

## IzoT™ U60 DIN Network Interface User's Guide

Describes the IzoT U60 DIN Network Interface, a TP/FT-10 channel type housed in a DIN 43880 2TE compliant enclosure. Explains the two protocol processing modes of operation, Layer 5 mode and Layer 2 mode

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## **FCC Compliance Statement – Class B**

This equipment has been tested and found to comply with the limits for a Class B digital device pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the manufacturer's instruction manual, may cause interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, you are encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

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## **IC Compliance Statement – Class B**

This Class B digital apparatus meets the requirements of the Canadian Interference-Causing Equipment Regulations of ICES-003.



DECLARATION OF CONFORMITY

**IzoT™ U60 FT DIN and U60 FT Network Interface Module**  
**IzoT U60 RS-485 DIN and U60 RS-485 Network Interface Module**

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Application of Council Directive: EMC Directive 2014/30/EU  
Low Voltage Directive 2014/35/EU  
RoHS Directive 2011/65/EU

Manufacturer's Name: Echelon Corporation

Manufacturer's Address: 550 Meridian Avenue  
San Jose, CA 95126  
USA

Manufacturer's Address in Europe: Echelon BV  
Printerweg 3  
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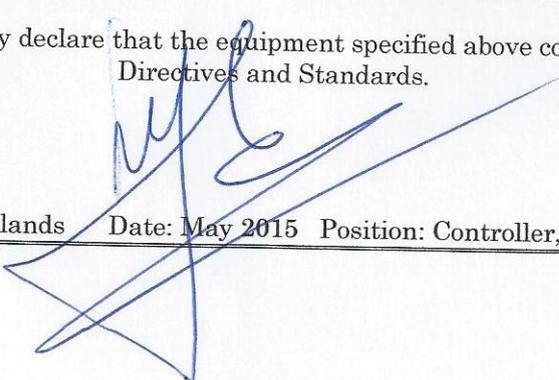
Product Model Numbers: 75060R-40, 65440R, 75060R-50, 65450R

Type of Equipment: Information Technology Equipment

Standards to which Conformity is Declared: IEC 60950-1:2005 (Second Edition) + Am 1:2009 + Am 2:201  
EN 55022:2010 EN 55024:2010  
EN 61000-4-2:2009 EN 61000-4-4:2004+A1  
EN 61000-4-5:2006 EN 61000-4-6:2009  
EN 61000-4-3:2006+A1+A2

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I, Wim Meijer, hereby declare that the equipment specified above conforms to the above Directives and Standards.

  
Place: Amersfoort, The Netherlands Date: May 2015 Position: Controller, Echelon Europe

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## Related Documentation

The following table lists related Echelon documentation that can be useful when using the U60 DIN Network Interface products. The latest versions of these manuals are available from the Echelon website at: [www.echelon.com/docs](http://www.echelon.com/docs).

Title	Part Number	Description
OpenLDV™ Programmer's Guide	078-0275-01D	This document describes Echelon's OpenLDV Network Driver and Software Development Kit (SDK)
Junction Box and Wiring Guideline for Twisted Pair LONWORKS® Networks	005-0023-01	This bulletin identifies the different types of cabling and junction boxes that may be used in twisted pair IzoT and LON networks
IzoT Manual	Available online at <a href="http://www.echelon.com/docs/izot">www.echelon.com/docs/izot</a>	This documentation describes how to use the IzoT SDK, a software development kit for the IzoT Platform. It also describes how to use the IzoT Router, a ready-to-run appliance for connecting IzoT and LON devices on an Ethernet channel with IzoT and LON devices on an FT or RS-485 channel, and for connecting Web pages and enterprise applications to IzoT and LON devices.

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## Support

If you have technical questions that are not answered by this document, or by the related documentation, you can obtain technical support via e-mail. Please contact [support@echelon.com](mailto:support@echelon.com).

See [www.echelon.com/support](http://www.echelon.com/support) for more information on Echelon's support and training services.

# **Introduction**

This chapter introduces the IzoT U60 DIN Network Interface and describes the U60 DIN hardware.

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## Overview

The U60 DIN Network Interface is a compact network interface for LonTalk/IP and LON twisted pair communications. Two models are available, one for FT (ISO/IEC 14908-2 TP/FT-10) channels and one for RS-485 (TP/RS-485) channels. The U60 provides a USB interface for attaching to a host computer, controller, or router, or for attaching to an Echelon IzoT Router. The U60 DIN Network Interface is packaged in a DIN 43880 2TE compliant enclosure.

You can use multiple U60 DIN Network Interfaces with hosts such as the IzoT Router that support multiple channels. When you attach multiple network interfaces to a host, each U60 provides an interface to a single twisted-pair channel. You can use up to four U60 DIN Network Interfaces with the IzoT Router to support routing of up to five twisted-pair LON channels, one using the IzoT Router's internal FT network interface, and up to four additional channels with external U60 DIN Network Interfaces.

