Deploying an Island-Wide Wireless Network

A case study on providing broadband internet service in American Samoa

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Blue Sky

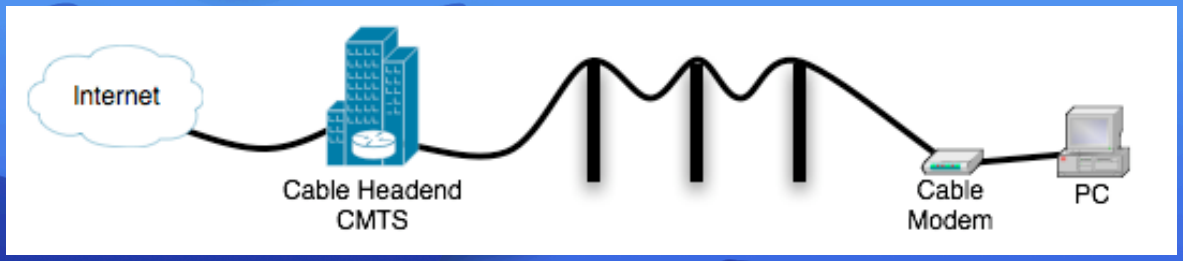
- ~400 Wireless subscribers
- Coverage available in 90% of the populated areas

Overview

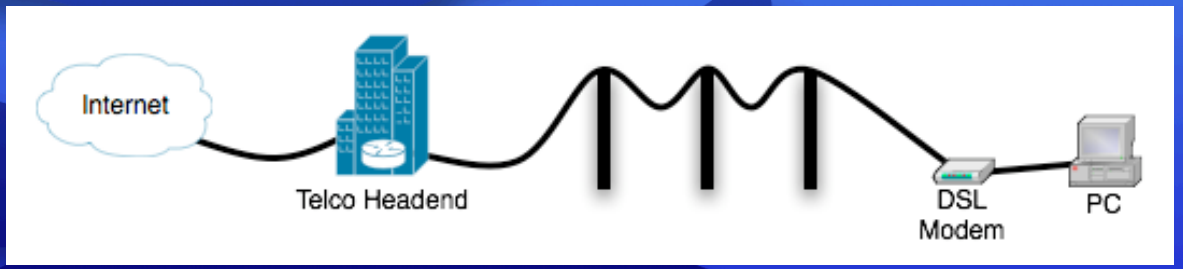
- Last mile connectivity options for Broadband Service Providers
- Reasons for choosing a fixed wireless solution
- Deployment

The Last Mile

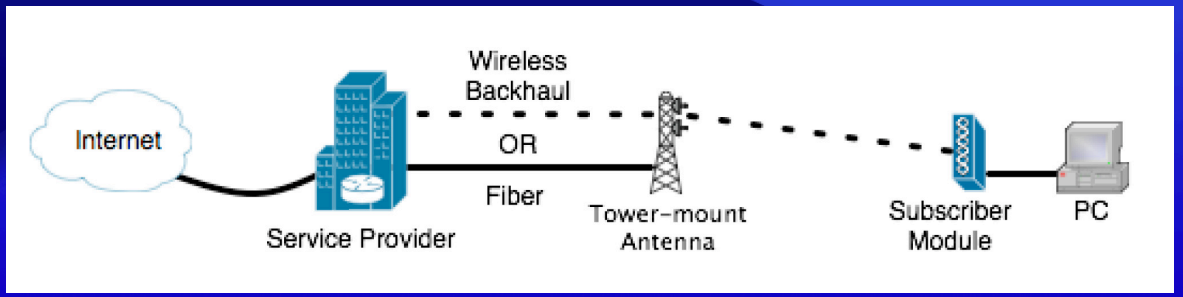
Cable



DSL



Wireless



Wireless Advantages

- Requires relatively less infrastructure
- Lack of outside plant maintenance
- Comparatively quick rollout
- Modular equipment
- Simple installation
- Layer-2 everywhere

Wireless Disadvantages

- Use of the unlicensed band presents issues
- Radio frequency interference is always a concern
- Line-of-sight is almost always required
- Layer-2 everywhere

Wireless Wins

- We have cell site towers for PCS that can be utilized for Wireless Access Points
- We don't have to build out physical connections for the last-mile
- Customer installations are easy to rollout
- The equipment is relatively inexpensive
  - $800USD per Subscriber Module;

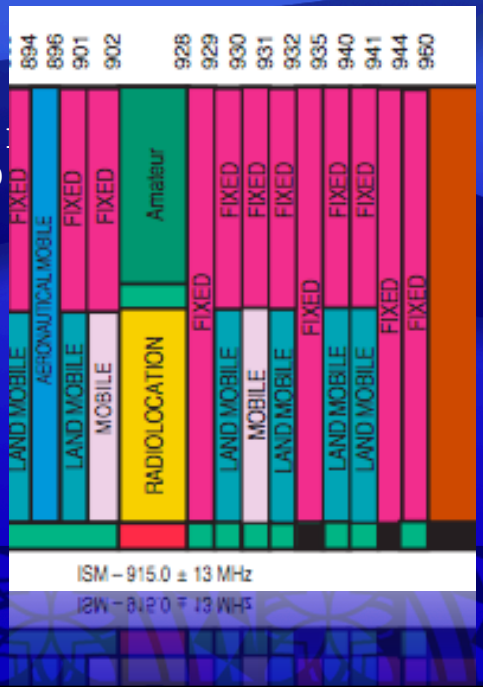
Motorola Canopy

- Operates on the 5.7Ghz and 900Mhz band
- SNMP v2c capable
- Access points have 7Mbps of total bandwidth
  - Usually configured for 3.5Mbps up/down
- Backhauls are either 10Mbps or 20Mbps
- VLAN support

Frequency

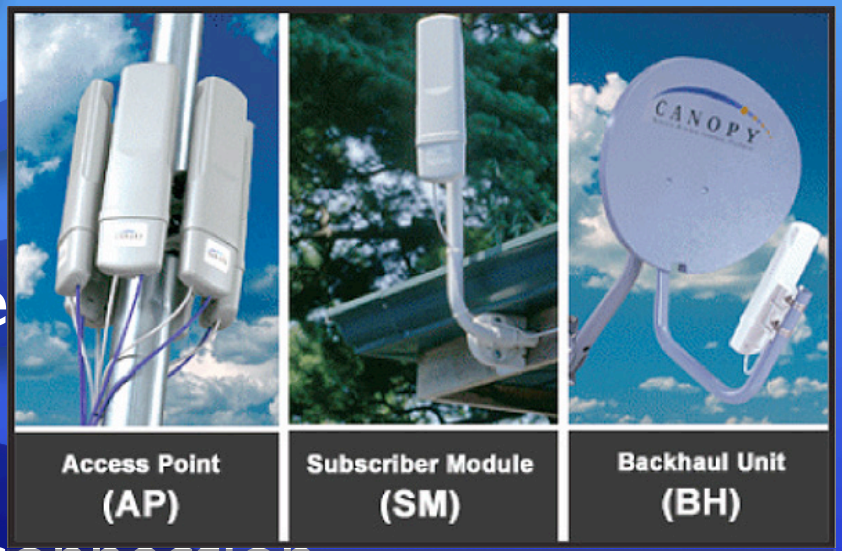
- The ISM Unlicensed Band (Industrial, Scientific and Medical)

