



# Teledatics Smashes Wi-Fi HaLow Distance Record

Groundbreaking Achievement Showcases the Future of Long-Range Wireless Communication

## Summary

Teledatics, in collaboration with Newracom and TE Connectivity, has set a new benchmark in wireless communication by achieving a 106-kilometer (66 mile) Wi-Fi HaLow connection. This groundbreaking test demonstrates the potential of Wi-Fi HaLow technology for long-range, low-power applications, paving the way for innovative wireless solutions and industrial applications.



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Authors: James Ewing [james@teledatics.com](mailto:james@teledatics.com), Dan Slater [dan@teledatics.com](mailto:dan@teledatics.com)

## Introduction to Wi-Fi HaLow

Wi-Fi HaLow (IEEE 802.11ah) is a sub-GHz wireless standard designed for long-range and low-power communication. It is particularly suited for wireless applications due to its ability to penetrate obstacles and provide extended coverage. Previous notable achievements include Morse Micro's 3-kilometer (1.8 mile) test, showcasing Wi-Fi HaLow's potential.

Wi-Fi HaLow utilizes frequencies below 1 GHz to achieve significantly extended range over legacy Wi-Fi at 2.4 GHz or Wi-Fi 6 & 7 at 5 GHz. These lower frequencies allow Wi-Fi HaLow signals to penetrate obstacles more effectively and cover greater distances, making it ideal for long range wireless applications.

## **Teledatics' Breakthrough**

### **Company Background**

Teledatics is a pioneer in Wi-Fi HaLow technology, having launched the first open-source HaLow development kit in 2021. The company has partnered with Newracom, leveraging their NRC7394 System-on-Chip (SoC), and TE Connectivity for high-performance antennas. This collaboration has enabled Teledatics to push the boundaries of long-range wireless communication.

### **The NRC7394 Chip**

The NRC7394 SoC by Newracom is a next-generation Wi-Fi HaLow chip that offers exceptional long-range and low-power capabilities. It supports full IEEE 802.11ah compliance, enabling robust communication over extended distances with minimal power consumption. This chip is integral to Teledatics' high-power Halomax™ modules.

