Lauritzen Inc.
Bringing new ideas to renewable energy

Internet Service to Remote Sites

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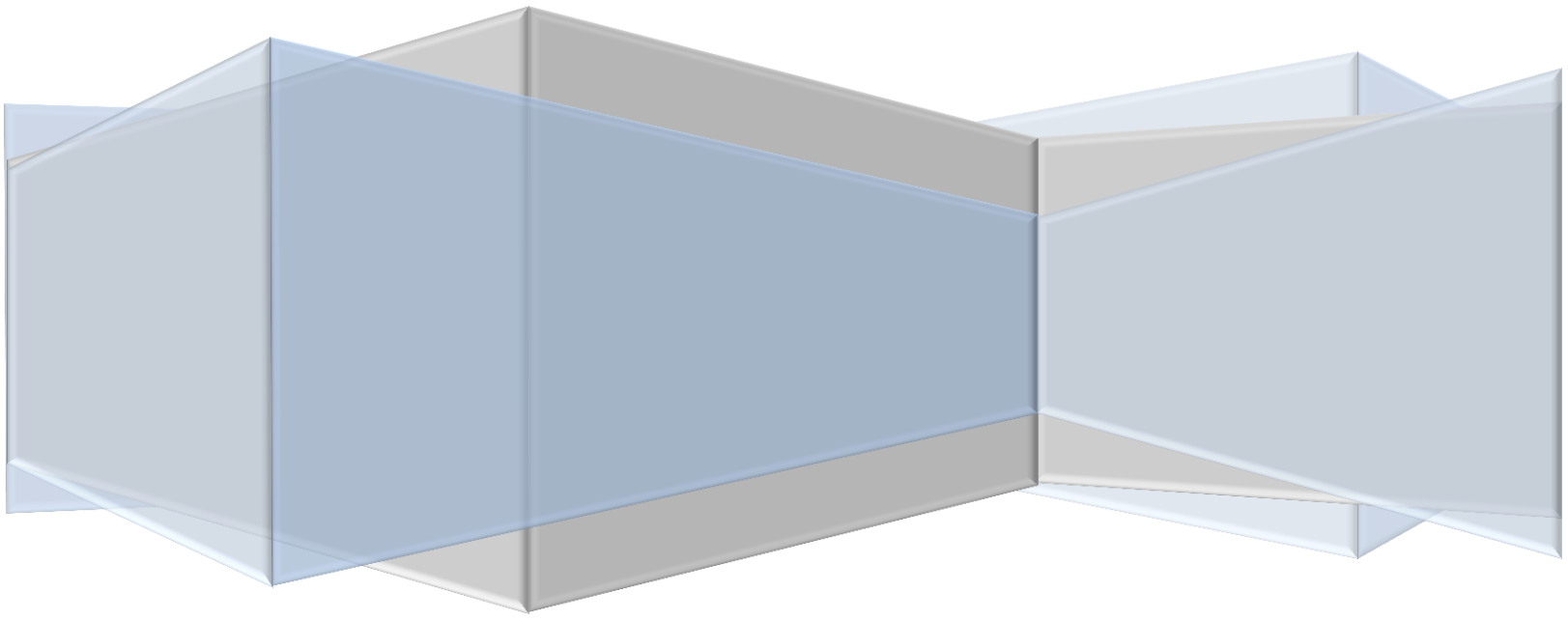

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1. Internet Service to Remote Sites – An Overview

Lauritzen Solar Tracker Control systems are used today throughout North America and Europe. A common challenge in deploying networked Solar Tracker Controllers in remote areas is Internet connectivity. This document will highlight the options available to the system designer and/or installer. There are two scenarios where Internet connectivity is needed, permanent (available all the time) and temporary for installation/troubleshooting. Internet enabled Valhalla software is included with all our products, but is not required. Some customers may choose to monitor their trackers locally without a permanent connection, but Lauritzen Inc. cannot troubleshoot issues remotely without a connection.

DISCLAIMER; Lauritzen cannot guarantee connection functionality of your site, nor can we guarantee functionality of the equipment listed or illustrated within this document. It is the responsibility of the site designer/engineer to select the best cost effective and functional solution.