- **902 to 928MHz**
- Spread spectrum 1 W
- Microwave ovens 750 W
- Industrial heaters up to 100
- Military radar up to 1000
- **2.4 to 2.4835GHz**
- Spread spectrum 1 W
- Microwave ovens 900 W
- **5.725 to 5.850GHz.**
- Spread spectrum 1 W



Modules

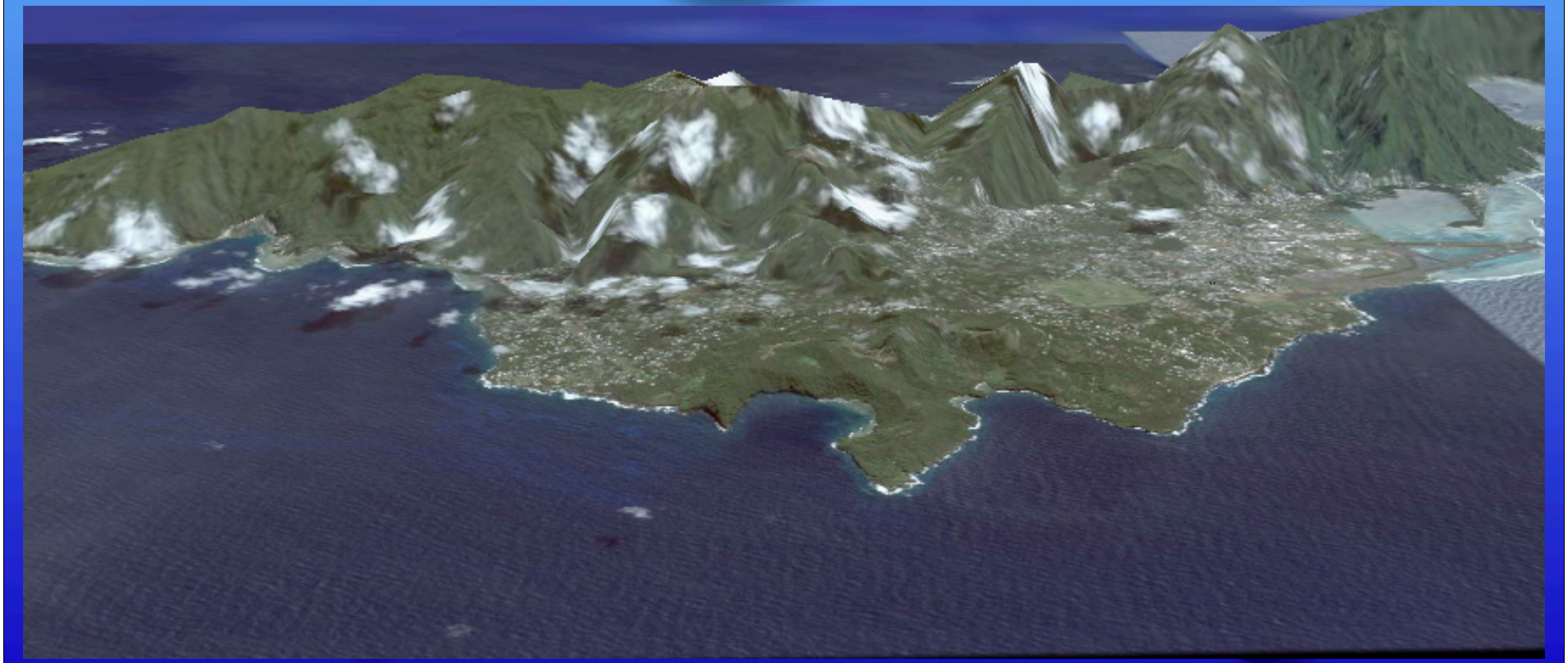
- Backhaul Unit
  - Point-to-point conne
- Access Point
  - Point-to-multipoint connection
- Subscriber Module
  - Receiver



