HIGH SPEED DATA FOR DISASTER RESPONSE

CARL LEON

COML, COMT, AUXCOM, CERT

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High Speed Data…

File Transfers

Video

Voice Telephony

Email

Everything you do from your "connected" desk

We have come to rely on high speed data for everything we do.
What If we lose it….

Seattle's top hazards...

1. Earthquakes
2. Snow and Ice
3. Windstorms
4. Power Outages
5. Cyber Attacks
6. Landslides
7. Disease Outbreaks
8. Flooding
9. Excessive Heat

10. Tsunamis/Seiches
11. Infrastructure and Structural Failures
12. Fires
13. Transportation Incidents
14. Water Shortages
15. Social Unrest
16. Attacks
17. Hazmat Incidents
18. Volcanic Hazards

Earthquakes in Seattle

1949 Seattle Fault Quake & 2001 Nisqually Quake

THREE DEFINITIONS OF HamWAN

- 1. It is WiFi on Steroids – we'll compare briefly to home wifi.
- 2. It is a set of standards.
- 3. It is the Puget Sound Data Ring (PSDR)

HAMWAN DEF #1

Home WiFi

- Shelf/Desk in House
  - Access Point
  - Antenna (omni)
- Laptop
  - WiFi Radio
  - Antenna (what will fit)
- Router

HamWAN

- Mountain Top
  - Access Point(s)
  - Antenna (sector)
- QTH
  - Wifi Radio
  - Antenna (dish)
- Router

STANDARDS

The nice thing about standards is that there are so many to choose from.

-Andrew S. Tannenbaum

HamWan DEF #2

HamWAN

index

A modern, multi-megabit, IP-based, digital network for amateur radio use!

HamWAN is a non-profit organization (501c3) developing best practices for high speed amateur radio data networks. HamWAN also runs the Puget Sound Data Ring, which is a real-world network implementation of the proposed designs.

So far, HamWAN networks have been used for things like low-latency repeater linking, real-time video feeds from distant locations, serving APRS I-gates, providing redundant internet access to emergency operations centers, and more. Any licensed radio amateur in the service area can connect their shack directly to the network with just a small investment in equipment and no recurring cost. Since many traditional uses for Internet at home are not compatible with Part 97 rules, this won't replace your home Internet connection. However, it works and acts just like one.

State of the **Puget Sound Data Ring**

HamWAN cells have been deployed to six sites. Each site is interconnected with 5.9 GHz modems and fully routed with OSPF. HamWAN provides routing to all existing AMPRNet systems. Examine the map below to determine if you're within the current HamWAN coverage area!