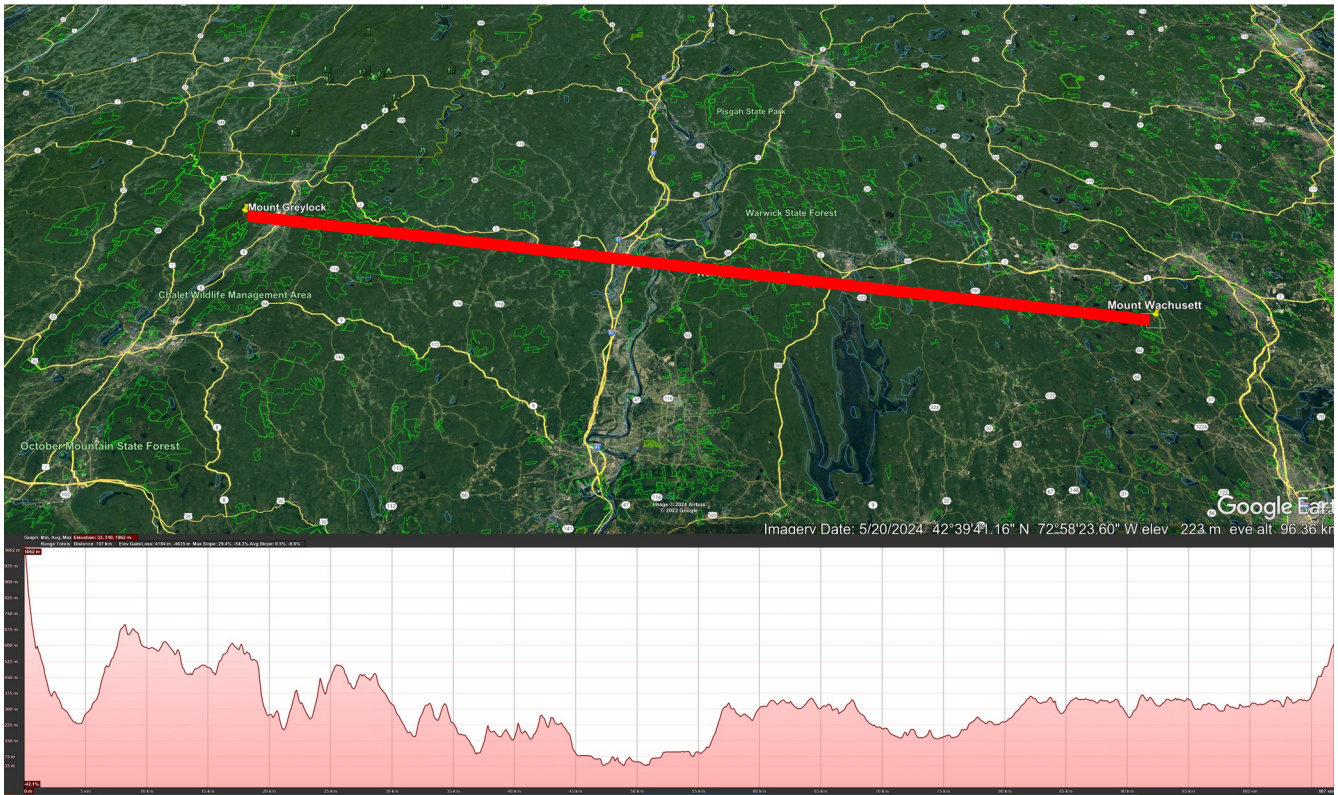
## **The 106 Kilometer Test**

### **Objectives**

The primary goal of the 106-kilometer (66 mile) test was to demonstrate the extended range capabilities of Wi-Fi HaLow and its suitability for applications requiring reliable long-distance communication.

### **Test Setup**

The test was conducted between Mount Greylock and Mount Wachusett in Massachusetts, utilizing Teledatics' high-power HaloMax™ module with Newracom's NRC7394 chip, and TE Connectivity long range antennas. The setup included 3D printed mounts for the electronics and antennas and LiPo batteries to power the electronics and ensure extended performance over the challenging terrain. The test equipment was mounted on portable tripods that were set up on-site for the test duration. The test fixtures are completely portable and all equipment was returned to Teledatics' facilities after the test concluded.



**Mount Greylock ←**

**106 km (66 mi)**

**→ Mount Wachusett**

**RPi4 → TD-WRLS**

**TD-WRLS → RPi4**

## Methodology

The test was conducted between Mount Greylock and Mount Wachusett in Massachusetts, utilizing Teledatics' high-power HaloMax™ module with Newracom's NRC7394 chip, and TE Connectivity long-range antennas. The setup included 3D-printed mounts for the electronics and antennas, and LiPo batteries to power the electronics and ensure extended performance over the challenging terrain. The test equipment was mounted on portable tripods that were set up on-site for the test duration. The test fixtures are completely portable, and all equipment was returned to Teledatics' facilities after the test concluded.

The link was achieved between two Raspberry Pi Model 4 units running the latest version of the Raspbian operating system. Two Teledatics TD-WRLS development kits were connected to the Raspberry units over USB. Power was fed to the Raspberry Pi units and the TD-WRLS development kits from LiPo batteries. TE Connectivity Yagi antennas were connected to the TD-WRLS. Compass headings and GPS location data were used to align the antennas.

# Results

## Performance Metrics

The test achieved impressive performance metrics.

- Signal strengths: -81 to -92 dB
- Connection bandwidth: 1, 2, and 4 MHz
- Frequency range: 902 to 928 MHz
- Distance: 106 kilometers (66 miles)

These results significantly exceed the previous record of 3 kilometers, underscoring the advancements made by Teledatics' HaloMax™ high power module.

