

INTELLIGENT TRANSPORTATION SOCIETY OF ALASKA

2024 Annual Meeting | Anchorage, AK | Sep 17th

Applications of Starlink Satellite Communications for Alaskan Remote Road Weather Information Systems

Michael Lilly, GW Scientific, George Mueller, GW Scientific, Gordon Scott, Alaska DOT&PF, Mike Burton, Campbell Scientific, Colter Holliday, Kachemak Electric Co.

Communication Needs

- Provide Real-Time – Current Conditions Information
- Allow Remote Diagnostics and Potential Maintenance
- Changing Station Operational Conditions
- Low Power Systems – Power Costs!!!

Advanced RWIS (Winter Hazards) Station – AAW01, Looking South towards station. Dalton Highway in background.

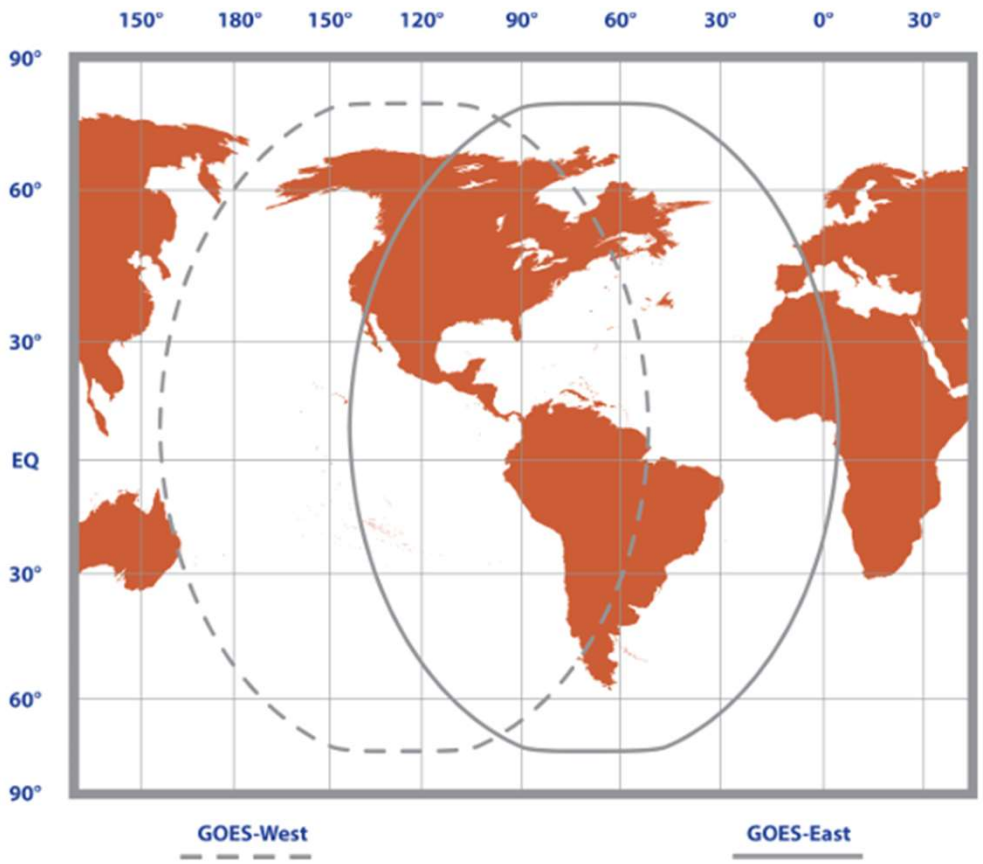
2-Way Communication Methods

- Radio (RF) Links
- Cellular Phone Networks
- Satellite
- Direct Internet Protocol Links
- Combined Methods

Advanced RWIS (Winter Hazards) Station – AAW01, Looking West towards multiple avalanche zones. Station located out of snow removal impact zone.

