cable is cut and hauled up to the Samoas and recommissioned at 1.1 gigabit per second as was done with PacRim West and Papua New Guinea. Sure it's 1/500th the capacity of the new AAG cable, but it's better than satellite.



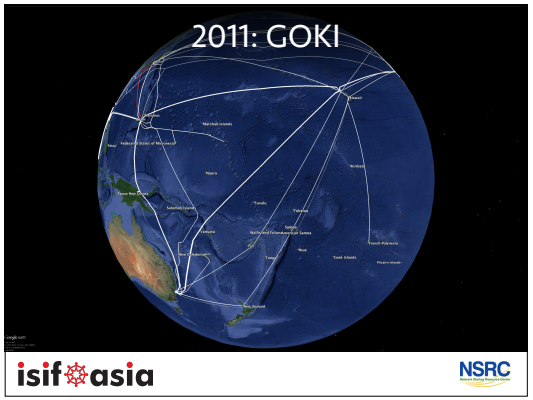
Rounding out 2009 we have Pipe's PPC1, which shoots north to Guam (anyone surprised?) at 1.9 terabits per second with a branch to PNG, and potential for four more branches in between. Though the potential is there, one of the operators who could take a branch thinks it'll be cheaper to build his own cable to Sydney.



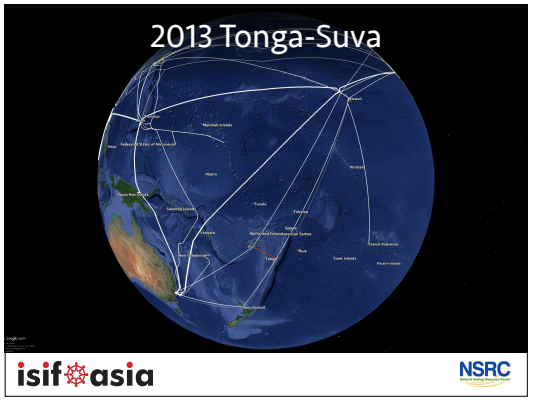
More Pacific infill comes about with a 20gbps cable linking Guam to Micronesia and the Marshall Islands. It's been reported this project relied on the US military as an anchor tenant.



And one more big Pacific project in 2010: Alcatel's 320gbps cable from Hawaii to French Polynesia. This is a big deal - if you remember from the last section of my presentation on distance, Tahiti is just about as far away as you can get from the rest of the world. Sure it was only lit with 2x 10gbps, but that's not bad for a set of islands with a quarter million people on them. That cable was turned up to 2x

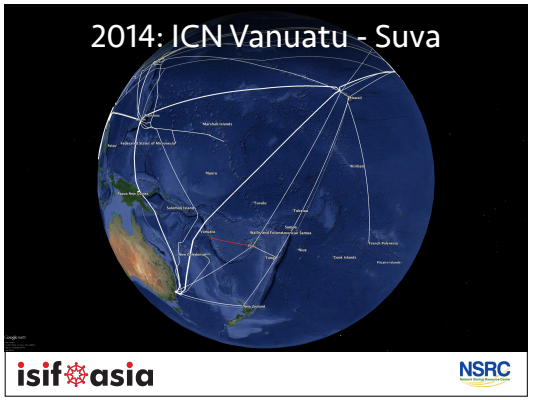


In 2011 we remove at least some of TPC-5 from service, and add a half-new cable called GOKI. 80gbps reported. What needs a direct path from Guam to Okinawa to Korea? I can think of one customer looking for a low latency path controlled by AT&T the whole way. Are any commercial providers using it? No idea.