HamWan DEF #3
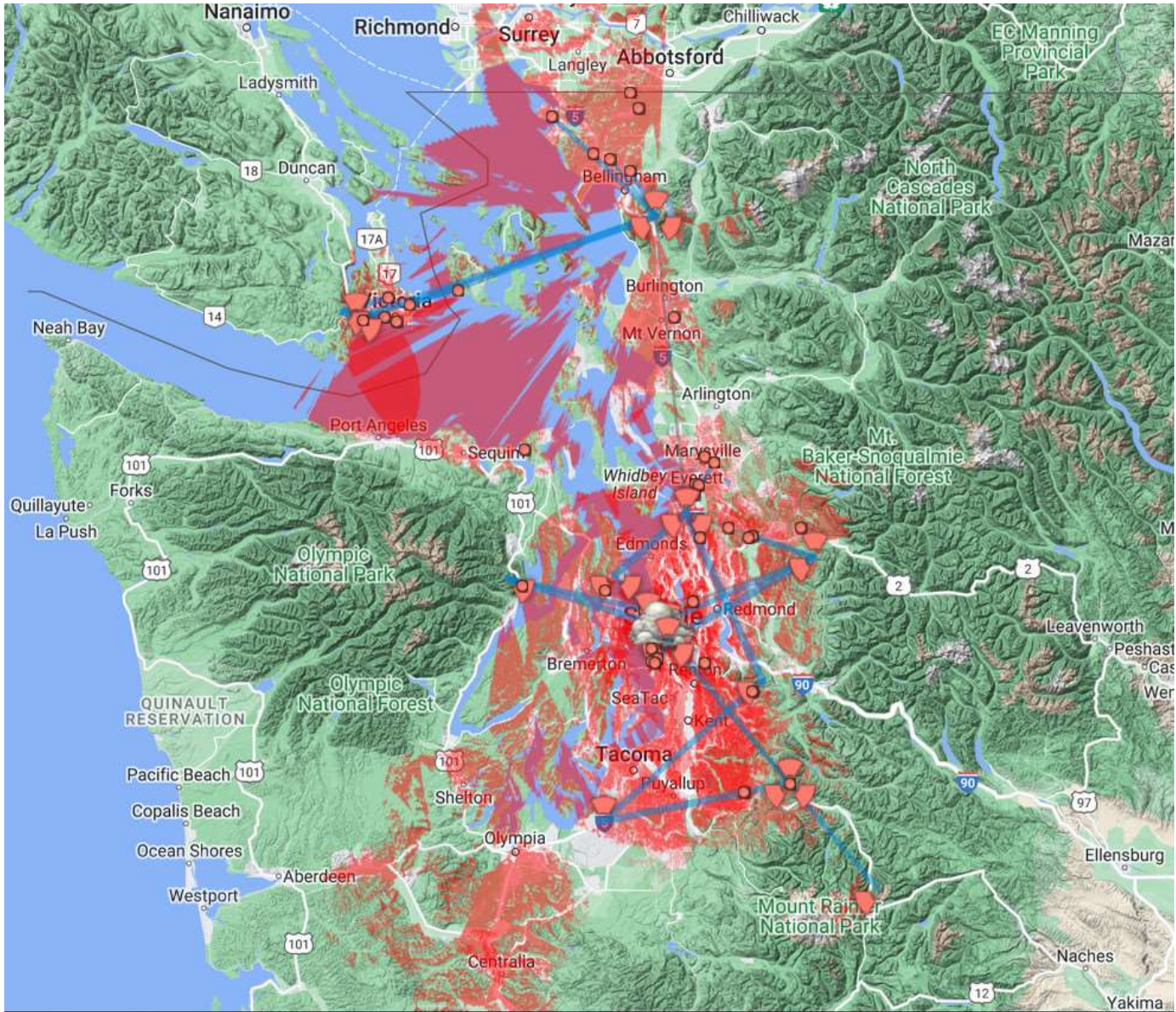
Sector Antenna

Sector 1
320° - 60°

Sector 3
180° - 320°

Sector 2
60° - 180°
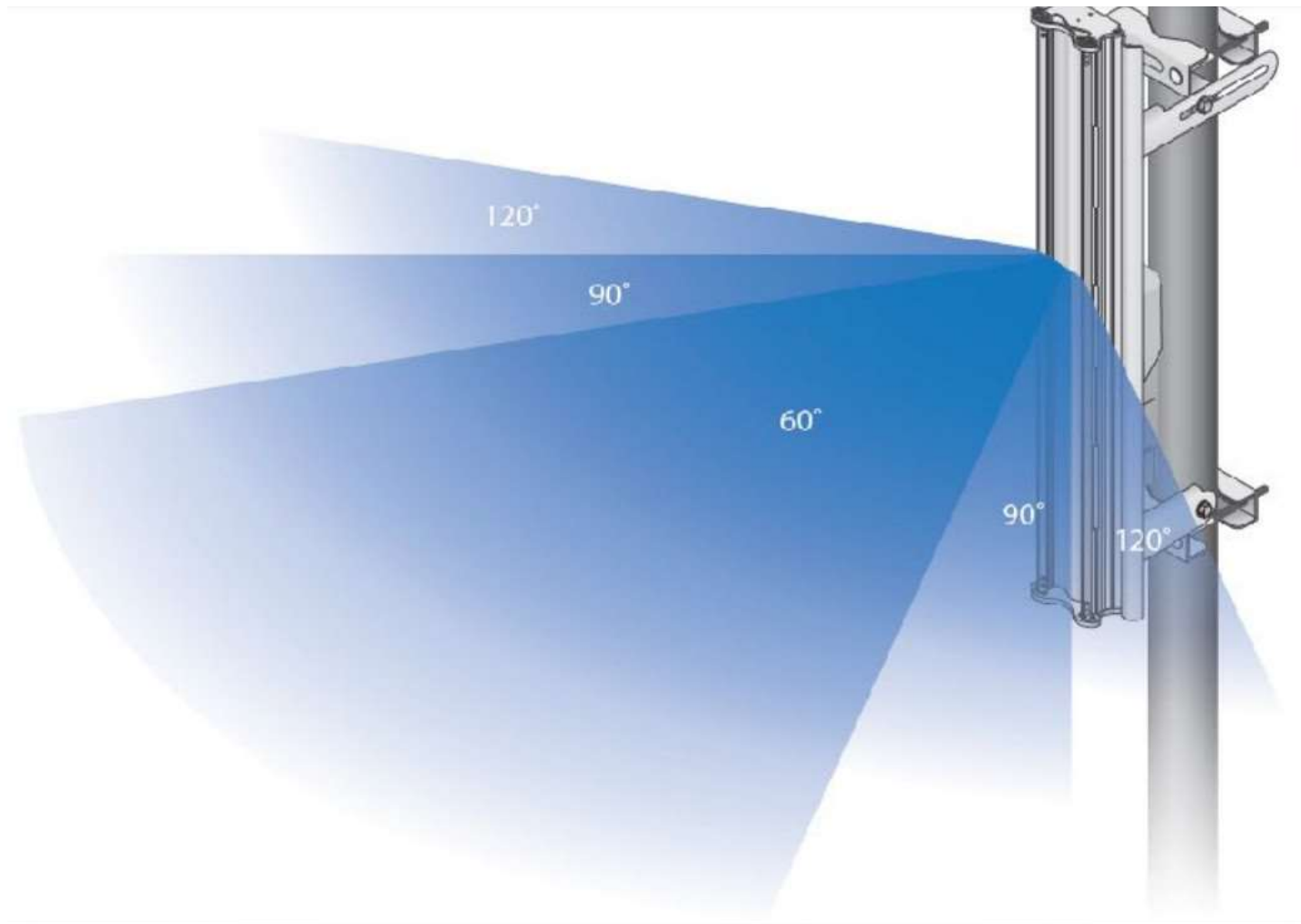
HamWAN Sector Antenna

HamWAN Client Antenna

High End, long distance, Client Requirements

Dish / Radio
CAT5 / RJ45's
Line of Site
~$350 - $500
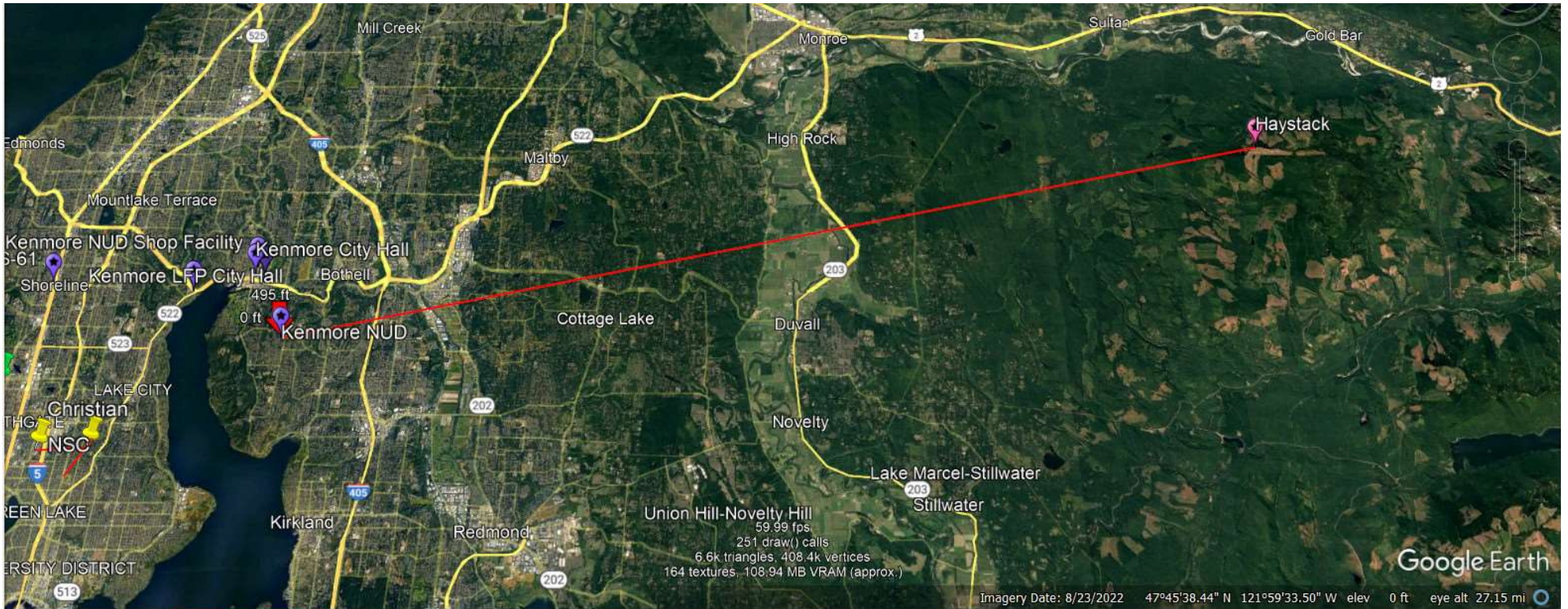
DynaDish 5
ID: RBDynaDishG-5HacD
FCC ID: TV7DYNADISHGAC
IC :7442A-DYNADISHGAC
E01:
W01:
SN : D6EA0D495BB4/047/r4

Mikrotikls SIA, Brivibas gatve 214i,
Riga, Latvia, LV1039

MikroTik

This device complies with Part 15 of the
FCC Rules. Operation is subject to the
following two conditions: 1) this device
may not cause harmful interference, and
2) this device must accept any inter-
ference received, including interference
that may cause undesired operation.