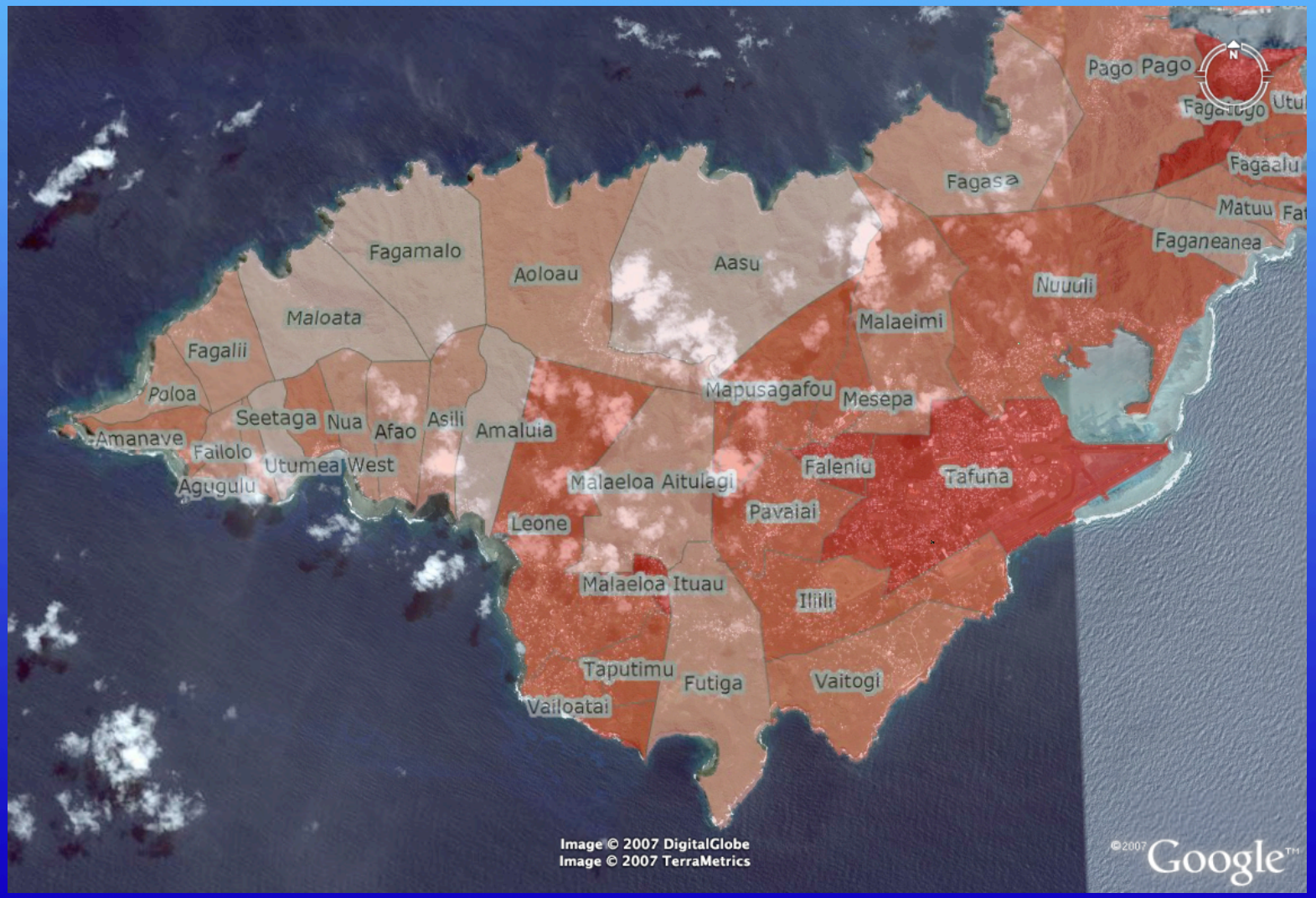
Deployment

- Terrain concerns
- Deployment strategies
- Using wireless backhauls
- Customer premises installation
- Solving line-of-sight issues
- Upgrading service