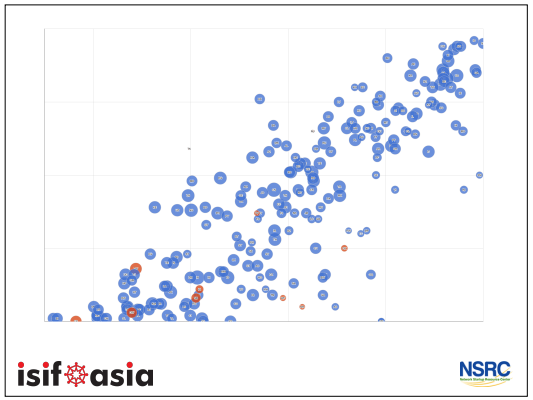
The last two years have seen two more small projects built by Alcatel Lucent Submarine Networks: the Tonga Suva cable in 2013 lit up at STM-16…

Tonga-Suva Landing Station: The Alcatel-Lucent 1620 Light Manager (LM) SLTE (Submarine Lightwave Transmission Equipment) is a DWDM terminal for use in repeatered submarine cable systems. It can be used on systems operating at N x 10 Gb/s, either as an upgrade for existing systems, or as a terminal for new systems. It supports up to 192 x 10 Gbit/s channels, with system capacity



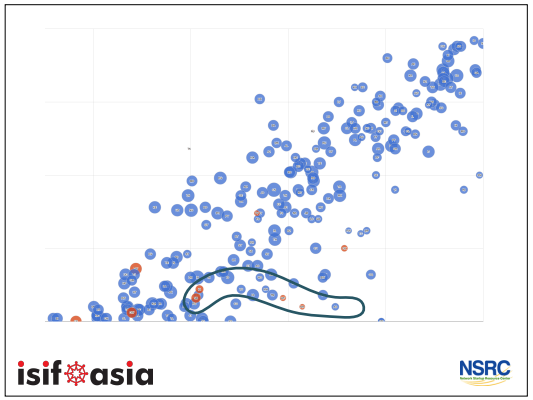
and last one, the ICN cable from Vanuatu to Fiji in 2014. While both were deployed with initial capability of 20gbps, neither has more than a few hundred mbps in use.

Look at the map. There's a fair amount of fibre there, even connecting places that are very far away. Now, does fibre access

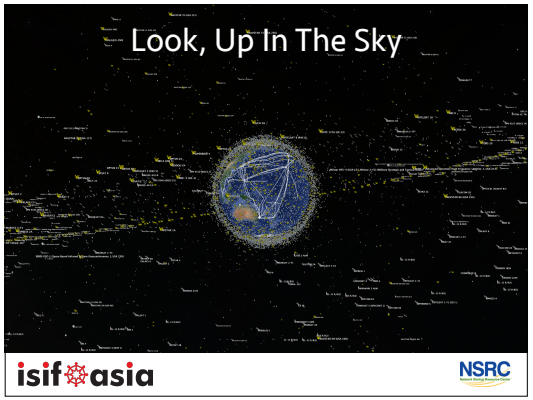


So back to our GDP per Capita vs. Internet Uptake, but this time, instead of colouring by distance, let's colour by access to fibre. All the blue countries have access to global fibre networks. The red don't.

It's hard to tell whether access to fibre makes a difference. There are



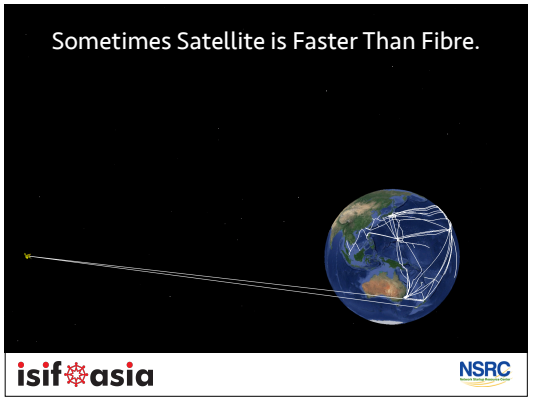
Of our group of underachievers - both American Samoa and Samoa are here, and they've had access to fibre since 2009. The Marshalls are here, and they've been online since 2010. Vanuatu has a good excuse, they've just been online a year - maybe things will change. But Papua New Guinea got its first fibre in 2006, and its second in 2009 and its Internet uptake is abysmal considering its size,