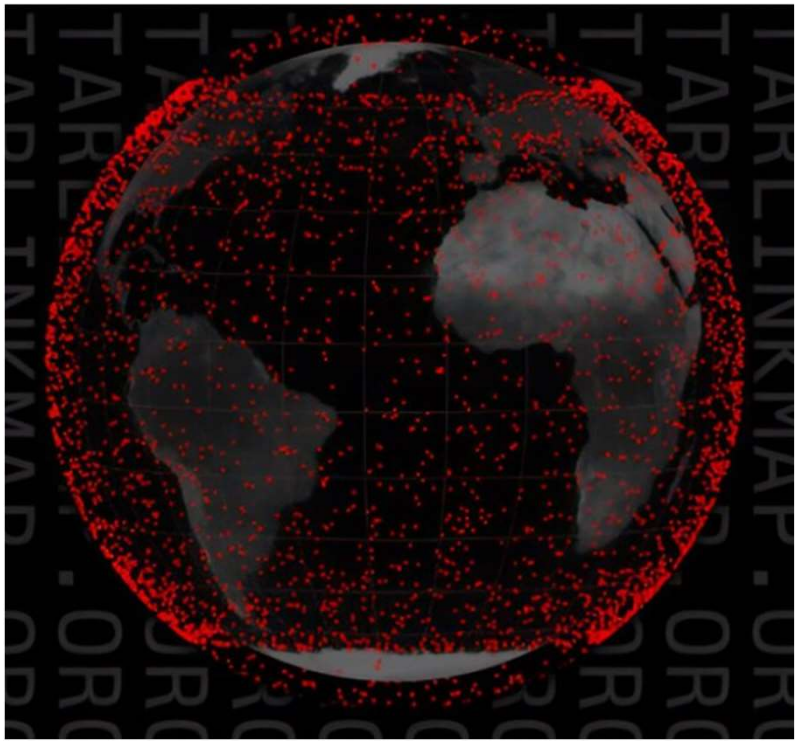
Satellite Categories

- Geostationary
  - Hughesnet
- High Earth Orbits
  - GEOS
- Low Earth Orbits (LEO)
  - Starlink



Satellite Internet Providers

- HughesNet
- Viasat
- OneWeb
- Telesat
- Kuiper (Amazon)
- Telstra
- Freedomsat
- NBN Sky Munster
- Starlink



Live map of all satellites above the earth. (Notice that the darker red (more satellites) towards the poles this is because of the orbits of LEO satellites. This means better coverage at higher latitudes.)

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SpaceX Starlink

Starlink is the world's most advanced satellite internet constellation, beaming terabytes per second to the most remote parts of Earth. Made possible by the advent of reusable rocketry, Starlink marks the beginning of a new age of orbital technology.

In the Starlink constellation, there are
5,601 orbiting satellites.