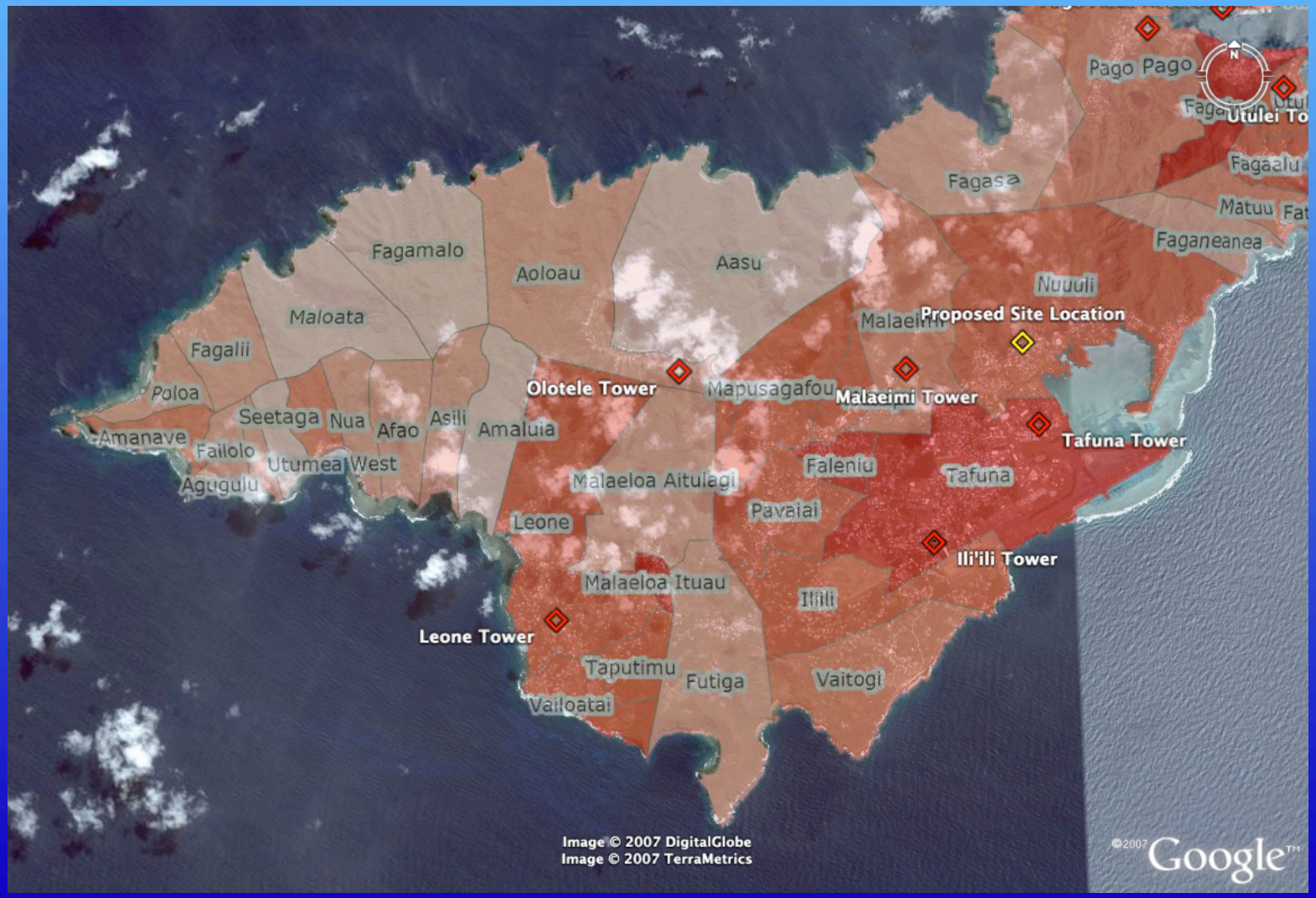
American Samoa Terrain



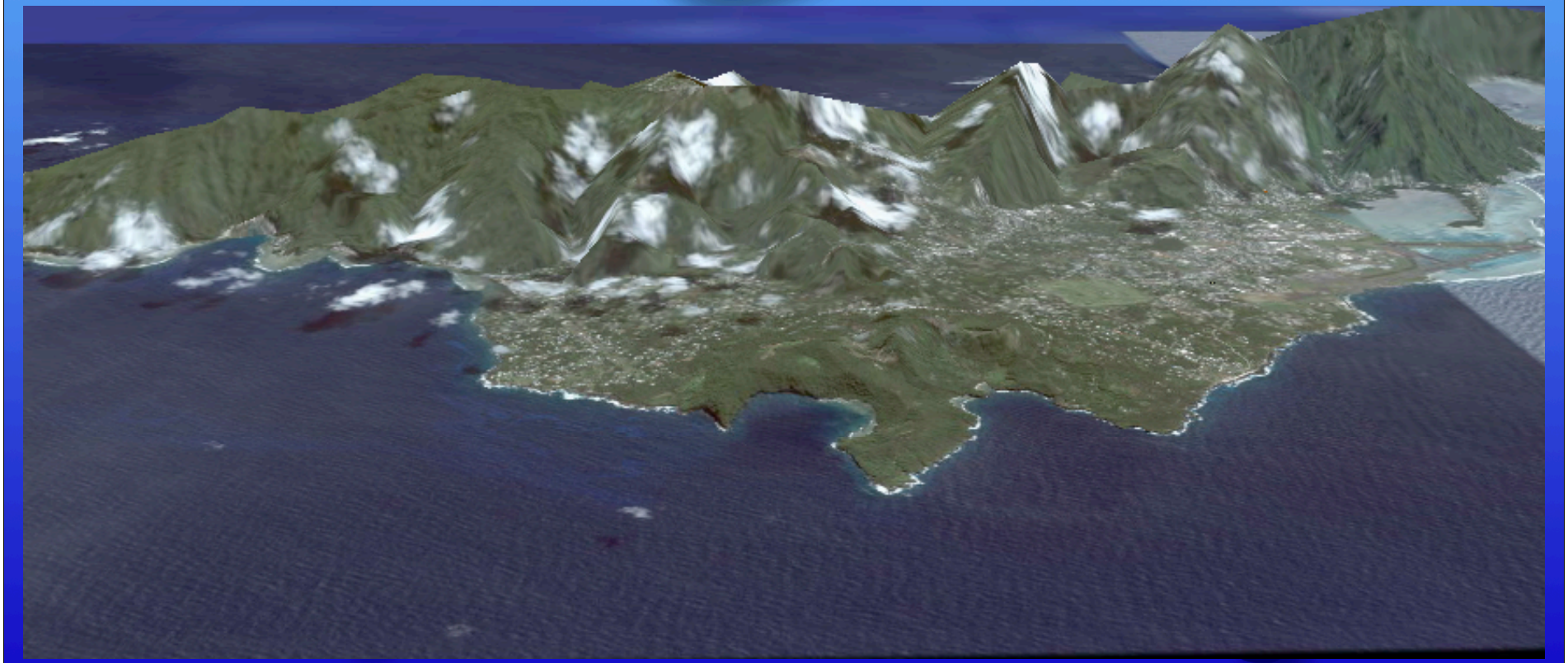
Population Density



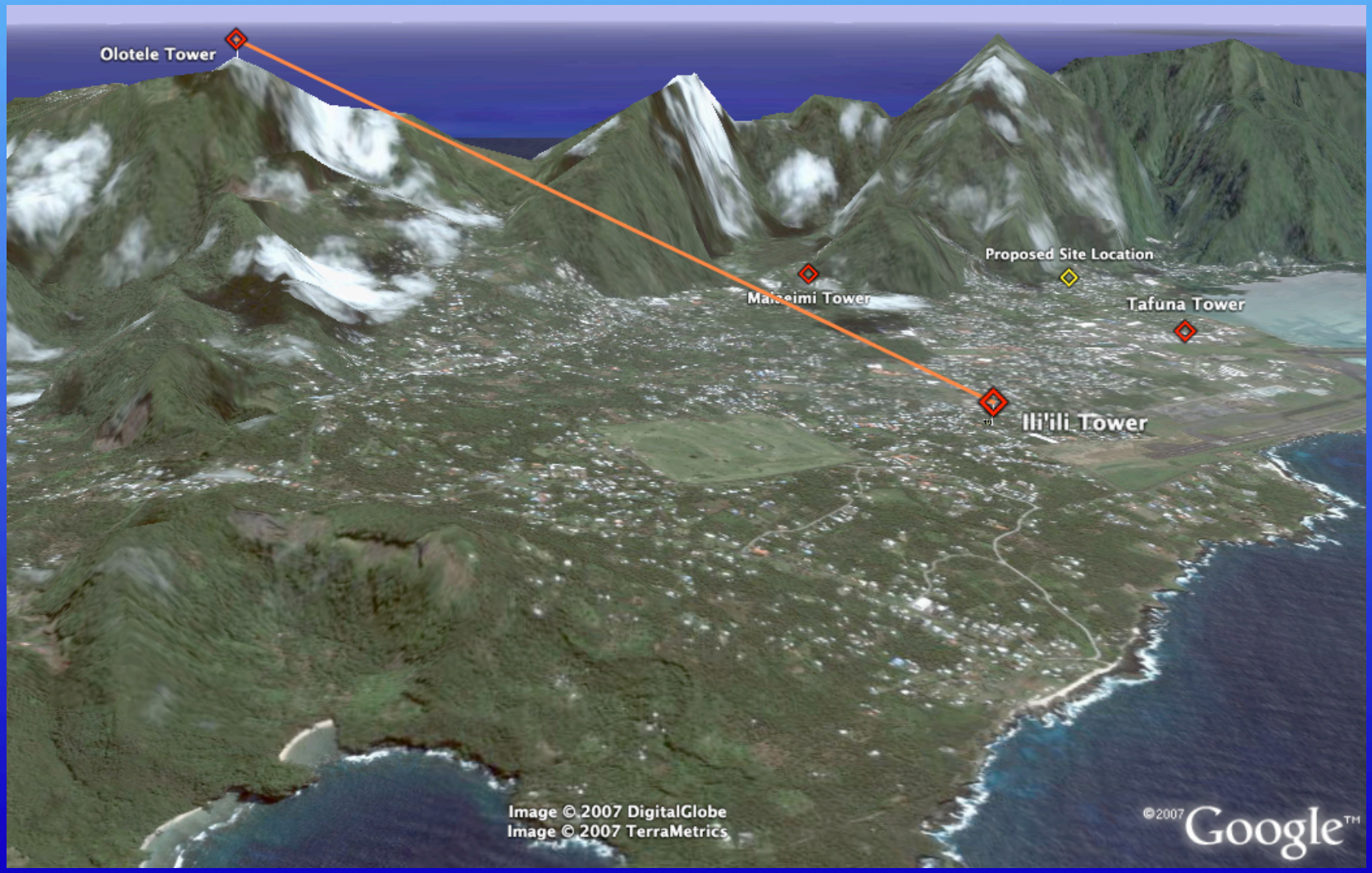
