# Support for time synchronization using I-8211W modules

| Applies to: | | | No. L6-003 |
|---|---|---|---|
| Platform | OS version | Kernel version | Classification |
| LX-8000/9000 series<br>LP-8x2x/9000 series | xUbuntu<br>(2017/05 later) | Kernel 3.2.14 and<br>20160825 later | Linux Applications |

The LX-8000/9000 and LP-8x2x/9000 series of controllers include a Pulse-per-second (PPS) function. This document demonstrates the implementation and use of the function based on an LP-8x2x controller in combination with I-8211W modules. The following is a demonstration of the configuration and processes involved.

To perform remote debugging, the following utilities are needed:

- **ntpd** - This is used to check the status of the NTP (Network Time Protocol). The command displays a list of connected time servers and associated information.
- **gpsd** - This is used to check whether the GPS service is operating correctly.

Before continuing, confirm which version of the OS is currently being used by the LinPAC controller. This is achieved using the command **"# cat /etc/version**", as illustrated in Figure 1 below.

### # cat /etc/version

```
root@LP-8000:~# cat /etc/version
LP-8K(Ubuntu Precise 12.04.4 LTS)
Linux Kernel : 20160825
Linux Rootfs : 20160909
root@LP-8000:~#
```

Figure 1. Confirming the version of OS

For full details of how to update the OS on an LP-8x2x module, refer to the "OS_Image Update Guide", which can be found at:
ftp://ftp.icpdas.com/pub/cd/linpac/napdos/lp-8x2x/user_manual/lp-8x21_9x21_osimage_update_en_v1.0.pdf

**Note:** When updating the OS, it is recommended that only the OS image file is copied to the microSD card, and then proceed with the update.


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In the following examples, we will use I-8211W modules to demonstrate the use of the time synchronization functions. First, insert the I-8211W (or other GPS module) into an available expansion slot on the LinPAC controller and then power on the LinPAC device. Once the Linux OS has booted, refer to the diagrams in Figures 2 and 3 for details of how to determine the device name for the “I-8211W” module:

- **For LX-8x31/9x31/9x71/9x81 devices (1, 3, or 7 slots)**




Figure 2. Identifying the device name for the I-8211W module

- **For LP-8x21 devices (1, 4, or 8 slots) or LP-9x21 devices (2, 4, or 8 slots)**




Figure 3. Identifying the device name for the I-8211W module


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The following is a description of the process for performing a PPS test:

## Step 1: Enable PPS support in the ntpd

Using the "vi" editor, modify the configuration file for the software ntp (/etc/ntp.conf), as illustrated in Figure 4 below.

**# vi /etc/ntp.conf**

```
# Specify one or more NTP servers.
# GPS PPS reference (NTP1)
server 127.127.28.1 prefer
fudge 127.127.28.1 refid PPS

# Use servers from the NTP Pool Project. Approved by Ubuntu Technical Board
# on 2011-02-08 (LP: #104525). See http://www.pool.ntp.orf/join.html for
# more information.
#server 0.ubuntu.pool.ntp.org
#server 1.ubuntu.pool.ntp.org
#server 2.ubuntu.pool.ntp.org
#server 3.ubuntu.pool.ntp.org

# Use Ubuntu's ntp server as a fallback.
#server ntp.ubuntu.com
```

Add the PPS time server

Disable all other references to time servers by adding a "#" character to them

Disable all other references to time servers by adding a "#" character to them

Figure 4. Modifying the configuration file for the ntp

## Step 2: Start the gpsd service

Use the "gpsd" command to connect to the I-8211W module, as illustrated in Figures 5 and 6 below.

- For LX-8x31/9x31/9x71/9x81 devices

```
~# gpsd -n /dev/ttyS7
~#
~# ps aux | grep gpsd
nobody    1697  0.7  0.3  12144  1556 ?        S<sl 02:46   0:00 gpsd -n /dev/ttyS7
root      1701  0.0  0.1   1516   548 ttyO0    S+   02:46   0:00 grep --color=auto gpsd
```

The name of the I-8211W device in Slot 1 on the LX-8x31/9x31

The Linux command used to check the software "gpsd"

Figure 5. Using the Linux command to start the gpsd service

- For LP-8x21/LP-9x21 devices

```
~# gpsd -n /dev/ttyS3
~#
~# ps aux | grep gpsd
nobody    2005  0.4  0.3  12144  1556 ?        S<sl 06:09   0:00 gpsd -n /dev/ttyS3
root      2009  0.0  0.1   1516   548 ttyO0    S+   06:10   0:00 grep --color=auto gpsd
```

The name of the I-8211W device in Slot 1 on the LX-8x21/9x21

The Linux command used to check the software "gpsd"

Figure 6. Using the Linux command to start the gpsd service


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## Step 3: Verify the status of the GPS signal

Use the "**cgps**" command to check the status of the GPS system. If the module is able to locate a valid GPS signal, the status of the GPS system will be listed as "3D FIX", as illustrated in Figure 7 below.