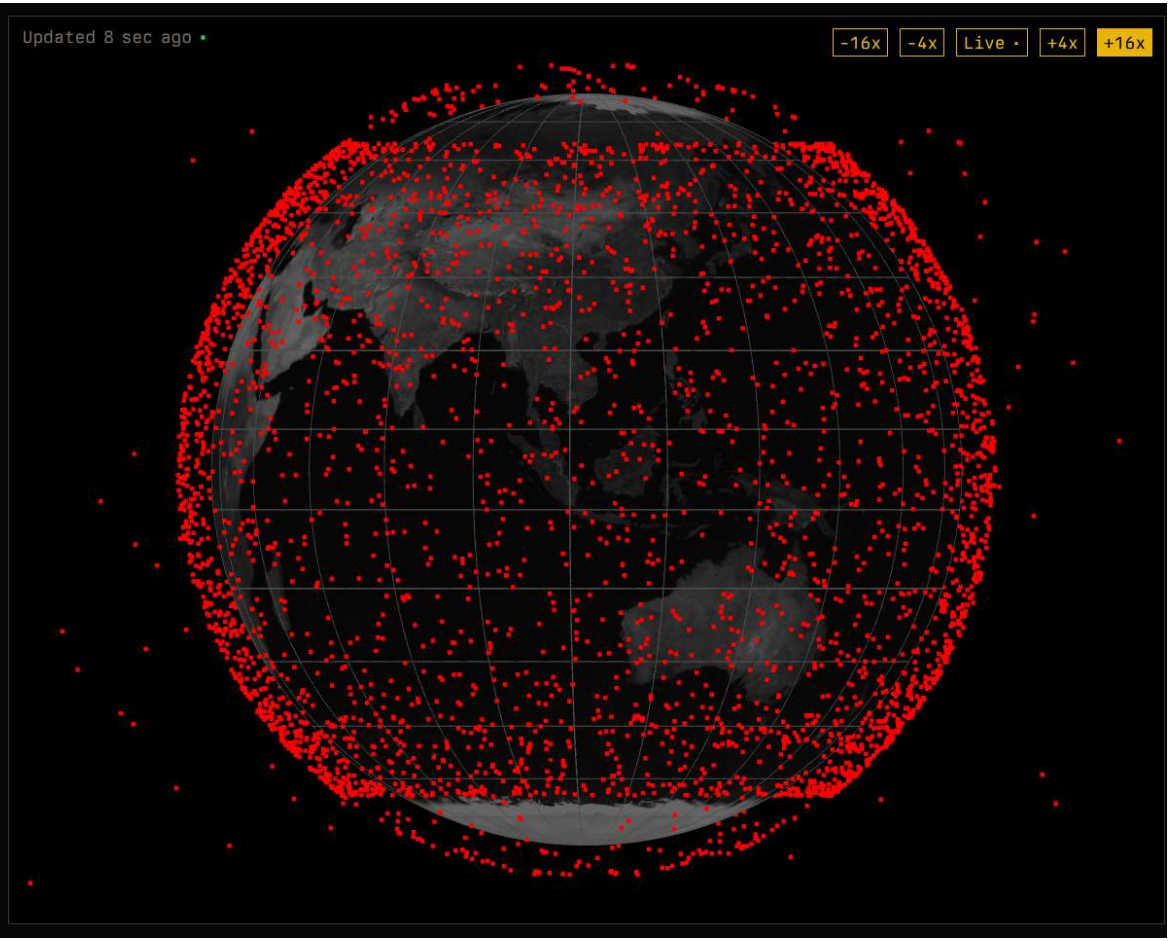
Multiple iterations of the Starlink satellite have been launched, adding features like laser inter-satellite links, smaller size, and reduced weight.

Starlink v1-1.5:
4,332 satellites.

Starlink v2 (mini):
1,269 satellites.

376 satellites
have been deorbited to incinerate on re-entry.