Access Point Deployment



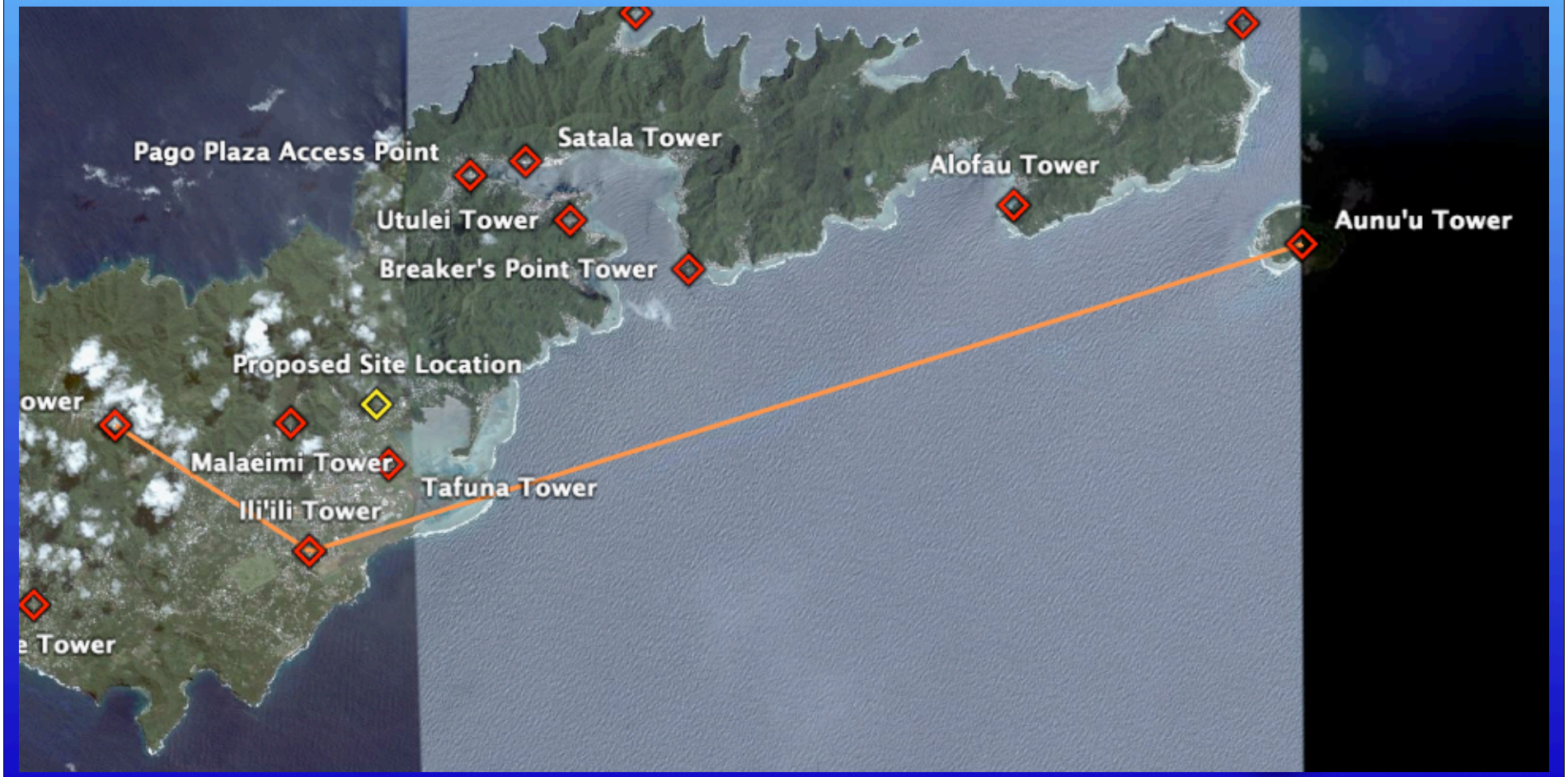
American Samoa Terrain



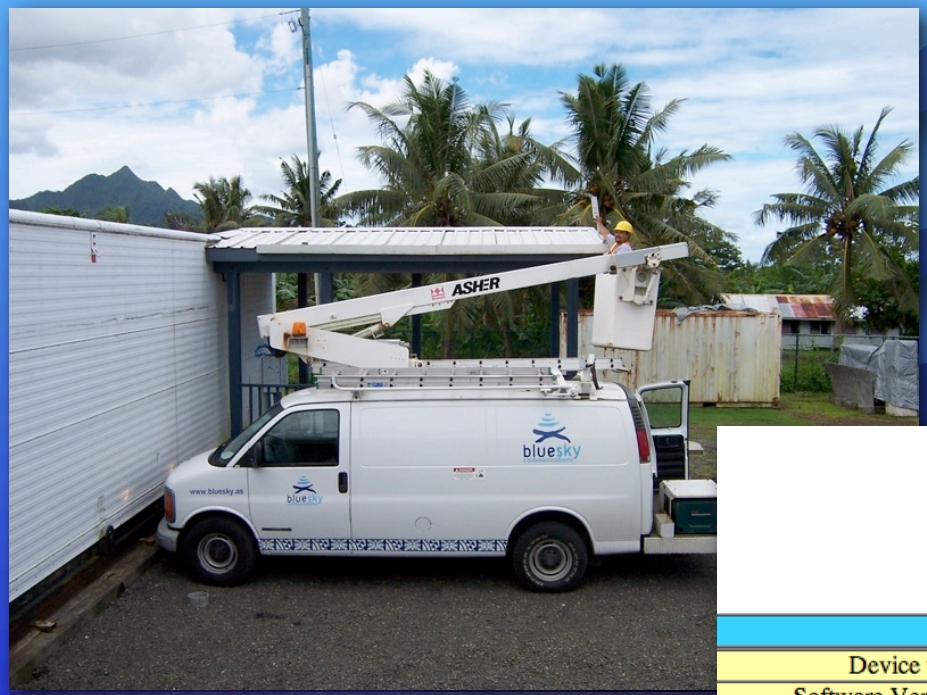
Olotele Backhaul ~3mi.