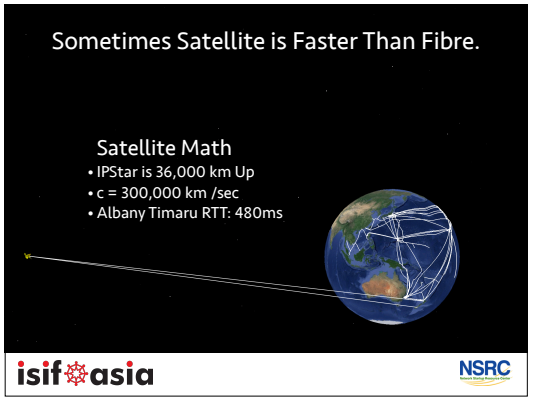
So the Cook Islands, who are a lot further away from the world than PNG, have higher Internet uptake.

And they're stuck with satellite. If stuck is the right word these days.

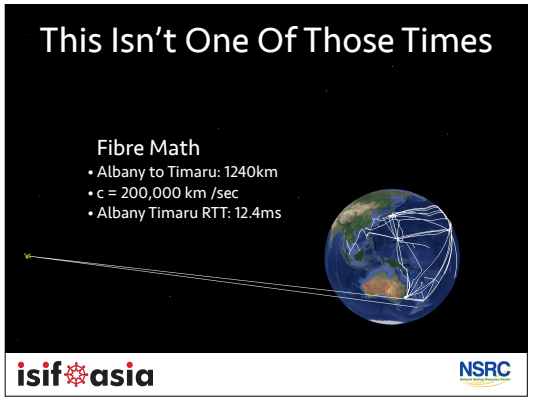
The map you see here is all the named, orbiting space objects,



Stuck with satellite isn't necessarily a bad thing. You see, sometimes satellite is faster than fibre.

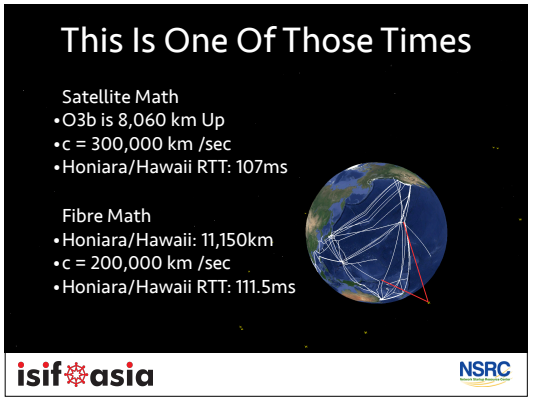


Let's do the math for IPStar, since many of us are familiar with it. By the way, this is a scale-accurate drawing of the path, if not the satellite itself.



Note the speed of light inside glass is only 2/3 the speed of light in a vacuum.

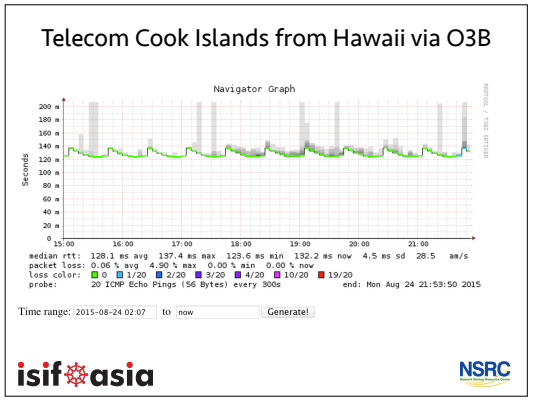
Right, I'm just having some fun here. But seriously.



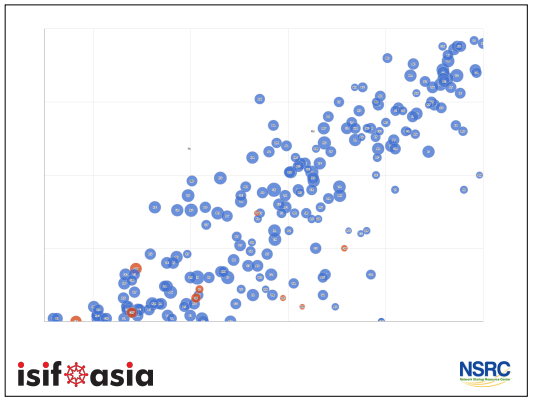
O3B is a constellation of satellites in medium earth orbit, each with ten 1.2gbps spot beams, covering earth from the equator plus or minus 45 degrees. Again via the What's Up database, you're seeing all of O3b's constellation in on the slide here, exactly as they were positioned when I took a screen shot a few days ago. There are a dozen up there now, and the constellation can accommodate up to

How can Satellite can be faster than fibre? It's really only 5,600 km from the Solomon Islands to Hawaii, but there's a story here.