## Connection Results

Output of HaLow STA connection to HaLow Access Point in the Raspbian wpa\_supplicant logs:

```
root@teledatics:/home/teledatics# journalctl -f
Jul 20 15:42:46 teledatics avahi-daemon[656]: Leaving mDNS multicast group on interface wlan1.IPv4 with address 192.168.100.2.
Jul 20 15:42:46 teledatics avahi-daemon[656]: Interface wlan1.IPv4 no longer relevant for mDNS.
Jul 20 15:42:46 teledatics systemd-networkd[333]: wlan1: Failed to disable IP masquerading, ignoring: No such file or directory
Jul 20 15:42:46 teledatics wpa_supplicant[1080]: wlan1: CTRL-EVENT-DSCP-POLICY clear_all
Jul 20 15:42:46 teledatics wpa_supplicant[1080]: nl80211: deinit ifname=wlan1 disabled_11b_rates=0
Jul 20 15:42:46 teledatics wpa_supplicant[1080]: wlan1: CTRL-EVENT-TERMINATING
Jul 20 15:42:46 teledatics systemd[1]: wpa_supplicant@wlan1.service: Deactivated successfully.
Jul 20 15:42:46 teledatics systemd[1]: Stopped wpa_supplicant@wlan1.service - WPA supplicant daemon (interface-specific version).
Jul 20 15:42:46 teledatics systemd[1]: Started wpa_supplicant@wlan1.service - WPA supplicant daemon (interface-specific version).
Jul 20 15:42:46 teledatics wpa_supplicant[1801]: Successfully initialized wpa_supplicant
Jul 20 15:42:54 teledatics kernel: nrc80211 spi7.0: nrc_mac_bss_info_changed(changed:BSS_CHANGED_TXPOWER[PW=30 TYPE=auto])
Jul 20 15:42:54 teledatics kernel: nrc80211 spi7.0: nrc_mac_bss_info_changed(changed:BSS_CHANGED_TXPOWER[PW=30 TYPE=auto])
Jul 20 15:42:54 teledatics wpa_supplicant[1801]: wlan1: interface state UNINITIALIZED->ENABLED
Jul 20 15:42:54 teledatics wpa_supplicant[1801]: wlan1: AP-ENABLED
Jul 20 15:42:54 teledatics wpa_supplicant[1801]: wlan1: CTRL-EVENT-CONNECTED - Connection to 02:00:01:45:eb:12 completed [id=0 id_str=]
Jul 20 15:42:54 teledatics systemd-networkd[333]: wlan1: Gained carrier
Jul 20 15:42:54 teledatics systemd-networkd[333]: wlan1: found matching network '/etc/systemd/network/14-wlan1_up.network', based on potentially unpredictable interface name.
Jul 20 15:42:54 teledatics avahi-daemon[656]: Joining mDNS multicast group on interface wlan1.IPv4 with address 192.168.100.2.
Jul 20 15:42:54 teledatics avahi-daemon[656]: New relevant interface wlan1.IPv4 for mDNS.
Jul 20 15:42:54 teledatics avahi-daemon[656]: Registering new address record for 192.168.100.2 on wlan1.IPv4.
Jul 20 15:43:08 teledatics kernel: nrc80211 spi7.0: nrc_mac_sta_state: sta:ca:fe:ba:be:12:34, 0->1
Jul 20 15:43:08 teledatics kernel: nrc80211 spi7.0: nrc_mac_sta_state: sta:ca:fe:ba:be:12:34, 1->2
Jul 20 15:43:08 teledatics kernel: nrc80211 spi7.0: nrc_mac_sta_state: sta:ca:fe:ba:be:12:34, 2->3
Jul 20 15:43:08 teledatics wpa_supplicant[1801]: wlan1: AP-STA-CONNECTED ca:fe:ba:be:12:34
Jul 20 15:43:08 teledatics kernel: nrc80211 spi7.0: nrc_mac_sta_state: sta:ca:fe:ba:be:12:34, 3->4
Jul 20 15:43:08 teledatics kernel: nrc80211 spi7.0: nrc_wim_change_sta_state: AMPDU is ready with peer (ca:fe:ba:be:12:34)
```