Aunu'u Backhaul ~12.5mi



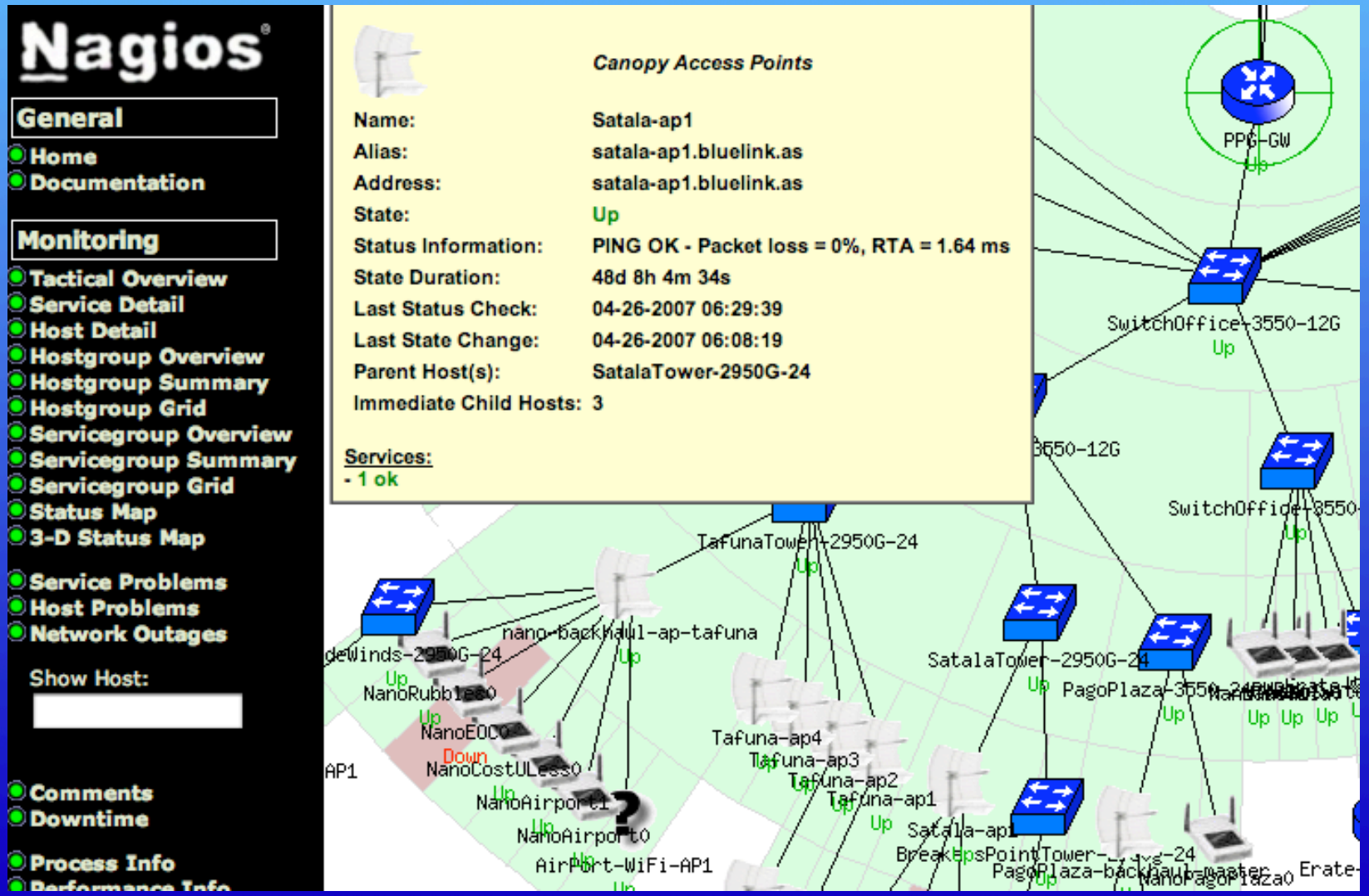
Installation



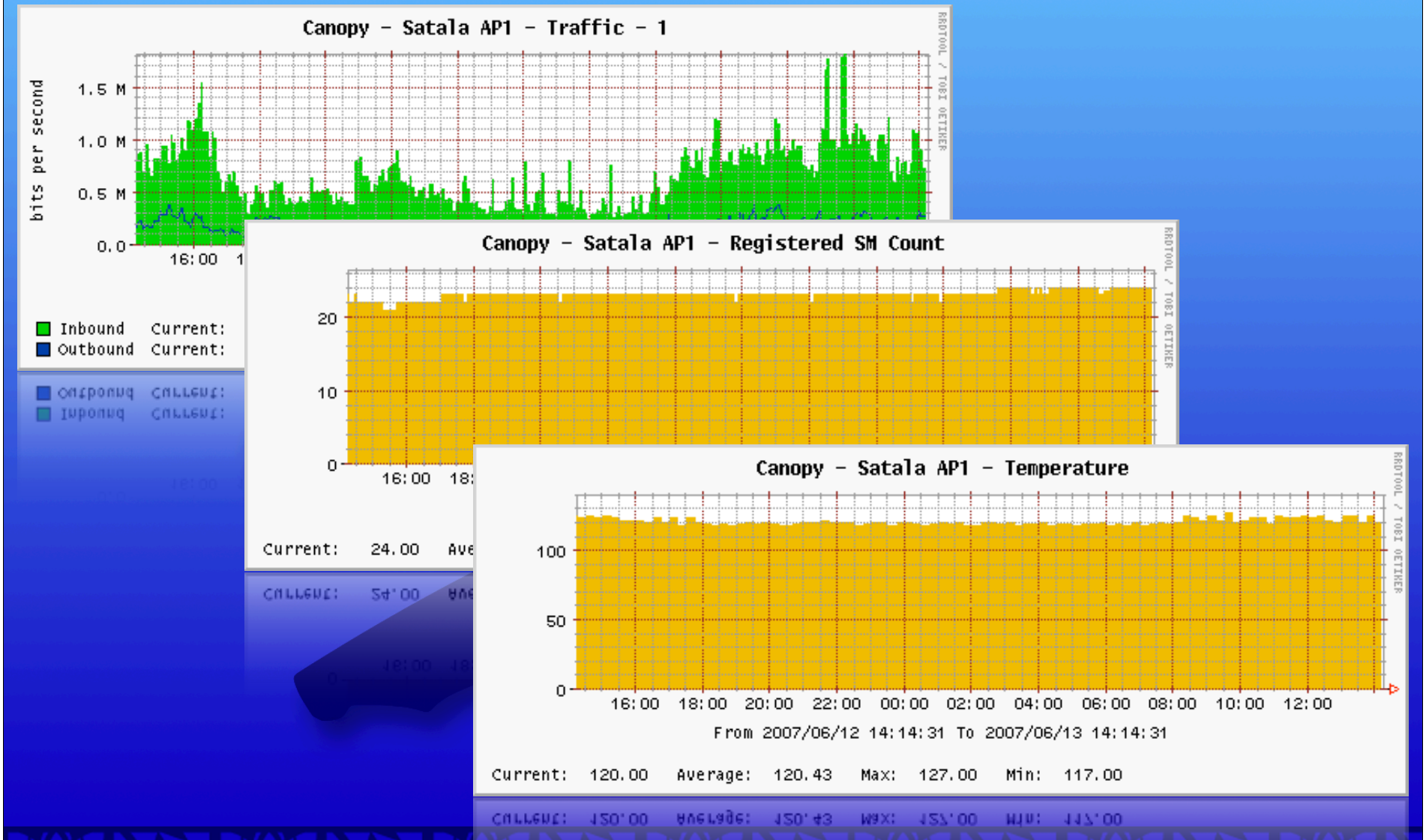
CANOPY
Motorola Wireless Internet Platform

Device Information	
Device type	5.7GHz - Multipoint - Subscriber Modem - 0a-00-3e-f1-fd-5d
Software Version	CANOPY 7.3.6 Oct 24 2005 12:06:56 SM-DES
Software Boot Version	CANOPYBOOT 3.0
FPGA Version	070605 (DES Sched)
Uptime	4d, 06:44:32
System Time	07:14:57 06/13/2007
Ethernet Interface	100Base-TX Full Duplex
Subscriber Modem Stats	
Session Status	REGISTERED
Registered AP	0a-00-3e-f6-de-f6
RSSI	828 (-67 dBm)
Jitter	7
Air Delay	349 (approximately 3.24 miles (17101 feet))