QRT 5
ID:RB911G-5HPnD-QRT
FCC ID:TV7RB912G-5HPND
ETH1:
WLAN:

SN:728C06289AF1/703

PWR ETH

NUD to Haystack

NUD to Indianola

NUD to Buck

City Hall to Haystack

City Hall to Buck

Kenmore FS to Haystack

Shoreline FS to Buck
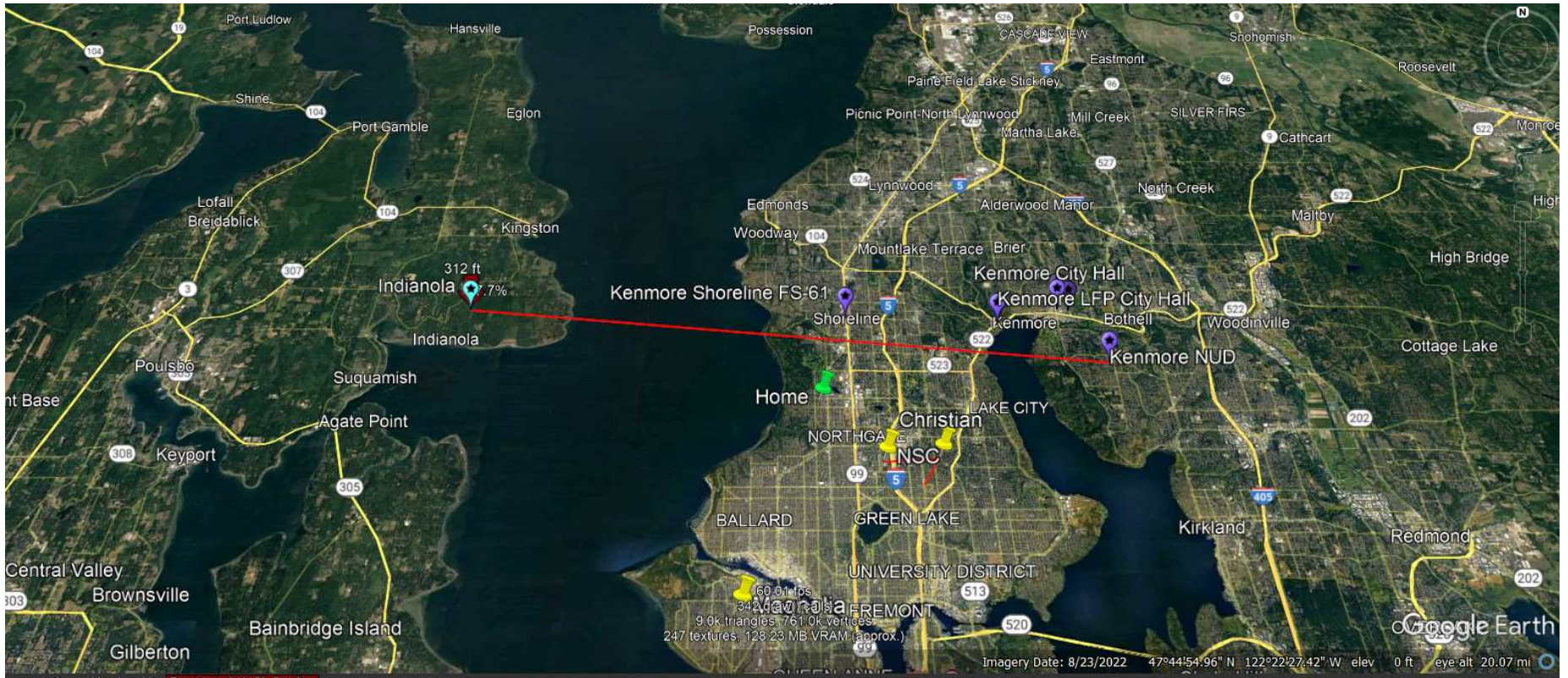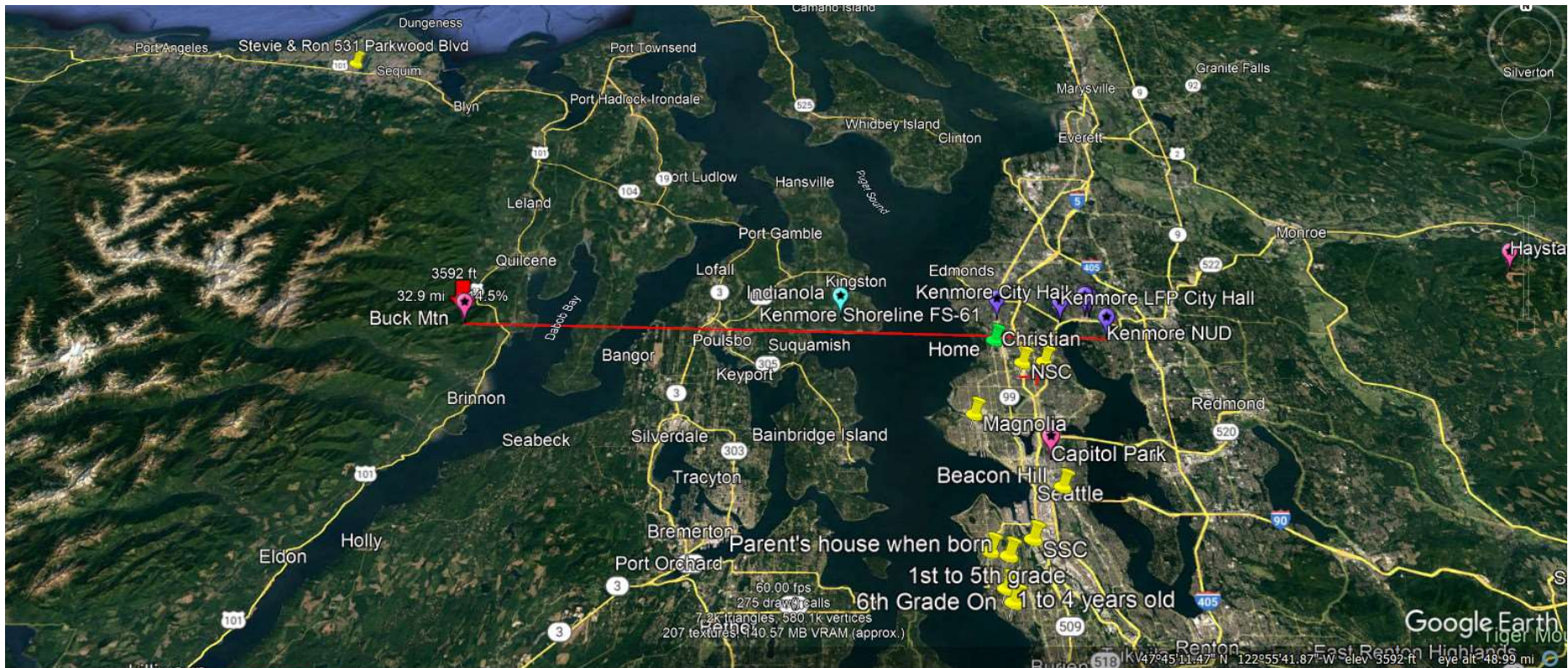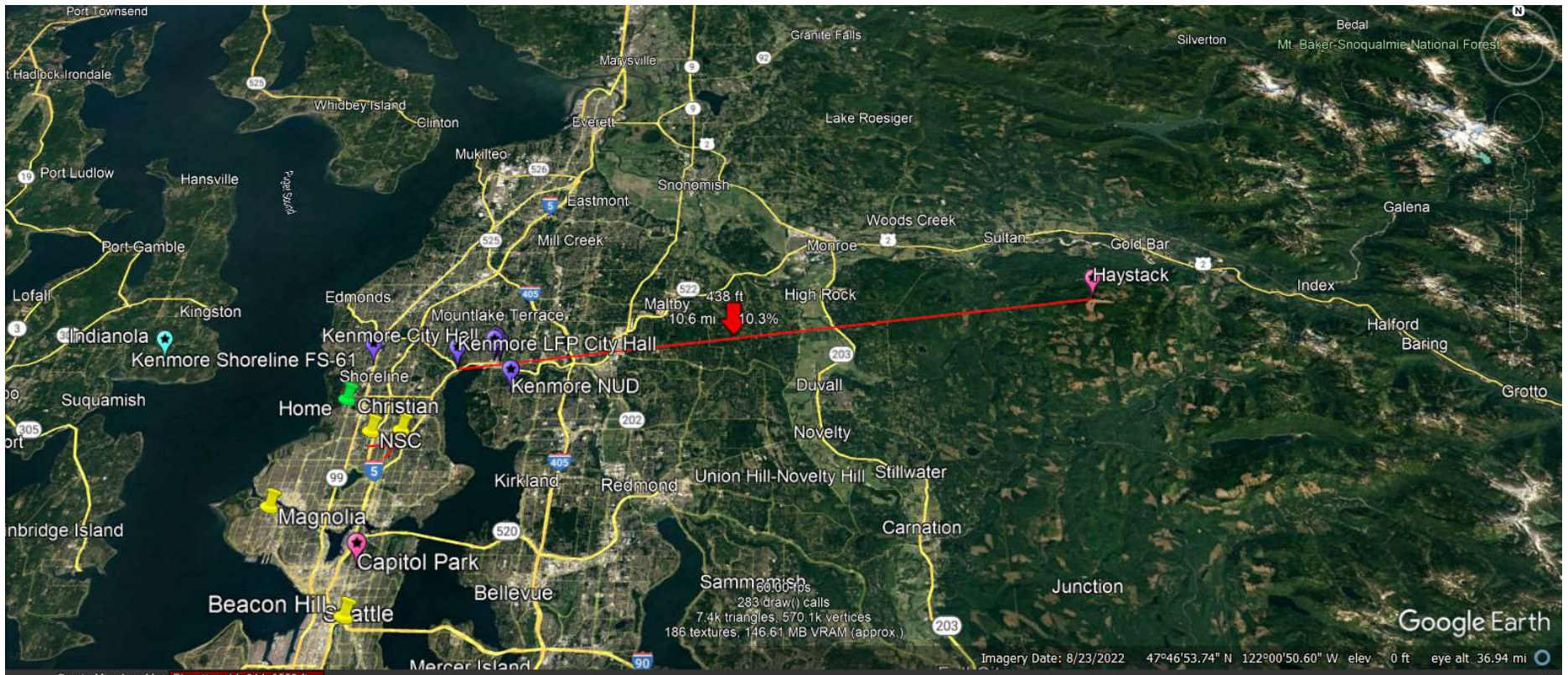