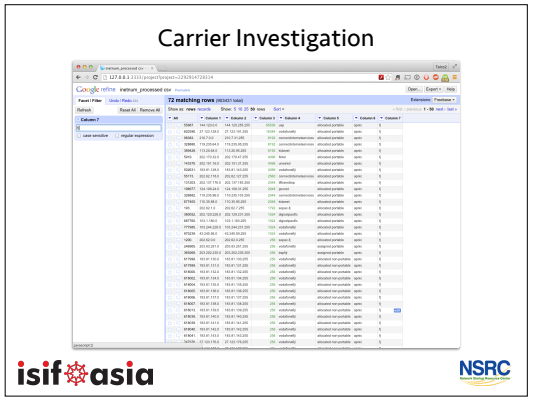
At PacNOG 16 in Honiara in December we had a chat with the CEO of Telekom Solomon Islands about his connectivity situation. At that time he'd had four different satellite bandwidth providers, and was



Don't believe me when I say Satellite can be fast? Have a look at some stats for Telecom Cook Islands, taken from a cheap VM at DRFortress in Honolulu. We're not quite at theoretical latency levels, but we're pretty close.

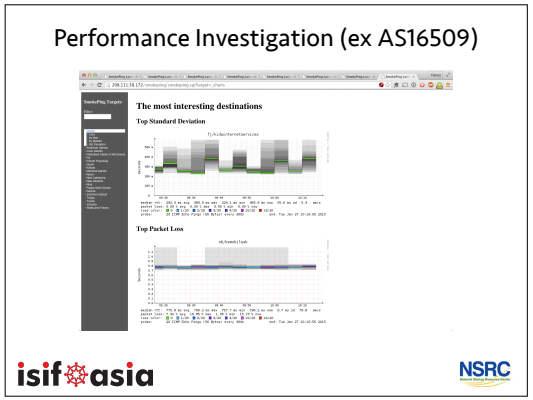


So we've got some countries with fibre doing quite poorly. We've got countries on satellite doing pretty well. And we've got some stories about how carriers and governments don't work together. Could it be the way things are strung together that's leading to high costs and low uptake?



To get a good picture of what was going on in the Pacific, I requested raw data access to APNIC's whois database, and imported into a data mining tool called OpenRefine.

I then trolled for allocations of greater than a /24 across each of the countries in the Pacific. Of course that means I missed a few - for



Once I found some networks, In December last year I spun up a set of eight VMs around the world and pointed 360 probes at 45 Pacific networks. Caveat: This first pass of probes is mostly hosted with Amazon. I was interested to see in quick and easy view of how telcos in the Pacific were performing latency-wise, as it could be an indication of transit and peering arrangements. I then put some of my

Right, so back to the Islands. I'll go through just a couple of examples. This is trimmed down a lot from my APRICOT talk.

BlueSky American Samoa

- HFC, Wireless, Cellular Operator
- Same Parent as ASH Cable & now Telecom Cooks
- Competes against ASH Customers
- ASH FY13 = US $5.8m (800mbps at $600/mbps)
- 768kbps Cable Subscribers Pay US $70/month

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Right here we've got a potential answer for why American Samoa has such expensive Internet, and why uptake is so low. We've got a limited capacity cable, expensive rates on it, and demand to support prices that are actually more expensive than some satellite Internet services. That was pretty easy. Let's look at performance.