Alerting


Nagios
General
Home
Documentation
Monitoring
Tactical Overview
Service Detail
Host Detail
Hostgroup Overview
Hostgroup Summary
Hostgroup Grid
Servicegroup Overview
Servicegroup Summary
Servicegroup Grid
Status Map
3-D Status Map
Service Problems
Host Problems
Network Outages
Show Host:
Comments
Downtime
Process Info
Canopy Access Points
Name: Satala-ap1
Alias: satala-ap1.bluelink.as
Address: satala-ap1.bluelink.as
State: Up
Status Information: PING OK - Packet loss = 0%, RTA = 1.64 ms
State Duration: 48d 8h 4m 34s
Last Status Check: 04-26-2007 06:29:39
Last State Change: 04-26-2007 06:08:19
Parent Host(s): SatalaTower-2950G-24
Immediate Child Hosts: 3
Services:
- 1 ok
PPG-GW
SwitchOffice-3550-12G
TafunaTower-2950G-24
nano-backhaul-ap-tafuna
NanoRubb1e80
NanoE0C0
NanoCostULess0
NanoAirport1
NanoAirport0
AirPort-WiFi-AP1
Tafuna-ap4
Tafuna-ap3
Tafuna-ap2
Tafuna-ap1
Satala-ap1
SatalaTower-2950G-24
PagoPlaza-backhaul-master
Down

Monitoring


Canopy - Satala AP1 - Traffic - 1
bits per second
1.5 M
1.0 M
0.5 M
0.0
16:00
Inbound Current:
Outbound Current:
RRDTOOL / TOBI OETIKER
Canopy - Satala AP1 - Registered SM Count
20
10
0
16:00
Current: 24.00
RRDTOOL / TOBI OETIKER
Canopy - Satala AP1 - Temperature
100
50
0
16:00 18:00 20:00 22:00 00:00 02:00 04:00 06:00 08:00 10:00 12:00
From 2007/06/12 14:14:31 To 2007/06/13 14:14:31
Current: 120.00 Average: 120.43 Max: 127.00 Min: 117.00
RRDTOOL / TOBI OETIKER

Layer-2 VLANs

- VLANs are used extensively to segregate broadcast domains
- Each site is allocated a /26 subnet on a distinct VLAN
- Each Access Point has a trunk port to carry multiple VLANs
- Canopy equipment is addressed from a protected VLAN

Service Upgrades

- Canopy Advantage
- 900Mhz Access Points
- Private VLAN Point-to-point connections

Canopy Advantage

- 2x Multiplier allows for up to 14Mbps shared bandwidth
- Hardware scheduling reduces latency
  - Usual wireless latency on a long hop (>3Mi) is reduced from ~80ms to ~8ms
  - Slight drop in signal strength
  - Must be 10Mhz above the noise floor

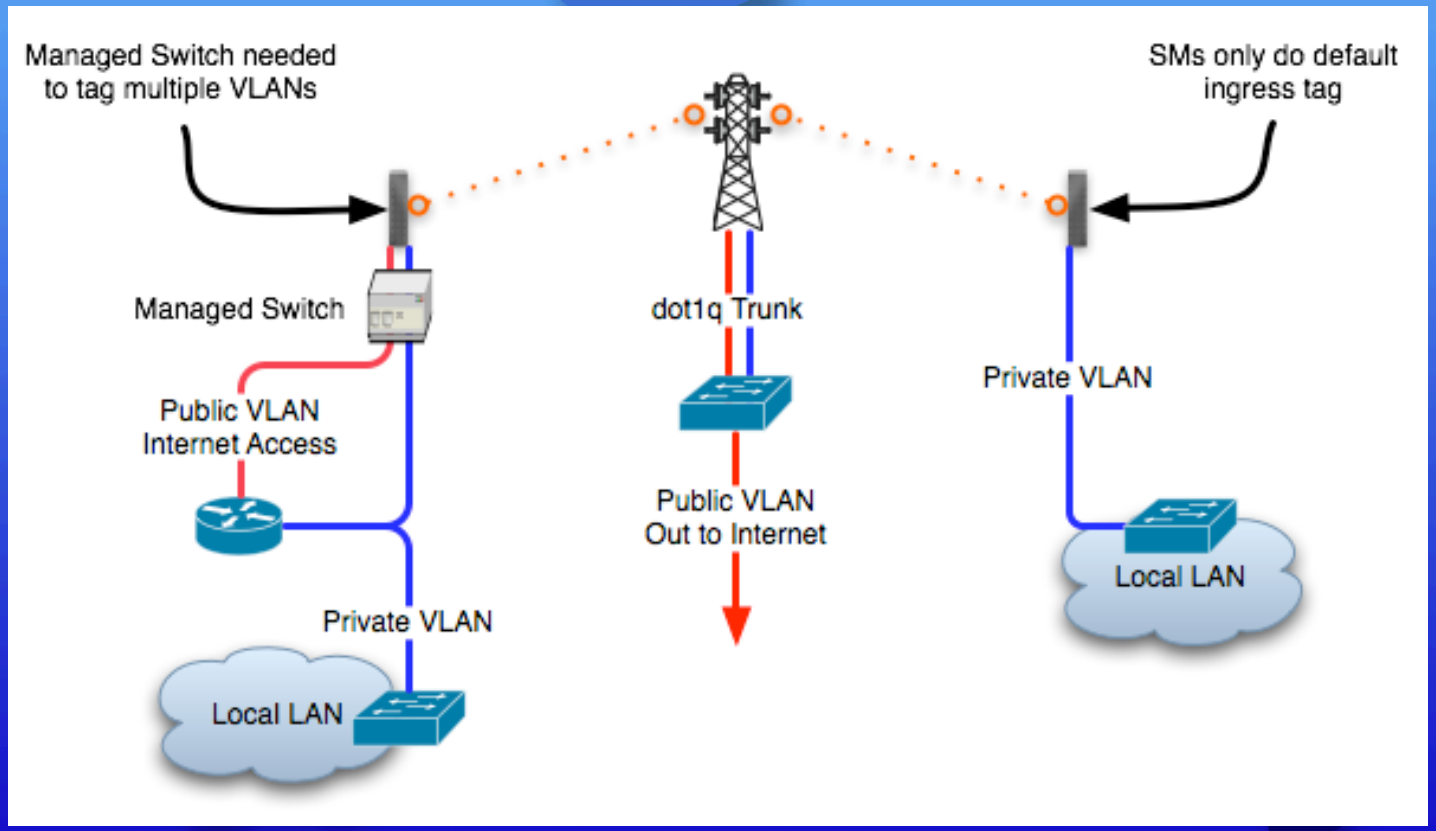
900Mhz Access Points

- 5.7Ghz modules are heavily reliant on line-of-sight
- 900Mhz modules operate on near line-of-sight
- Better foliage penetration
- Operates in conjuction with 5.7Ghz
- 900Mhz band is the same one used by