5,977 satellites



https://www.starlinkmap.org/

Benefits of LEO Satellite Constellations

- More deployment options
- Lower transmission distances
- Lower Latencies

Klondike Highway @ US Border, Bill Glude, 12/28/23

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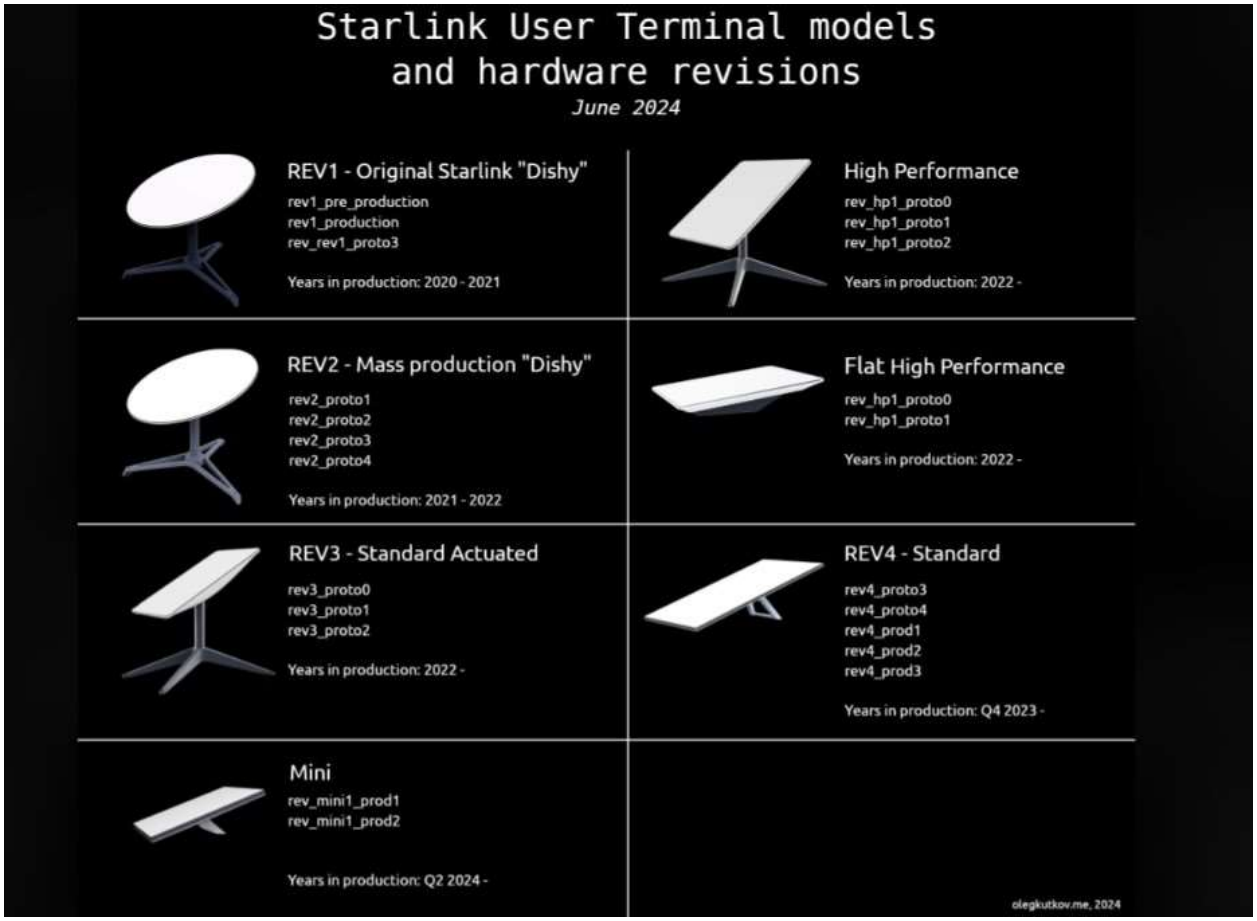
Dalton

Future?



Klondike

Power Required for Different Starlink Systems

- High Performance
  - 110-150 watts
- Standard
  - 75-100 watts
- Mini
  - 25-40 watts

Starlink Standard on stem, DOT Chandalar M&O Camp Bunkhouse, M. Lilly, March 2024

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Power Budget Spreadsheet

Steps

1. Select loads (click Add/Delete/Edit/Archive to add devices, if needed)
2. Adjust Program Intervals (scan and communications intervals)
3. Enter Minimum Average Temperature
4. Enter Desired Backup and Battery Size (auto selection optional)
5. Enter Sun Hours for area
6. Size Solar panel (auto selection optional)

LOADS: All

Select Devices: CR1000X, HygroVUE5, RMYng 05108-45, RMYoung 5103, SnowVUE10 AAI, Starlink Mini, CH201

System Total: 22.4 mAmps

Program Interval: Scan Interval 10.00 Seconds; Comms Interval 60 Minutes

Lowest AveTemp: Min Average Values Set by Location (Temp °C)