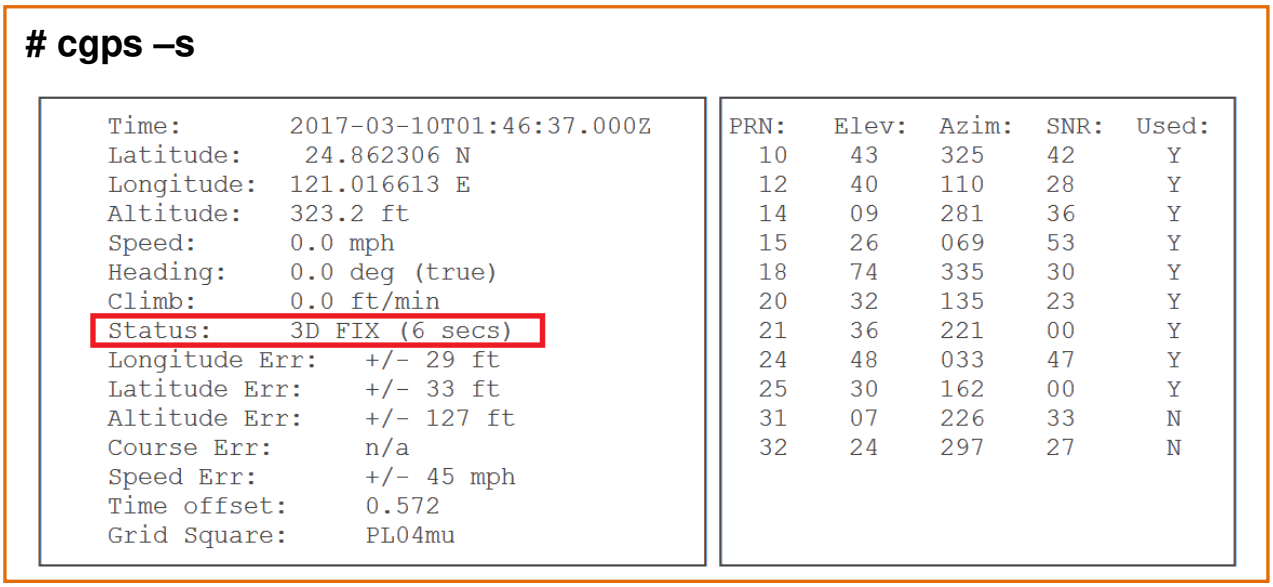



Figure 7. Checking the status of the GPS signal

However, if the module is unable to identify a valid GPS signal, the status of the GPS system will be listed as either "NO FIX" or "gps timeout". For more details of how to resolve this issue, refer to "Q2: What do I do if the GPS status is shown as "NO FIX" or "gps timeout" after using the Linux command "cgps"?" in the troubleshooting.

## Step 4: Restart the NTPD Service

Use the Linux command "**service ntp restart**" to restart the "ntp" daemon, as illustrated in Figure 8 below.

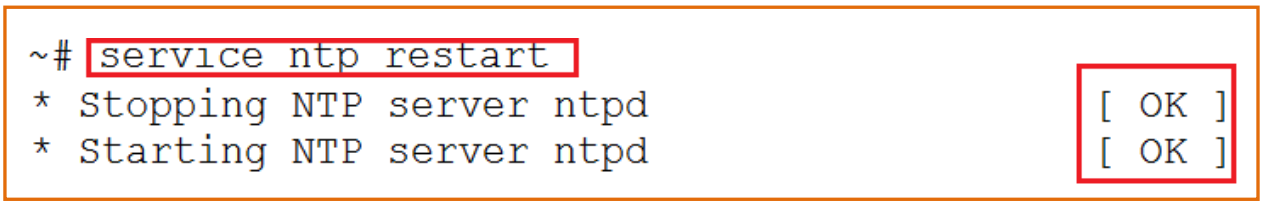



Figure 8. Restarting the "ntp" daemon


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## Step 5: Check the status of the NTP Service

After the NTPD Service has been operating for around 20 to 30 minutes, use the "**ntpq –p**" command to check for any timing errors, as illustrated in Figure 9 below. Note that any timing delays that are < 1 ms indicate a timing error.