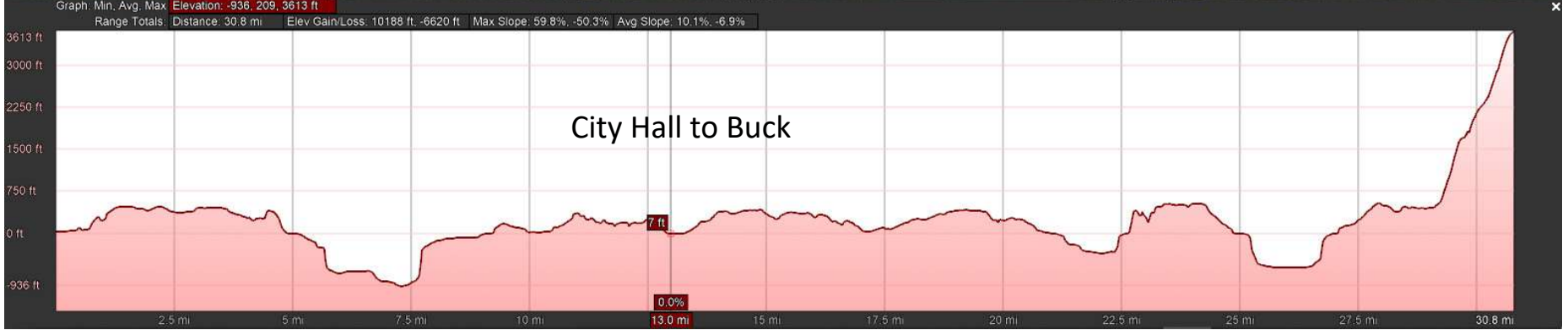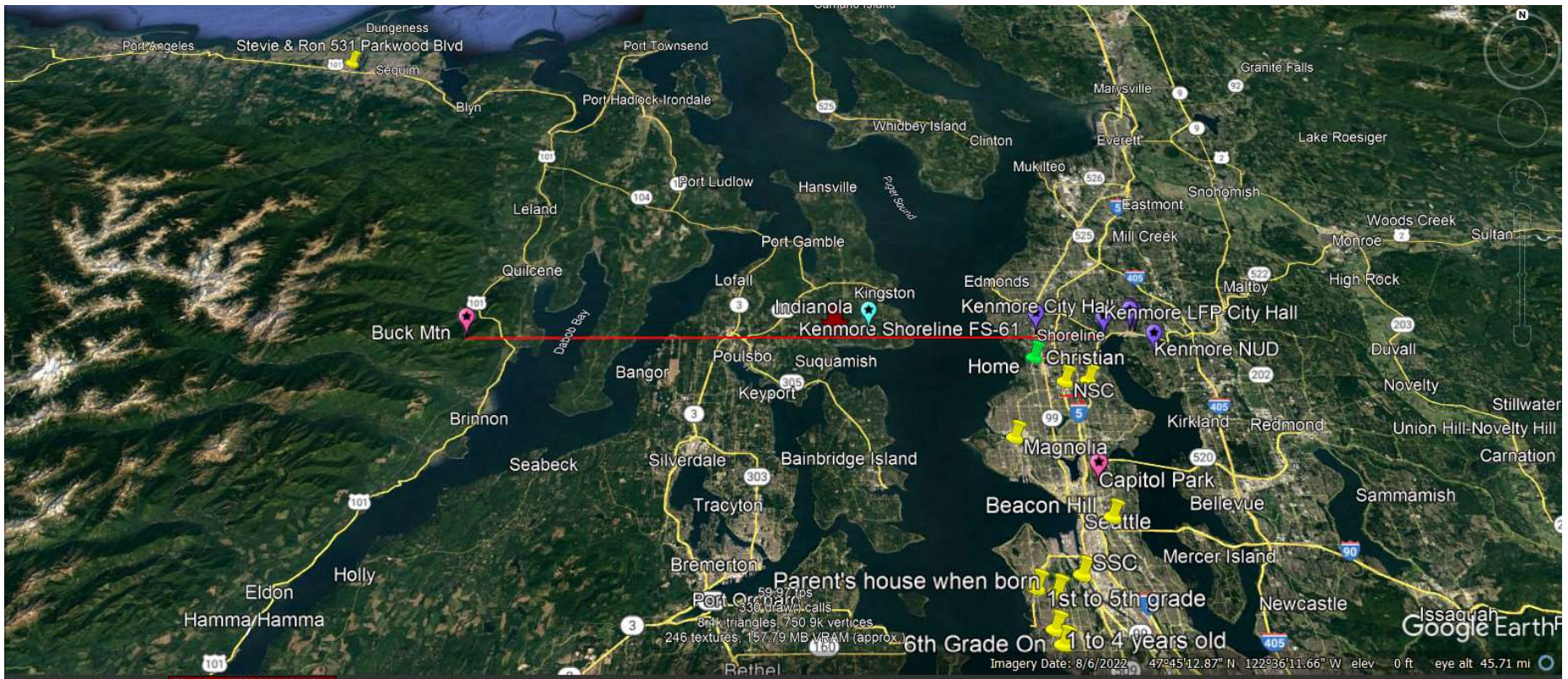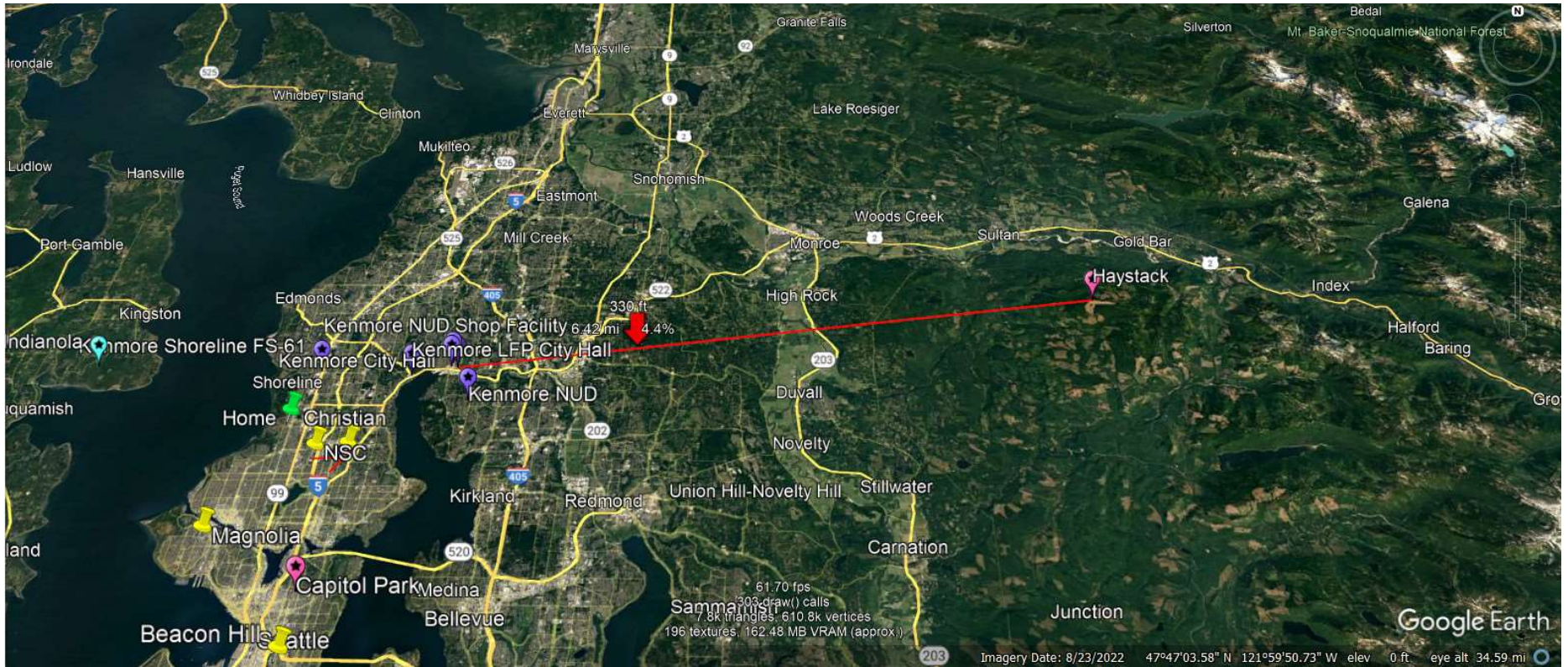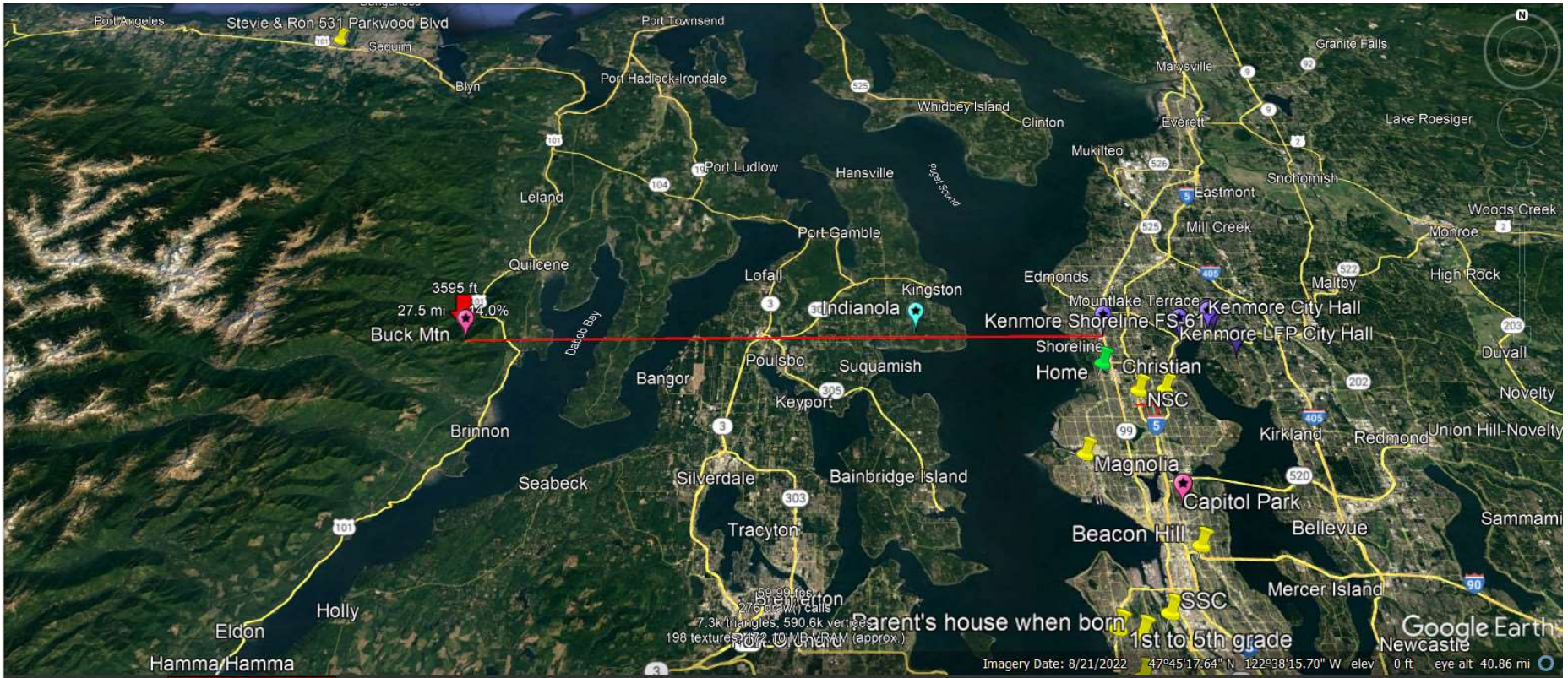
IMPORTANT CONSIDERATIONS