Private VLAN Point-to-point

- Private VLAN segregation
- Allows customers to connect satellite offices
- Ideal replacement for T1/Frame Relay links
- For bandwidth intensive applications, Backhaul units are used in place of SMs

Private VLAN Setup

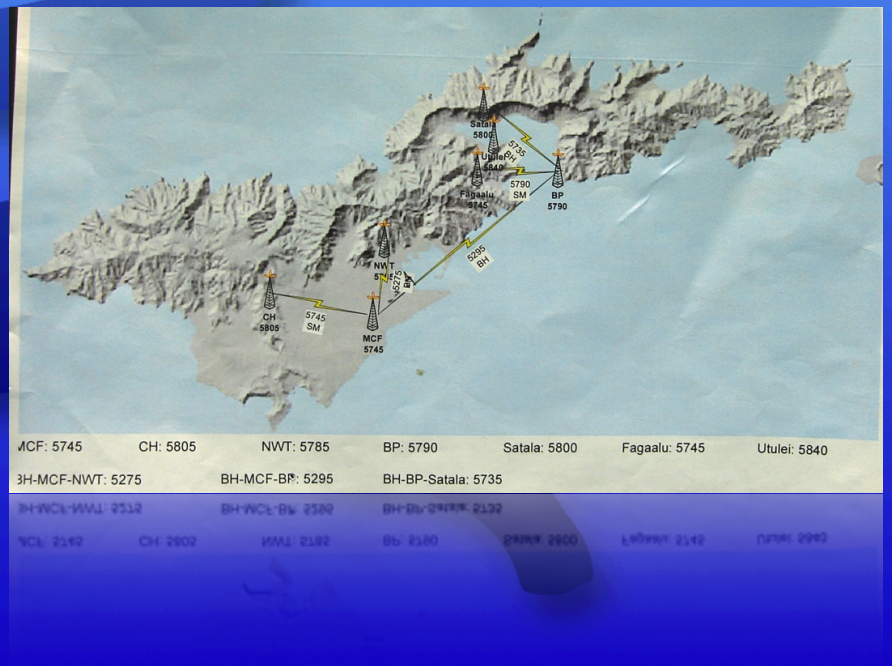


Notes about bandwidth

- There is a hard limit to upstream bandwidth on a subscriber module
- 5.7Ghz SM only reaches about 1Mbps upstream in real-world conditions
- Asynchronous links are normally utilized
- Wireless bandwidth far exceeds satellite bandwidth

Frequency Map

- Work out the frequency map with any other service providers using the same frequency range
- 10-15Mhz separation is ideal
- Update each other regularly



Final Impressions

- Performs well
- Relatively stable
- Highly configurable
- Cross-training in RF technologies needed
- Cooperation is necessary

Module Placement

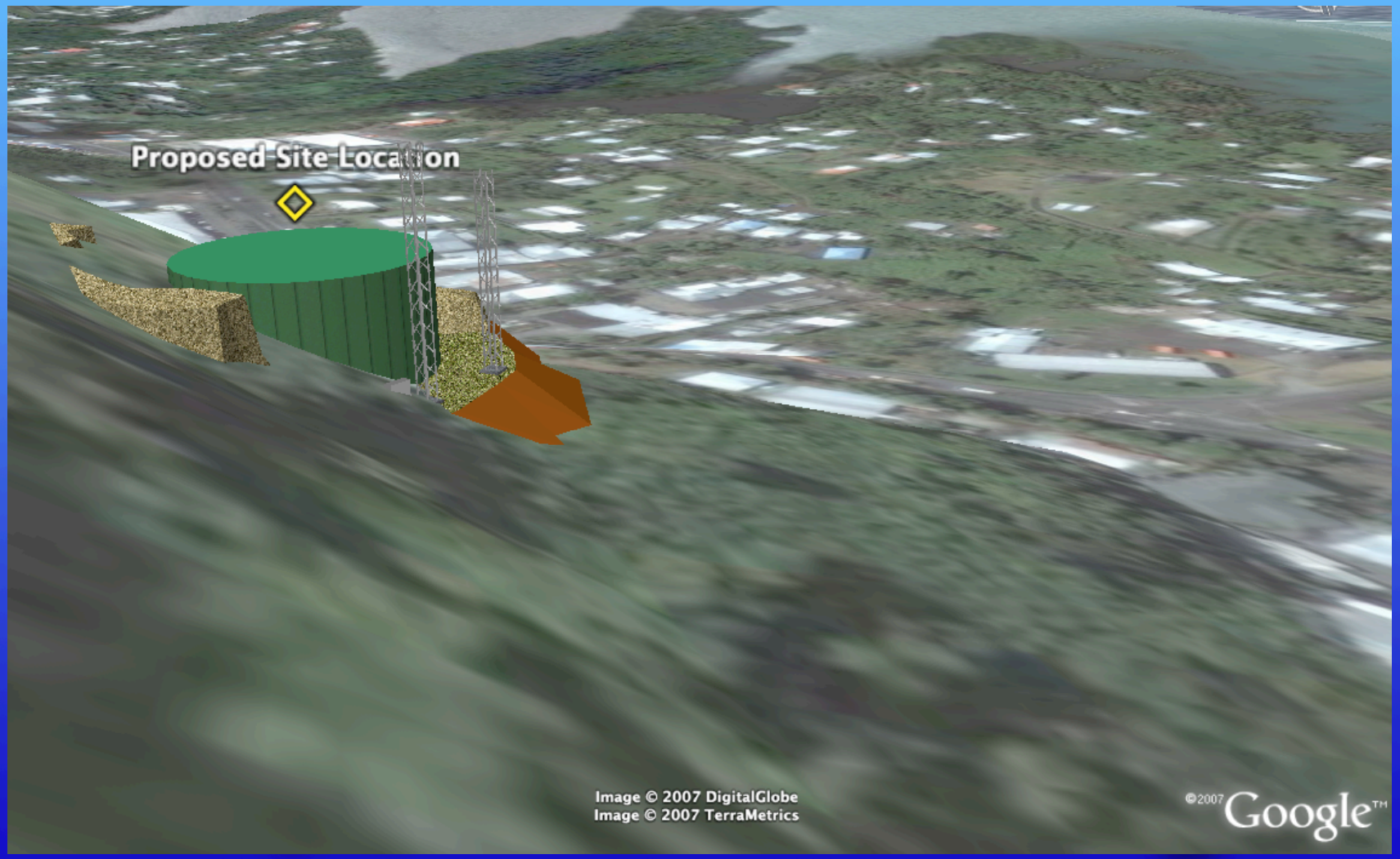
- The higher the better
- Take terrain into consideration
- Keep expansion in mind

Best Current Practices

- What's important is what works

Tools

- Google Earth
- Google Sketchup
- Microsoft Visio or Omnigraffle
- Nagios
- Cacti


Proposed Site Location
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