The U60 has two protocol modes of operation—*Layer 2 mode* and *Layer 5 mode* that can be selected by the host application.

In Layer 2 mode, the U60 implements Layers 1 and 2 of the ISO/IEC 14908-1 and 14908-2 protocol and is compatible with the LonTalk Device Stack EX included with the IzoT SDK Standard and Premium Editions. The LonTalk Device Stack EX provides source code for LonTalk /IP and classic LON compatible protocol stacks.

In Layer 5 mode, the U60 implements Layers 1 through 5 of the ISO/IEC 14908-1 and 14908-2 protocol and is compatible with Echelon's previous generation Microprocessor Interface Program (MIP) products.

When used with a Windows computer, the mode is typically selected automatically by the application.

A **Service** LED indicates the network status of the U60, with **Rx** and **Tx** LEDs providing an indication of packet reception and transmission.

The U60 DIN is powered through its USB interface.

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## Mechanical Dimensions

The U60 DIN 43880 2TE enclosure is 35mm (1.38") wide, 89.5mm (3.52") high and 66.5mm (2.62") deep excluding the network connectors.



The U60 FT DIN

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## Visual Indicators

Three LEDs are located in the centre of the enclosure. The yellow **Service** LED on the left (labelled **Link or Service**), provides a visual indication of the network status of the U60. The **RX** LED in the middle flashes green when data is received from the network. The **TX** LED on the right flashes green when data is transmitted onto the network.

The Service status is also provided to the host via the USB interface so that the host can provide a network Service indicator if required.

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## Connectors

The U60 FT DIN has a two-way network connector with push clips to retain the network cabling. The network connection is polarity insensitive.

The U60 RS-485 DIN has a three-way network connector, also with push clips to retain the network cabling. The three positions of the connector are used for the following: + (Signal + or B), - (Signal - or A), and SC (Signal Common). When used in unbiased LONWORKS RS-485 networks, the network connection is polarity insensitive.

Both the U60 FT DIN and U60 RS-485 DIN also have Micro B female USB connectors for connection to a host processor and come supplied with a suitable USB Type A to Micro-B cable.

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## Compatibility

The U60 DIN is compatible with the IzoT Router, Windows computers with OpenLDV 5, with hosts communicating with a Layer 5 MIP interface, and with hosts communicating with a Layer 2 MIP interface including hosts implementing the IzoT Device Stack EX.

## Getting Started

This chapter explains how to install and start using the IzoT U60 DIN Network Interface.

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## Getting Started with the U60 for an IzoT Router

You can use the U60 DIN Network Interface to add connectivity to an additional FT or RS-485 channel, in addition to the FT channel attached to the LON port of the IzoT Router. You can add up to four additional external U60 DIN Network Interfaces (either LON FT or LON RS-485) to the IzoT Router.

To add one or two external U60 interfaces, plug each U60 into one of the external USB ports on the IzoT Router. To add three or four external U60 interfaces, plug each U60 into a port of an external powered USB hub, and plug the USB hub into the IzoT Router. Once you plug in a new U60, the IzoT Router takes a minute to reconfigure itself. During this time Web page access may not be available. The IzoT Router and U60 DIN Network Interface have been tested with the D-Line DUB-H7 and the Manhattan 10-port powered USB hubs. You can use any powered USB hub that complies with the USB 2.0 standard.

When you add a new external U60 interface, the IzoT Router automatically creates a LAN IP-70 to LON router for the channel attached to the U60 interface. The routers available in an IzoT Router are listed on the IzoT Router System Web page, and you can use the Service Pin buttons on this Web page to send Service messages for any of the routers. If you are installing the IzoT Router in a managed network using a network management tool such as IzoT CT or the LonMaker tool, you can install the routers using your network management tool. If you have multiple U60 interfaces, you can associate your physical U60 interfaces with the listed routers using the MAC ID for the U60 interfaces. The MAC ID for the LON interface of each router is listed in the LON column of the router table on the IzoT Router System Web page. The MAC ID for each physical U60 is printed on a MAC ID label that is included with each U60 interface. For easy reference, a 5-digit install code is also printed on the label. The install code is the last 5 digits of the MAC ID, and provides a shorter identifier than the 12-digit MAC ID.

You can add a Layer 5 or Protocol Analyzer Layer 2 remote network interface (RNI) for the built-in FT interface and for any of your external U60 interfaces. See the Using the RNI and IP-852 Network Interfaces topic in the online *IzoT Manual* at [www.echelon.com/docs/izot](http://www.echelon.com/docs/izot) for more information.

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## Getting Started with the U60 for a Windows Computer

You can use the U60 DIN Network Interface to attach a computer running Microsoft Windows to a LON network. To use a U60 with a Windows computer, install OpenLDV 5, attach the U60, and configure the LONWORKS Interfaces application as described in the following sections.