2. Site Inspection

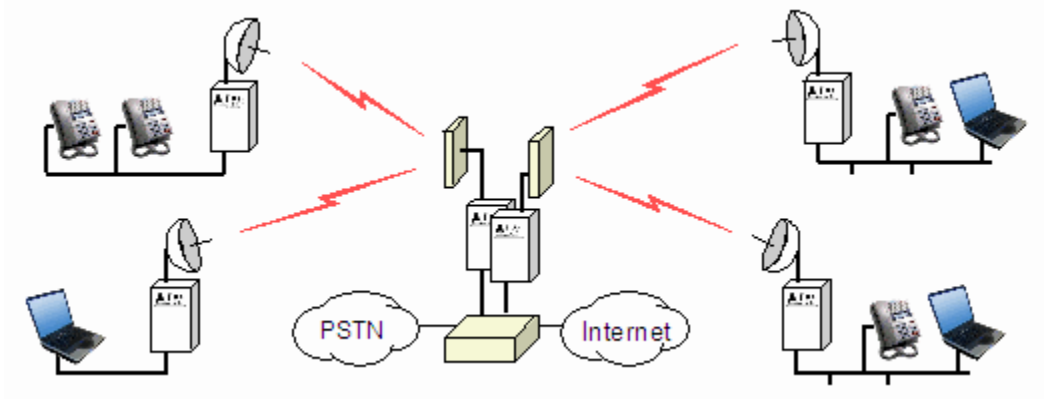
Prior to site installation, a site inspection should be carried out with respect to available connection methods. Most remote sites are located beyond reach of internet cable or DSL service providers. Common to all remote sites, is a wireless network solution which can be one of either:

1) Ethernet bridge to an existing Internet service
2) Cell phone based Internet service
3) Satellite based Internet service

Most wireless plans carry a monthly data limit, or a fee per quantity of data transferred. As a rule of thumb, a typical deployed Lauritzen solar tracker controller will transfer app 50MB per month – assuming a server contact interval of 10 minutes. Another important consideration is the environment. Remote sites may require installation at a site with extreme temperatures. Mounting the electronics in a weather proof enclosure, and providing an outdoor antenna and consistent power will increase the cost of the installation.

3. Radio Bridge to Existing Internet Service

In rural areas, where there is poor or no cell phone service, a wireless Ethernet bridge can be used to provide service by using 900 MHz or 2.4 GHz (license free), or 5GHz radio. Since these bands are unlicensed, the possibility of interference needs to be taken into account. Some manufacturers use spread spectrum techniques to minimize the problem of interference. http://www.afar.net/wireless/ethernet-bridge/ claims a 50 mile (80km) range for its products. Data rate is 1 to 150 Mbps depending upon model. This unit is installed in an outdoor enclosure. Because of line of site issues, this type of system most likely cannot be used for temporary connectivity.



Point to Point Wireless Bridge

http://www.avalanwireless.com/product-details-5_8_ghz_outdoor_10_mbps_wireless_ethernet_bridge-1041.htm offers a pair of 5.8 GHz Outdoor 10 Mbps Wireless Ethernet Bridge for ~$2800 US with a 15 mile (22 km)line of site range. The startup costs for this is high, but once established there is no additional connectivity or service charge. This solution would work for facilities that have a nearby head end with existing connectivity such as DSL. Another possibility is to use WiFi with a directional antenna.

Nov-2017; one of our customers recently installed a site where a Ubiquiti PBE-M5-300 Powerbeam bridge was installed to provide Ethernet wireless communication across a 1500ft distance.

Link to Ubiquiti site: https://www.ubnt.com/airmax/powerbeam/

The Powerbeam equipment mounts the radio directly on the antenna-rear to minimize loss, and reduce cost. The system was installed by the electrical contractor, and configured by an IT administrator of the system owner (school district). At a cost of less than USD200, this appears to be a very attractive solution.

4. Cell Phone Internet Service

Cell phone Internet service is provided using the 3g/4g network available from cellular towers, so will only work in areas where there is coverage. Monthly costs vary from $30-100 per month plus startup fees. The costs of the solutions vary quite a bit as well. A build your own solution based on consumer grade devices will cost around ~$500 , while industrial grade devices cost over $1000. Temporary connections can use one of many consumer grade routers (Netgear MBRN3000, Cradlepoint MBR1200) advertised as 3g/4g capable. These typically use a 3g/4g usb modem or aircard (obtained separately) to provide the cellular service. For permanent installations, a more expensive commercial cellular router is recommended as well as a weather-proof enclosure and a stable power supply.

Speed:

- Down speed: 0.4 to 50 Mbps
- Up speed: 0.2 to 6 Mbps
- Latency: (less is better) 250 to 800 ms, depending on your area

Temporary/mobile connectivity:

1) The Cradlepoint MBR900 http://www.wirelessnwifi.com/Cradlepoint-MBR900 Cellular 3G/4G Router ($105) is one example of a router with both Ethernet ports and WiFi – so multiple devices can be connected. These routers need to attached to a USB 3g(or 4g) modem (one compatible with the MBR900 is the AT&T USBConnect Momentum 4G. In certain circumstances an external antenna might be needed, and only certain USB modems support external antennas. The cost of the modem will vary depending on the contract cost. Cellular USB modems are experiencing rapid changes, and the compatibility of a particular modem needs to be checked before selection. Additional Information on external cellular booster antennas and installation:
http://colonialwireless.com/files/DirectionalAntennaInstallGuide.pdf
http://www.usantennashop.com/index.php?route=product/category&path=196_202

Permanent connectivity:

2) B&B Electronics: http://www.bb-elec.com/product_multi_family.asp?MultiFamilyId=108&TrailType=Sub&Trail=916 The cpan-WAN-B311-A can be provisioned by Verizon and costs $951.