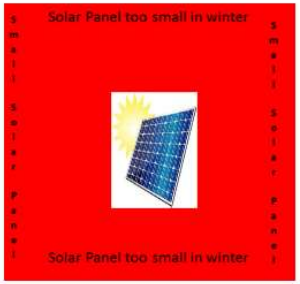
Storage Reserve: Battery Size 400 Ah; Desired Backup 14 Days

Charging Source: Equiv. Sun Hours Values Set by Location; Solar Panel SP90

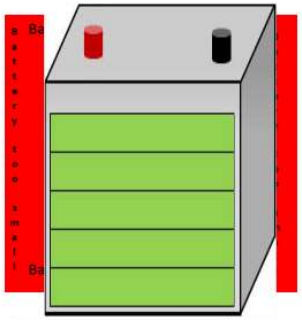
Admin | Save | Display

Estimated battery amp hours corrected for temperature:	229.6	Amp Hours	Daily Load: 0.65 Amp Hours
Minimum estimated battery amperage required for system:	20	Amp Hours	
Estimated backup with selected battery:	284.5	Days	Minimum Daily Solar: 0.3 - 24.9 Amp Hours
Estimated solar panel wattage requirement for system:	193.6	Watts	

Add/Delete/Archive/Edit | View Device Specifications | Reset | Assign Defaults | Compare | Save | Delete | Print

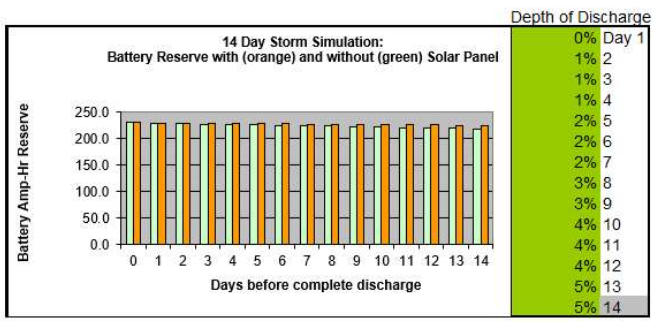


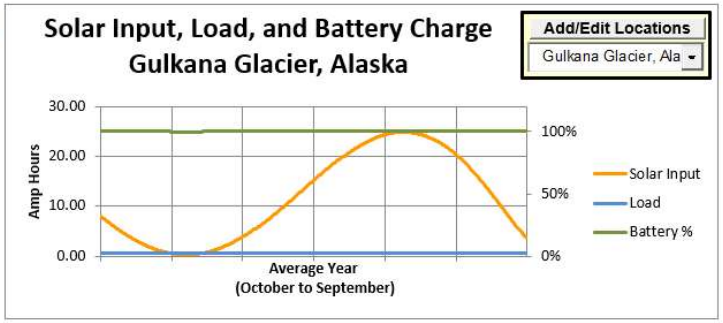
Auto Select Solar Panel

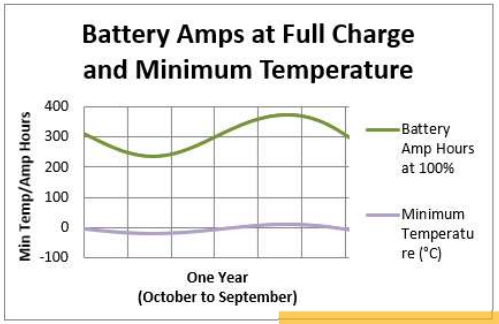


Auto Select Battery

Hint: Increase Solar Panel size or decrease loads or try slower Scan or Comms Interval