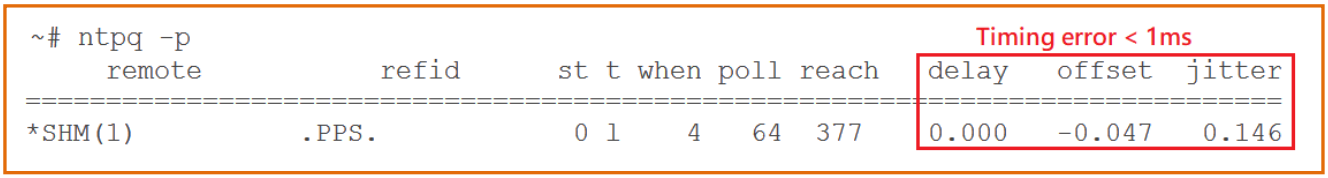



Figure 9. Checking the status of the NTP Service

If there are no updated messages relating to the status of the NTP Service, refer to "Q4: How do I check whether or not my NTP server is operating correctly?" in the troubleshooting section below.


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# Troubleshooting

***Q1: What can I do if the Linux device name for the I-8211W module isn't detected?***

**Ans:**

This generally means that the Linux driver is not installed or that the module is not configured correctly. First, re-insert the I-8211W module into the slot. After the I-8211W module has been configured, the Linux driver modules (8250.ko) must be reinstalled, as illustrated in Figures 10 and 11 below.

- For LP-8x21/9x21 devices

```
~# modprobe -r 8250          Remove Linux driver module "8250"
~#
~# modprobe 8250             Install Linux driver module "8250"
~#
~# dmesg | grep ttyS3        Check that the driver correctly detects the name of the I-8211W device in slot 1
[ 4769.158641] serial8250.0: ttyS3 at MMIO 0x1001060 (irq = 640) is a 16550A
```

Figure 10. Reinstalling and checking the Linux driver modules

- For LX-8x31/9x31/9x71/9x81 devices

```
~#modprobe -r icpdas_8250    Remove Linux driver module "icpdas_8250"
~#
~#modprobe icpdas_8250       Install Linux driver module "icpdas_8250"
~#
~#dmesg | grep ttyS7         Check that the driver correctly detects the name of the I-8211W device in slot 1
[ 4769.162708] serial8250.0: ttyS7 at MMIO 0x1002060 (irq = 641) is a 16550A
```

Figure 11. Reinstalling and checking the Linux driver modules


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***Q2: What do I do if the GPS status is shown as "NO FIX" or "gps timeout" after using the Linux command "cgps"?***

**Ans:**

The reason for this can be complicated, including:

(1) A GPS signal cannot be received in this location.

(2) No antenna has been installed.

(3) The wrong operator parameters have been configured.

(4) The hardware data interface (/dev/ttyS*) is incorrectly configured.

If any of these situations occur, try one or more of the following options:

(1) Ensure that the antenna is correctly connected.

(2) Move the antenna to a location where a GPS signal can be received.

(3) Check that the detected device name is correct for the I-8211W module you are using, or reinstall the Linux driver. For more details, refer to the information provided in "Q1: What can I do if the Linux device name for the I-8211W module isn't detected?" above.

(4) If the error still exists after performing the options above, try disconnecting and reconnecting the power supply.

***Q3: How do I enable the LinPAC + PPS function at boot time?***

**Ans:**

To achieve this, we need to add a script code to the "**/etc/rc.local**" file, as illustrated in Figures 12 and 13 below.