1. This is Amateur Radio – need a control operator, no encryption, no commercial activity, etc.
2. PSDR may or may not be connected to the Internet (in a disaster environment).
   But it should remain active in and of itself
   Possible backup link by Starlink
       File and Winlink server at Seattle EOC
3. Connected to Snohomish County EOC
4. Connected to Washington State Eoc
5. Connected to Seattle EOC
6. Not connected to King County EOC

AREDN
AMATEUR RADIO EMERGENCY DATA NETWORK

Amateur Radio Emergency Data Network

Login | Register

| HOME | SOFTWARE ▼ | DOCS ▼ | FORUM | MAP | ABOUT US ▼ | CODE ▼ | SHOP | DONATE |

2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |

900 MHz	Channel	4	5	6	7
	Ctr Freq	907	912	917	922
	Status	Shared with US unlicensed			

You are responsible for using frequencies, channels, bandwidths, and power levels that comply with your country's amateur radio license requirements.

2.4 GHz	Channel	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8 *
	Ctr Freq	2.387	2.392	2.397	2.402	2.407	2.412	2.417	2.422	2.427	2.432	2.437	2.442	2.447
	Status	non-US only	Unshared			Cannot Use	Shared with US unlicensed							

* Only 5 MHz channel width is available on channel 8

3.4 GHz	Channel	76	77	78	79	80	81	82	83	84	85	86	87	88	89
	Ctr Freq	3.380	3.385	3.390	3.395	3.400	3.405	3.410	3.415	3.420	3.425	3.430	3.435	3.440	3.445
	Status	US Amateur operations remain on a secondary basis but are subject to removal at any time by FCC notice*													

* per FCC 20-138 IV-E-69

www.Arednmesh.org

Similar to HamWAN, AREDN utilizes amateur radio frequencies to transport high speed digital data. However, there are many differences. AREDN nodes are all part of a mesh network, so any specific link can fail without taking down the entire network.

MESH TOPOLOGY

We have HamWAN for the backbone, shown in red in this illustration. AREDN can help us bridge the "last mile", bringing connection to areas that are not able to directly see a HamWAN site.
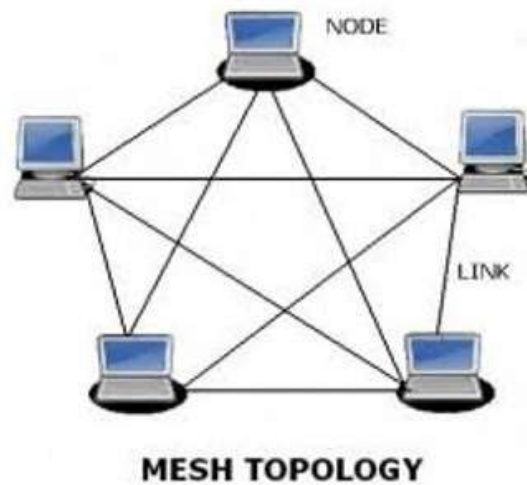
AREDN

The AREDN Mesh network has elements designed to traverse a variety of terrain and urban environments.