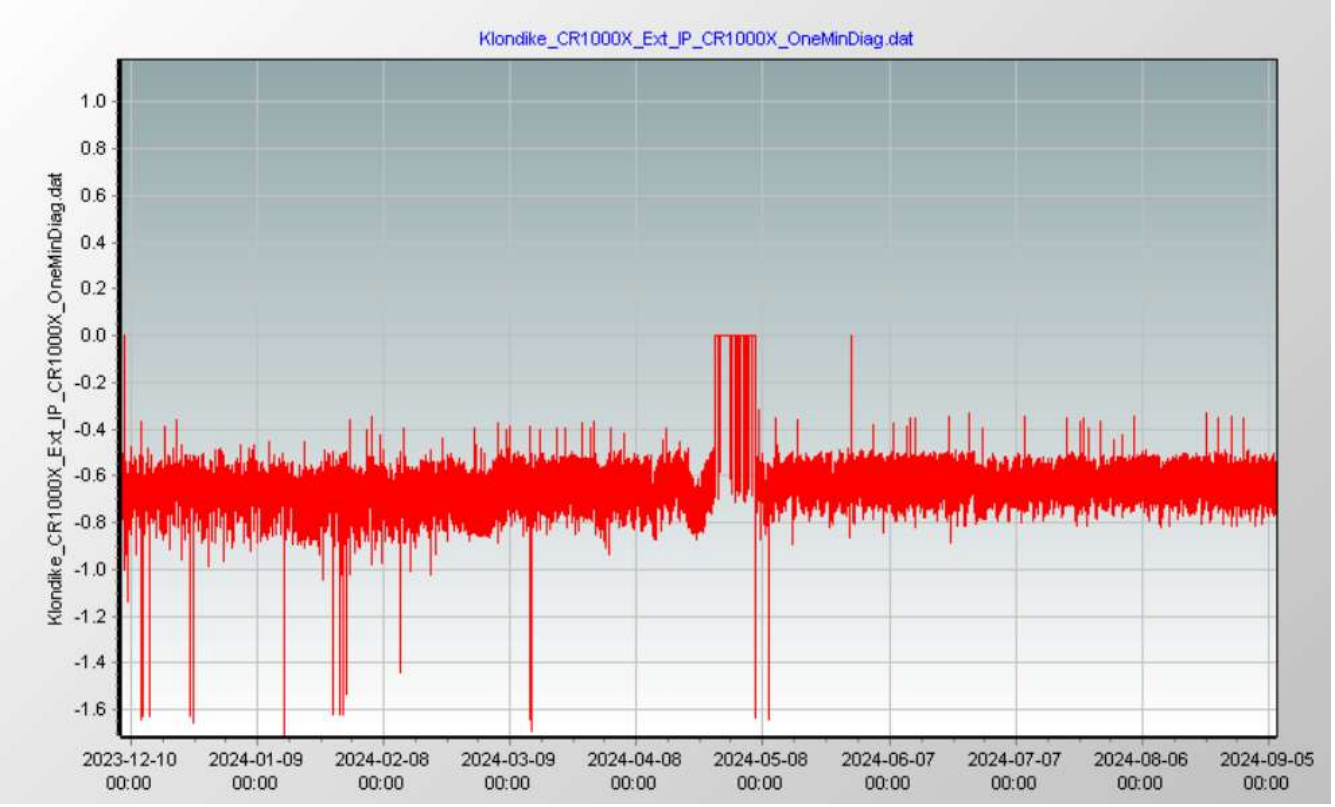
Campbell Scientific Power Budget Tool

Communication Requirements

- Fixed IP Addressing
  - Public IP Setting
- Port Forwarding
- Ability to Disable Starlink Router
- Support for Multiple Devices

Dalton Highway, Chandalar M&O Camp, April 2024

Klondike AC Measurement Examples



High Performance and Standard Starlink Systems Require Max 1-minute AC Current

Remote Weather Stations

- Only Power When Needed
- Summer versus winter Power
- Excess Bandwidth Available
- No Heating Requirements
- Mini-Starlink has Good Potential
- Still Applications for High Performance and Standard Units

Mini-RWIS Station, Alaska Highway MP 1285

Thank You

Questions?