- For LP-8x21/9x21 devices

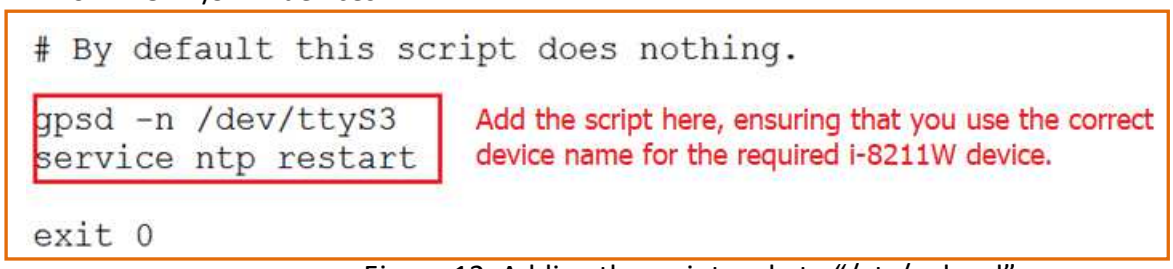



Figure 12. Adding the script code to "/etc/rc.local"

- For LX-8x31/9x31/9x71/9x81 devices

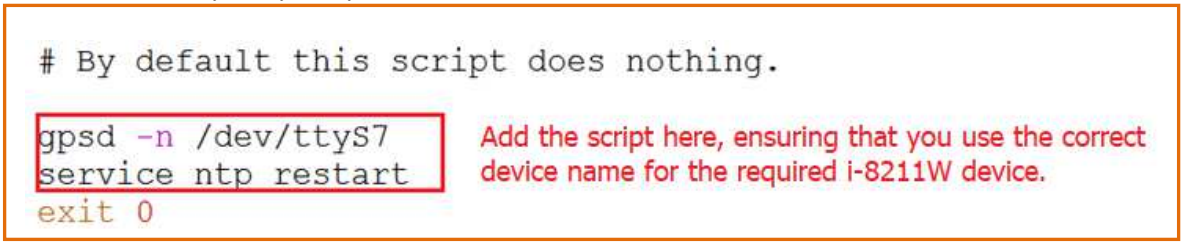



Figure 13. Adding the script code to "/etc/rc.local"


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***Q4: How do I check whether or not my NTP server is operating correctly?***

**Ans:**

Use the "**getttyinfo /dev/ttyS***" command to check whether or not the NTP Server is operating correctly. If the "DCD" value is constantly changing between **0** or **1**, it indicates that the NTP server is functioning correctly, as illustrated in Figure 14 below.

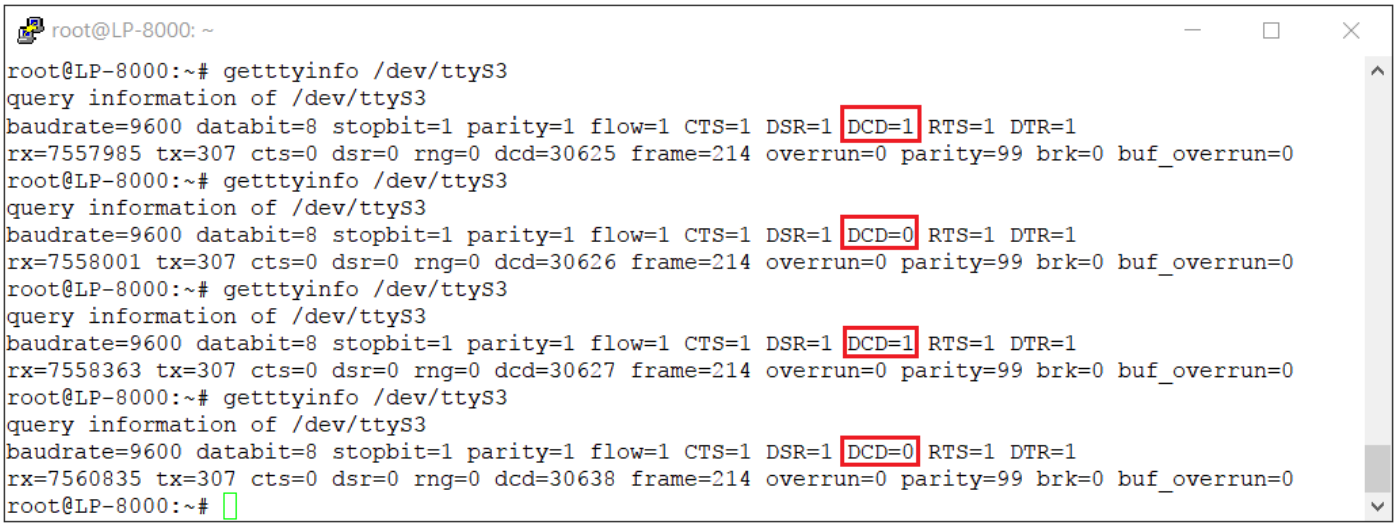



Figure 14. Checking whether or not the NTP Server is operating correctly


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