BlueSky AS Performance

Location	Distance	Best RTT	Actual RTT	Ratio
Tokyo	7,617	76.17	240	3.15
Singapore	9,552	95.52	300	3.14
Sydney	4,397	43.97	270	6.14
Ireland	15,435	154.35	280	1.81
Sao Paulo	12,613	126.13	290	2.30
North Virginia	11,330	113.3	190	1.68
Oregon	8212	82.12	140	1.70
Hawaii	4144	41.44	60	1.45
Overall Performance Indicator:				2.67

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Hawaii and the west coast look ok, but the rest of Asia looks pretty sad. In particular, Sydney. Look at that mess. It looks an awful lot like BlueSky learns Sydney-bound routes from transit on the west coast of the US, not from Hawaii. Not a great outcome for the large population of Samoans in Australia and New Zealand trying to Skype their families in the Pacific.

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Since the commissioning of their new cable, the Marshalls Islands Telecommunications Authority have been keen to improve Internet connectivity and uptake, and given the amount of bandwidth they have into Guam, I see that happening pretty quick.

MINTA

- MINTA: Marshall Islands National Telecoms Authority
  - 1gbps on Hantru-1, /22 from APNIC
  - Fibre + Wireless “Ring” Backbone
  - GeoStationary Satellite or Wireless to Some Islands
  - 512kbps ADSL Subscribers Pay US $70/month

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Connectivity is still very expensive for the locals, but performance should be pretty good given their proximity to Guam. Let’s see.

MINTA Performance

Location	Distance	Best RTT	Actual RTT	Ratio
Tokyo	4,646	46.46	69	1.49
Singapore	7,487	74.87	146	1.95
Sydney	5,018	50.18	168	3.35
Ireland	13,304	133.04	336	2.53
Sao Paulo	15,579	155.79	353	2.27
North Virginia	11,340	113.4	238	2.10
Oregon	7717	77.17	197	2.55
Hawaii	3850	38.5	219	5.69
Overall Performance Indicator:				2.74

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In general MINTA looks fantastic, but the loser here is Hawaii. A traceroute confirms that despite Hawaii-Guam being the biggest cable route in the Pacific, traffic here is routing Hawaii, Los Angeles, Tokyo, Guam, then on to the Marshall Islands. Sydney also routes via Tokyo, most likely shooting straight through Guam on the way.

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Vanuatu is a real interesting case. There’s a new cable, and the Internet market is is getting competitive, but backhaul is still very expensive.

Telsat

- Sub-155mbps on ICN cable @ $600/month
- Upstream via Fibre is same $$ as via VSAT
- Shifting Contracted VSAT Capacity to In-Country Links
- Peers at VIX & Gets Free CDN
- 512kbps Wireless Subscribers Pay US $35/month

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It's just a matter of time before Vanuatu lifts its Internet penetration given the products on the market now since last year's cable installation.

Note the entry level broadband price - it's half what you'd pay in American Samoa, yet their international bandwidth costs are the

Telsat Performance

Location	Distance	Best RTT	Actual RTT	Ratio
Tokyo	6,370	63.7	251	3.94
Singapore	7189	71.89	170	2.36
Sydney	2596	25.96	59	2.27
Ireland	15,783	157.83	363	2.30
Sao Paulo	14369	143.69	415	2.89
North Virginia	13325	133.25	280	2.10
Oregon	9854	98.54	249	2.53
Hawaii	5676	56.76	274	4.83
Overall Performance Indicator:				2.90

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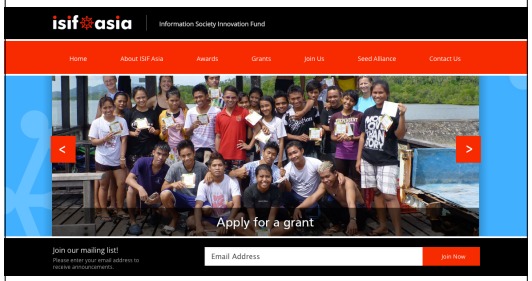
Telsat doesn't achieve a single score under 2. Given the way the cables run, they should be seeing a ratio of 1-1.5 to Hawaii. Instead, we have what we have. All their traffic passes through Fiji and is dropped in Sydney.