Backbone   Relay   Endpoint
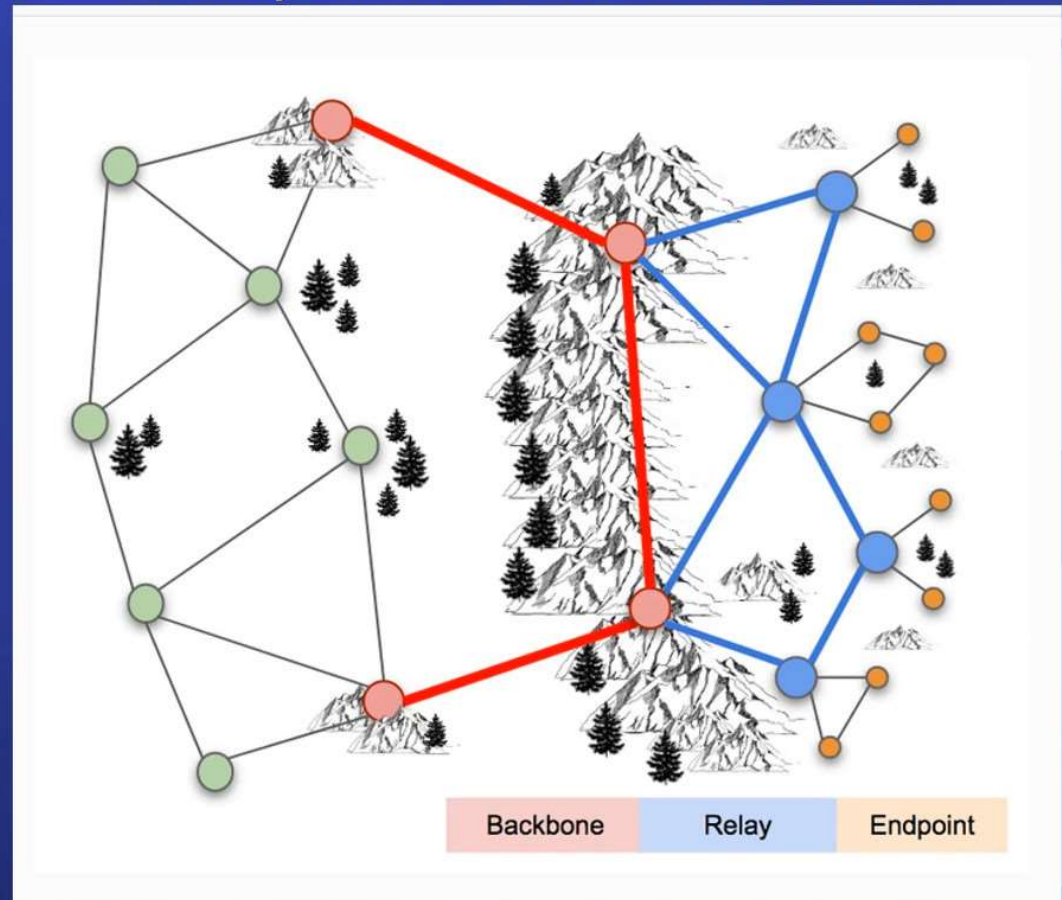
AREDN

Over the years the AREDN Project has developed software support for nearly 70 commercial wireless routers---moving them from their Part 15 allocation into adjacent Part 97 allocations in the .9, 2, 3, and 5 GHz bands---providing an inexpensive and easy way for hams to implement high-speed (up to 144 Mbps) data networks in support of Emergency Operations Centers (EOCs), Non-governmental Agencies (NGOs) and first responders.

Locally, we have chosen to utilize the 2.4 GHz band, using channel -2 which is not available to regular wifi systems. This gives us a clear channel, without normal wifi interference.

AREDN Offers 2 Non-Shared Channels on 2.4 GHz

2.4 GHz	Channel	-2	-1	0*	1	2	3	4	5	6
	Status	Ham Band				Shared Ham and ISM/WiFi Band				
	Freq	2.397	2.402	2.407	2.412	2.417	2.422	2.427	2.432	2.437

*Not available for use

24 Non-Shared Channels on 3.4 GHz

3.4 GHz	Channel	76	77	78	79	80	81	82	83	84	85	86	87
	Status	Ham Band											
	Freq	3.380	3.385	3.390	3.395	3.400	3.405	3.410	3.415	3.420	3.425	3.430	3.435
		88	89	90	91	92	93	94	95	96	97	98	99
		3.440	3.445	3.450	3.455	3.460	3.465	3.470	3.475	3.480	3.485	3.490	3.495

Refer to your local band plan for coordination

52 Channels, 14 Non-Shared, on 5.8 GHz

5.8 GHz	Channel	133	134	135	136	137	138	139	140	141	142	143	144	145
	Status	Ham Band shared with U-NII-2C/wifi/unlicensed												
	Freq	5.665	5.670	5.675	5.680	5.685	5.690	5.695	5.700	5.705	5.710	5.715	5.720	5.725
		146	147	148	149	150	151	152	153	154	155	156	157	158
		Ham Band shared with U-NII-3/wifi/unlicensed												
		5.730	5.735	5.740	5.745	5.750	5.755	5.760	5.765	5.770	5.775	5.780	5.785	5.790
		159	160	161	162	163	164	165	166	167	168	169	170	171
		Ham Band shared with U-NII-3/wifi/unlicensed											Ham Band	
		5.795	5.800	5.805	5.810	5.815	5.820	5.825	5.830	5.835	5.840	5.845	5.850	5.855
		172	173	174	175	176	177	178	179	180	181	182	183	184
		Ham Band												
		5.860	5.865	5.870	5.875	5.880	5.885	5.890	5.895	5.900	5.905	5.910	5.915	5.920

Refer to your local band plan for coordination; ★ 5825 to 5850 Shared under Part 15.247 with a limited number of WISP operators and may be encountered at tower sites

GL.iNet GL-AR750 (Creta) Travel AC VPN Router, 300Mbps(2.4GHz)+433Mbps(5GHz) Wi-Fi, 128MB RAM, MicroSD Storage Support, Repeater Bridge, OpenWrt/LEDE pre-Installed, Power Adapter and Cables Included

Visit the GL.iNet Store
4.3 ★★★★☆ · 1,716 ratings | 230 answered questions

Amazon's Choice for "vpn client router"

-17% $49⁹⁰
List Price: $59.90

✓prime
FREE Returns ⌄

Save up to 9% with business pricing. Sign up for free Amazon Business account

Brand	GL.iNet
Model Name	GL-AR750
Special Feature	WPS
Frequency Band Class	Dual-Band
Wireless Communication Standard	802.11ac

⌄ See more

Delivery | Pickup

$49⁹⁰
✓prime
FREE Returns ⌄

FREE delivery **Friday, July 7**.
Order within 10 hrs 35 mins

◉ Deliver to Cart - Seattle 98177

In Stock

Qty: 1 ⌄

Add to Cart

Buy Now

Payment	Secure transaction
Ships from	Amazon
Sold by	GL Technologies
Returns	Eligible for Return, Refund or Replacement within 30 days of receipt
Support	Free Amazon tech support included

☐ Add a gift receipt for easy returns

Add to List ⌄

GL.iNet GL-AR300M16-Ext Portable Mini Travel Wireless Pocket Router - WiFi Router/Access Point/Extender/WDS | OpenWrt | 2 x Ethernet Ports | OpenVPN/Wireguard VPN | USB 2.0 Port

Visit the GL.iNet Store
4.2 ★★★★☆ · 1,084 ratings

Amazon's Choice Overall Pick

-24% $31⁹⁰
List Price: $41.90 ⓘ

✓prime Same-Day
FREE Returns ⌄

Save up to 5% with business pricing. Sign up for a free Amazon Business account

Pay $31.90 $0.00 for this order. Get a $150 Amazon Gift Card upon approval for the Amazon Business Prime Card. Terms apply. Learn more.