Output of the wireless iw command at the Access Point showing connection link strength:

```
root@teledatics:/home/teledatics# iw wlan1 station dump
Station ca:fe:ba:be:12:34 (on wlan1)
    inactive time: 4536 ms
    rx bytes:      2935
    rx packets:    68
    tx bytes:      16474
    tx packets:    167
    tx retries:    0
    tx failed:     10
    rx drop misc:  1
    signal:        -88 dBm
```

```

signal avg:      -88 dBm
tx bitrate:     6.0 MBit/s
tx duration:    0 us
rx bitrate:     6.0 MBit/s
rx duration:    0 us
expected throughput: 4.882Mbps
authorized:     yes
authenticated:  yes
associated:     yes
preamble:      long
WMM/WME:       yes
MFP:           no
TDLS peer:     no
DTIM period:   2
beacon interval:100
short slot time:yes
connected time: 1253 seconds
associated at [boottime]: 3299.619s
associated at: 1721502523424 ms
current time: 1721503776655 ms

```

Output of the Newracom cli\_app command showing link strength and expected throughput:

```

root@teledatics:/home/teledatics# cli_app show sta 0
STATION      MAC_ADDR          AID    STATE      TX bit rate      RX bit rate
=====
0            ca:fe:ba:be:12:34  1      ASSOC      1.50MBit/s(MCS 0) 1.50MBit/s(MCS 0)
Duplicate AID count : 0
=====

```

## Comparison with Previous Tests

The Teledatics 106 km test shatters the previous 3 km distance record set by Morse Micro, achieving an astonishing 35-fold increase. This underscores significant advancements in both HaLow hardware and software, showcasing the unparalleled capabilities of Teledatics HaloMax™ products for extended-range communication.

## Implications and Applications

### Impact on Wireless Connectivity

The success of this test underscores the significant benefits of HaLow communication, offering robust, long-range connectivity for devices across industrial, agricultural, and urban landscapes. The exceptional range and low power consumption of Wi-Fi HaLow position it as the premier solution for diverse applications, from precision farming and advanced industrial automation to long-range drone & rover connectivity.

### Future Prospects

Teledatics plans to build on this success during the launch of its HaloMax™ and LoraMax™ long range communications modules and associated products on Crowd Supply in 2024. Further testing and development will continue to push the boundaries of Wi-Fi HaLow technology, expanding its applications and enhancing its performance.

<https://www.crowdsupply.com/teledatics-incorporated/multi-mile-wireless>

# **Conclusion**

## **Summary of Achievements**

The 106-kilometer Wi-Fi HaLow test by Teledatics represents a major milestone in wireless communication, demonstrating the technology's unparalleled range and reliability. This achievement sets the stage for widespread adoption of Wi-Fi HaLow in various industries.

## **Acknowledgments**

Teledatics acknowledges the hard work and dedication of their engineering team and the support from Newracom and TE Connectivity, which were crucial to the success of this test.

# Appendices

## Test Setup Specifications

Raspberry Pi Model 4

- Raspbian Operating System
- Linux 6.x kernel

Teledatics TD-WRLS development kit

Teledatics TD-HALOC m.2 card

Teledatics TD-HALOM 902-928 MHz 1W HaloMax™ module

TE Connectivity Yagi Antennas

## References

List of sources and additional reading materials used to compile this white paper.

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5. Newracom. "Introducing the NRC7394, NEWRACOM's Solution for Lower Power and Cost Effective Wi-Fi HaLow." June 27, 2023. <https://newracom.com/blog/introducing-the-nrc7394-newracoms-solution-for-lower-power-and-cost-effective-wi-fi-halow>
6. IoT Evolution World. "World's Longest-Range Wi-Fi HaLow Solution Demonstrated by IoT Innovators at Morse Micro." January 23, 2024. <https://www.iotevolutionworld.com/iot/articles/458458-worlds-longest-range-wi-fi-halow-solution-demonstrated.htm>
7. CrowdSupply, "Long-range, low-power, sub-1 GHz frequency band communication." June 15, 2024. <https://www.crowdsupply.com/teledatics-incorporated/multi-mile-wireless>

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For more information and updates, please visit [Teledatics](#) and [Newracom](#).