3) Phoenix Contact http://eshop.phoenixcontact.de/phoenix/treeViewClick.do?UID=2313863&parentUID=852648509&reloadFrame=true has a product line for secure remote Internet access via an industrial quality router with VPN functionality. Supplied as standard: 1 x PSI-MODEM-PAC/FLAT3ETHG including antenna and Vodafone SIM card – flat rate (see cell phone contract) Pricing for a unit without simcard was $1100.

4) http://www.avalanwireless.com/marketing_resources/product_briefs/AW-NetDrop_Product_Brief.pdf offers a 3g/4g cellular gateway for $999. This does not include the cost of a WiFi or Ethernet only router.

Unit	Initial Cost	External Antenna	Temperature	Voltage
Router+modem+ antenna	~$300			
2 B&B	~$1000	50 Ohm SMA	-30 to +75° C*	9-30v
3 Phoenix	~$1100 + simcard	50 Ohm SMA (F)	-25 to +55°C	12-48v
4 Avalan	~$999 + router	(2dbi included)**	-40 to +70°C	18vdc POE***

*Reduced performance above 60° C

** 11 dbi optional

*** Power over Ethernet

5. Satellite Based Internet Connection

This service is available all across the U.S (World)., even in places where DSL and cable cannot or will not go. It does not matter where you live or how far out from the populated areas your home is situated. All you need is a clear view of the sky. Obstructed views are the only things that can prevent data from being sent and received. Using this technology consumers do not have to count on cables to come all the way into their home like they do with broadband service. Satellite is the ideal delivery system for online access for those of us who live in secluded areas and in other places where DSL and cable aren't available for one reason or another".

According to http://netforbeginners.about.com:

Speed:

- Down speed: 0.5 to 1 Mbps
- Up speed: less than 1 Mbps
- Latency: (less is better) 800 to 2500 ms, depending on your area

Cost:

- $100 to $250 per month, plus $300 to $1000 for the satellite dish, plus installation fees

Good:

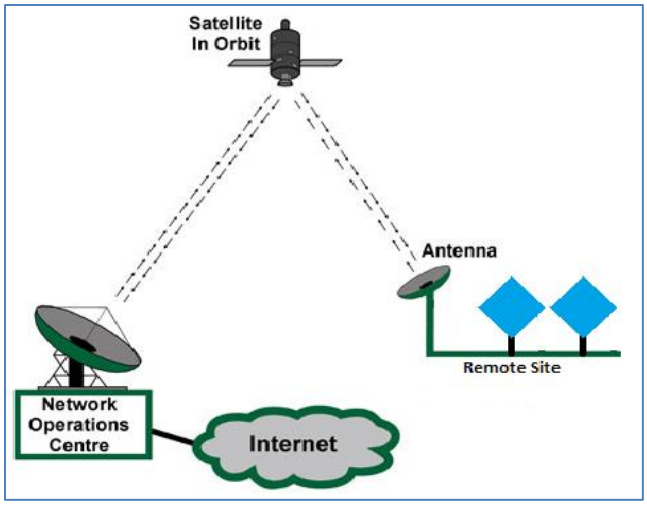
- Can bring internet to remote users where cell coverage is unavailable

Bad:

- Very slow, and latency is often over 800 milliseconds.
- Expensive to install, expensive to subscribe to.
- Can be unreliable if your locale is cloudy and rainy, or if your line of sight to parts of the sky are obscured by trees and mountains."

Examples: WildBlue satellite internet." http://business.hughesnet.com/

Hughes Satellite has an Express 200 plan for $109 per month. This will require a professional dish installation. This plan specifies 300Kb uploads.



Satellite Internet

6. Connection Cost Considerations

For small installations where internet connectivity already exists, and there is a clear site line of less than 10 miles, a pair of flat panel WiFi long range antennas will be the cheapest way to go.

If cellular connectivity is available – cellular modems appear to be the next best cost alternative. No special site preparation is needed. If no cellular is available, satellite internet appears to be the next best available alternative. Both these methods let the user control their end of the infrastructure.

Point to point Internet solutions using a radio bridge require a high initial startup cost, and also put the support burden on the user. Both ends of the connection need to be maintained, and could be impacted by new construction or interference these installation require line of site and are limited in range. They are cost effective only if the operational time line is relatively long and maintenance costs are very low.

Type	Upload Speed	Initial Cost	Monthly Cost
WiFi Long Range	>6Mbps	$200	$0
Radio Ethernet	1-2Mbps	$2800	$10? (service contract)
Cellular Modem	.2-6Mbps	$600 - 1200	$50-100
Satellite Internet	<1Mbps	$300-1000	$60-200

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