Brand	GL.iNet
Special Feature	Access Point Mode, Remote Access
Frequency Band Class	Single-Band
Wireless Communication Standard	2.4 GHz Radio Frequency

Delivery | Pickup

$31⁹⁰
✓prime Same-Day
FREE Returns ⌄

FREE delivery **Today**
5 PM - 10 PM. Order within 2 hrs 37 mins

◉ Deliver to Cart - Seattle 98177

In Stock

Qty: 1 ⌄

Add to Cart

Buy Now

Payment	Secure transaction
Ships from	Amazon
Sold by	GL Technologies
Returns	Eligible for Return, Refund or Replacement within 30 days of receipt

☐ Add a gift receipt for easy returns

Add to List ⌄

Roll over image to zoom in

TP-Link 2.4GHz N300 Long Range Outdoor CPE for PtP and PtMP Transmission | Point to Point Wireless Bridge | 9dBi, 5km+ | Passive PoE Powered w/ Free PoE Injector | Pharos Control (CPE210)

Visit the TP-Link Store
4.2 ★★★★☆ · 4,636 ratings | 1000+ answered questions

$39⁹⁹

✓prime
FREE Returns ⌄

Limited Time Offer - pay $39.99 $0.00 for this order. Get a $200 Amazon Gift Card upon approval for the Amazon Business Prime Card. Offer ends 07/31/23. Terms apply. Learn more.

May be available at a lower price from other sellers, potentially without free Prime shipping.

Style: N300 | 2.4GHz

AC867	5GHz	N300	2.4GHz	N500	5GHz
$63.95	**$39.99** ✓prime	$49.99 ✓prime

Antenna	Built-in 9dBi 2x2 Dual-polarized Directional AntennaBeam Width: 65° (H-Plane) / 35° (E-Plane)Note: For more details, please refer to datasheet
Brand	TP-Link
Color	N300	2.4GHz
Number of Channels	1
Maximum Range	5 Kilometers
Item Dimensions LxWxH	8.82 x 3.11 x 2.36 inches

Delivery | Pickup

Buy new:
$39⁹⁹
✓prime
FREE Returns ⌄

FREE delivery **Thursday, July 6**.
Order within 4 hrs 16 mins

◉ Deliver to Cart - Seattle 98177

In Stock

Qty: 1 ⌄

Add to Cart

Buy Now

Payment	Secure transaction
Ships from	Amazon.com
Sold by	Amazon.com
Returns	Eligible for Return, Refund or Replacement within 30 days of receipt
Packaging	Shows what's inside

Add a Protection Plan:
☐ 3-Year Protection for $5.99
☐ 2-Year Protection for $3.99
☐ Tech Unlimited - 30% OFF COUPON LIMITED TIME Protect Many Devices with 1 Plan (Renews Monthly Until Cancelled) for $16.99/month

---

Roll over image to zoom in

MikroTik hAP ac lite Dual-concurrent Access Point (RB952Ui-5ac2nD-US)

Brand: MikroTik
4.5 ★★★★☆ · 545 ratings | 42 answered questions

Amazon's Choice for "mikrotik hap ac lite"

$57⁰⁰

✓prime One-Day
FREE Returns ⌄

Limited Time Offer - pay $57.00 $0.00 for this order. Get a $200 Amazon Gift Card upon approval for the Amazon Business Prime Card. Offer ends 07/31/23. Terms apply. Learn more.

Brand	MikroTik
Model Name	HAP ac lite
Special Feature	Access Point Mode
Wireless Communication Standard	802.11a
Compatible Devices	Personal Computer

⌄ See more

About this item
- 5 x 10/100Mbps Ethernet ports (PoE output on port 5)
- RB952Ui-5ac2nD-US (USA) is factory locked for 2412-2462MHz, 5170-5250MHz and 5725-5835MHz frequencies. This lock can not be removed.

Have one to sell? Sell on Amazon

🏴 Report incorrect product information

$57⁰⁰
✓prime One-Day
FREE Returns ⌄

FREE delivery **Tomorrow**
10 AM - 3 PM. Order within 12 hrs 32 mins

◉ Deliver to Cart - Seattle 98177

In Stock

Qty: 1 ⌄

Add to Cart

Buy Now

Payment	Secure transaction
Ships from	Amazon
Sold by	GETIC.
Returns	Eligible for Return, Refund or Replacement within 30 days of receipt
Support	Free Amazon tech support included

☐ Add a gift receipt for easy returns

Add to List ⌄

New (12) from
$57⁰⁰ ✓prime FREE One-Day ❯

We (Seattle ACS) see AREDN as being a very viable "last mile" link, to get a high speed data source (whatever it is), from wherever it is, to wherever you need it.

You have a good line of sight HamWAN shot available at intersection "x". You need data 3 blocks south-east of that location. Place a HamWAN client at "x" and use AREDN Mesh to extend that service to where you need it 3 blocks away. Possibly a single two-point mesh, possibly 1 or more intermediate mesh devices. But quick and easy to set up, very low power demand, very low "infrastructure" requirement.

IF you can get enough AREDN nodes in a community, you can simply mesh across that entire community without nay external connectivity, and still have a very valuable resource.

A possible use: You have set up multiple soft sided sheltering units (big tents) spread out over a large portion of Marymoor Park. With AREDN Mesh connected at a single point to a desired network (internet or simply part of your city network even if no internet is available), you could easily set up a laptop and voip phone connection at each of the shelters.

And last, but not least…

STARLINK

- Direct connectivity to low-earth-orbit satellites provides global access to the Internet.
- Lightweight, portable, requires clear view of the sky.
- Requires regular 120 VAC power (anywhere from 40 to 200 watts, idles at about 40 watts).
- Links back to a ground station, typically in the geographic area you are located in (Redmond serves this area). System adapts as needed to link further away if/as necessary.
- There are multiple account types, with initial hardware cost ranging from ~$600 to ~$2500.
- There are monthly service costs starting at about $120 (and ranging to over $500).
- As a business, Starlink is VERY DIFFICULT to work with (or even contact).

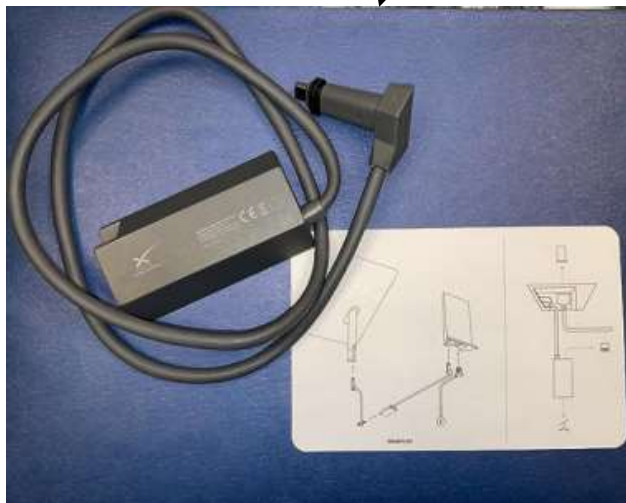- BUT, it provides what you need, when you need it, where you need it.

Starlink

You can get a 75 foot, or 150 foot, cable to go between the "dish" and the router. The cable uses proprietary connectors that are both difficult to connect, and easy to damage. Care is needed in connecting and using the cable.

The consumer version of Starlink does not include an ethernet connection on the router, you have to add an external adapter to get an ethernet connection