On the upside, Telsat is milliseconds away from other Vanuatu carriers

A Peering Strategy for the Pacific



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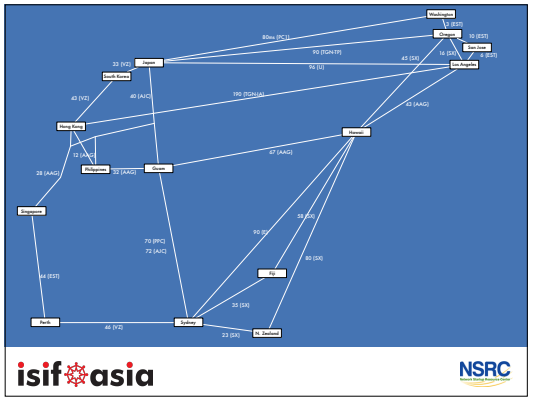
The preliminary work I did looking at 45 networks from EC2 led to an ISIF grant, awarded in March for a an expanded project starting in June. In this project I'm going to dive a lot deeper into connectivity, and thanks to the RIPE Atlas project, soon I'll be charting interconnectivity of Pacific Networks.

Guam is one of the best connected locations in the world when it comes to physical connectivity. All those cables. Let's see how they do from an IP standpoint. You'll notice in the next table there are a few more hosts in the mix. Since ISIF came on board supporting the project in June, I've had funding to set up a pile of new virtual machines. I've also done some work to refine my distance model.



The distance model is now a best path model. There are a lot of cables out there, but this collection of latencies is as good as I can find, for now, and I've used it to evaluate each of Guam's five carriers.

Guam Docomo Pacific

Location	Distance	Best Direct	Best Cable	Actual RTT	Ratio
San Jose	9400	94	115	145	1.26
Los Angeles	9800	98	110	128	1.16
Oregon	9100	91	126	161	1.28
Seattle	9100	91	120	162	1.35
Honolulu	6100	61	67	206	3.07
Tokyo	2500	25	40	260	6.50
Seoul	3200	32	77	283	3.68
Hong Kong	3400	34	44	312	7.09
Singapore	4700	47	72	336	4.67
Sydney	5300	53	70	298	4.26
Overall Performance Indicator:					4.29

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Now owned by Japan's Docomo but they still haven't got good transit to Japan. In fact, it takes them 260ms RTT when it should take them 40ms.

Guam Telecoms Authority

Location	Distance	Best Direct	Best Cable	Actual RTT	Ratio
San Jose	9400	94	115	170	1.48
Los Angeles	9800	98	110	128	1.16
Oregon	9100	91	126	148	1.17
Seattle	9100	91	120	156	1.30
Honolulu	6100	61	67	179	2.67
Tokyo	2500	25	40	180	4.50
Seoul	3200	32	77	195	2.53
Hong Kong	3400	34	44	156	3.55
Singapore	4700	47	72	320	4.44
Sydney	5300	53	70	277	3.96
Overall Performance Indicator:					3.35

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Guam's incumbent provider has great connectivity to the US< and average connectivity everywhere else. Tokyo and Singapore are exceptionally bad - but not as bad as via Docomo.

iConnect Guam

Location	Distance	Best Direct	Best Cable	Actual RTT	Ratio
San Jose	9400	94	115	123	1.07
Los Angeles	9800	98	110	126	1.15
Oregon	9100	91	126	145	1.15
Seattle	9100	91	120	154	1.28
Honolulu	6100	61	67	165	2.46
Tokyo	2500	25	40	243	6.08
Seoul	3200	32	77	270	3.51
Hong Kong	3400	34	44	197	4.48
Singapore	4700	47	72	300	4.17
Sydney	5300	53	70	270	3.86
Overall Performance Indicator:					3.65

isif asia NSRC

iConnect is owned by a Philippines company. No transit to Asia though. Tokyo bad again.

IT&E (Micronesian Telecom)

Location	Distance	Best Direct	Best Cable	Actual RTT	Ratio
San Jose	9400	94	115	127	1.10
Los Angeles	9800	98	110	112	1.02
Oregon	9100	91	126	147	1.17
Seattle	9100	91	120	154	1.28
Honolulu	6100	61	67	162	2.42
Tokyo	2500	25	40	212	5.30
Seoul	3200	32	77	190	2.47
Hong Kong	3400	34	44	159	3.61
Singapore	4700	47	72	315	4.38
Sydney	5300	53	70	255	3.64
Overall Performance Indicator:					3.30

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And the final ISP here, who also own that cable to the Marianas that broke in July.

ns.gov.gu via Sprint

Location	Distance	Best Direct	Best Cable	Actual RTT	Ratio
San Jose	9400	94	115	133	1.16
Los Angeles	9800	98	110	139	1.26
Oregon	9100	91	126	150	1.19
Seattle	9100	91	120	153	1.28
Honolulu	6100	61	67	182	2.72
Tokyo	2500	25	40	238	5.95
Seoul	3200	32	77	260	3.38
Hong Kong	3400	34	44	292	6.64
Singapore	4700	47	72	300	4.17
Sydney	5300	53	70	425	6.07
Overall Performance Indicator:					4.23

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One special case though. It happens that Guam's .gu authoritative nameservers are hosted in-country by an organisation that has a special connection via Sprint - probably through one of Sprint's stacks of voice circuits. There's no peering between Sprint and the other ISPs on island, so getting to .gu from Guam requires a trip to the states and back. Performance from Asia is the worst of any providers.

Guam Summary

- Guam's biggest industry? The US Military
- So Guam ISPs transit to the USA
- Guam's second biggest industry? Tourism from Asia
- Performance for 2nd biggest industry ignored
- Research & Education? Hope partners are in the US

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Guam's second largest industry is asian tourism, and as we all know tourism these days is heavily reliant on the Internet. What to do…

Pacific Interconnectivity

- Focus on Transit to the nearest big market
- No regard for other Pacific Island countries
  - Vanuatu -> Suva traffic routes via Australia
- Typically no peering or interconnection on islands
- In PNG two carriers take two different fibres out
- Vanuatu Exchange works - due to government help

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Getting to the wrap-up here.

Interconnectivity Issues

- NZ to Hawaii $/mbps == NZ to California $/mbps
- Vanuatu-Suva cheap, but no good transit from Suva
- Domestic transit in Fiji, Hawaii is very expensive
- Peering is difficult in Hawaii, impossible in Fiji
- Stopping along the way for big carriers is expensive
- Pacific Interconnectivity today = Market Failure

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The “impossible” on Fiji has to do with a particular sanctioned monopoly for national transit, awarded by the government to a company called Fintel.

And The Problems Continue

- Samoa has new World Bank & ADB Funding
- Next Pacific Cable will be Apia to Suva
- ISPs are already negotiating SCC bandwidth to USA
- One ISP was proud of not having to deal with Fiji
- No consideration of performance to Pacific countries
- Only cost per gig is considered when purchasing

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Real Issues for The Pacific

- Communications between islands suffer
- Communications on-island suffer (WS,FJ,SB,etc..)
- Education Networks performance suffers
- Sub-optimal routing benefits few
- Market failure compounded by regulatory failure
- High costs could be affecting Internet uptake

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And this behaviour leads to…

Next Steps: ISIF Project

- Document Pacific Economic, Social, & Educational Ties
- Monitor Interconnectivity to/from ~ 60 Pacific networks
- Determine Regional Routing Inefficiencies
- Analyse Benefits of Regional Peering Points
  - Does every country need an exchange? Maybe not.
- Develop a Strategy for Improving Interconnectivity

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Because no one cares about performance unless real users are being impacted, this is as much a social and economic study as it is a performance study.

How Can You Help?

- Interviews: Tell me your stories, please!
  - Where have things gone right?
  - Where have things gone wrong?
- RIPE Atlas Probes: Host one, please!
  - They use around ~10kbps of traffic
  - Only need to allow ping, traceroute, http(s)

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This is my wrap-up for now. In addition to handing out Atlas probes, I'll be interviewing users, carriers, and regulators in a number of countries to explore what's going on, and what we can do to help. If you'd like to get involved, please get in touch.

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