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### Installing the OpenLDV 5 software

The OpenLDV 5, or newer, driver is required to use a U60 with a Windows computer. OpenLDV 5 is compatible with the IzoT Net Server, OpenLNS Server, and LNS Server, and is also compatible with all IzoT Net, OpenLNS, and LNS applications and tools including the IzoT Commissioning Tool(CT), OpenLNS CT, and LonMaker Integration Tool. Install the OpenLDV 5 software before connecting the USB DIN interface to your computer. You must have Administrator privileges on your computer to perform the installation.

To install the OpenLDV 5 software, follow these steps:

1. Download OpenLDV 5 from [here](#), run the installer and follow the instructions.
2. The OpenLDV 5 installer includes and automatically installs all required USB driver files.

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## Connecting the USB Network Interface

After you have installed the OpenLDV 5 software, plug the U60 Network Interface into your computer and connect to an FT or RS-485 channel.

To do so, follow these steps:

1. Connect the network cabling to the U60.
2. Insert the Micro-B USB plug of the supplied USB cable into the USB connector on the USB DIN.
3. Insert the Type A USB plug of the supplied USB cable into an available USB port on your computer.
4. If this is the only LONWORKS interface installed on your computer, it will automatically **LON1** as the default name, and you can proceed directly to your software application and begin using the interface as LON1. If you have multiple LONWORKS network interfaces, you can use the LonWorks Interfaces application described in the next section to determine the name of each of your network interfaces.

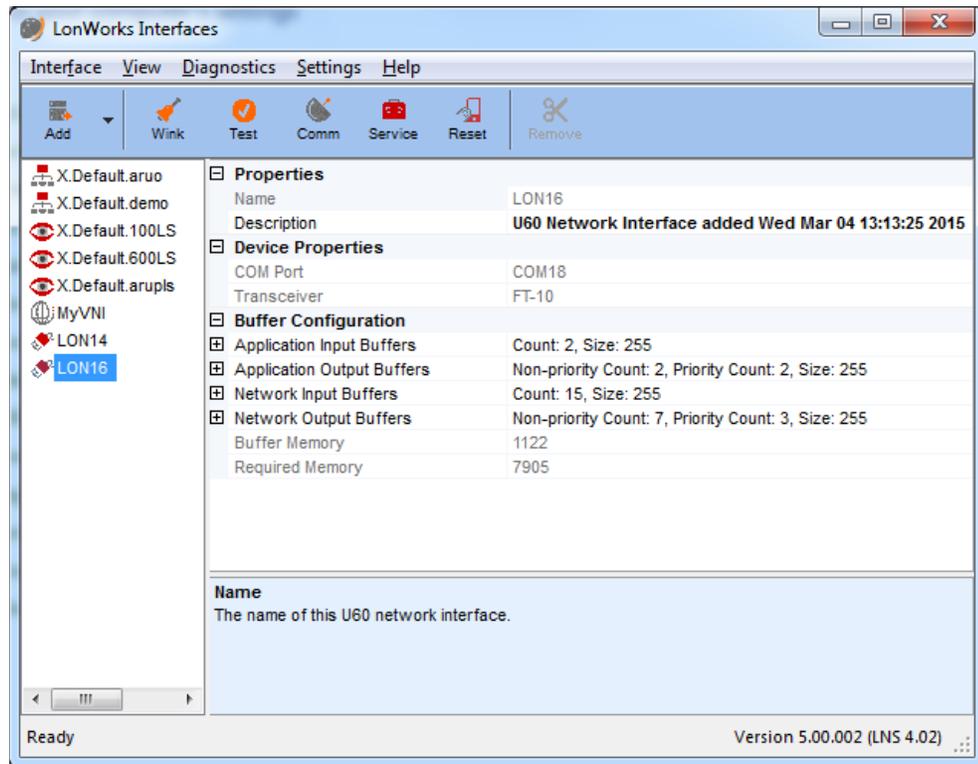
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## Using the LONWORKS Interfaces Application

You can use the LONWORKS Interfaces application to configure, test, reset, or remove a LONWORKS USB interface. These procedures are described in the following sections. The LONWORKS Interfaces application is in the Windows Control Panel

Each LONWORKS USB interface has a unique ID, and the LONWORKS Interfaces application keeps track of each LONWORKS network interface plugged into a computer, even after they have been detached from the computer. This means that you can remove a particular USB interface from your computer and later reattach it, and it will continue to use the same LONWORKS network interface name (e.g. LON1 or LON2) once you reattach it and it is recognized by your computer, regardless of how many USB interfaces are plugged into your computer, or in which order. It also means that each USB interface will retain the network interface name assigned to it, even after it has been detached from your computer.

The following figure illustrates the LONWORKS Interfaces application windows with a U60 FT DIN Network Interface selected.



The list of network interfaces in the left pane of the LONWORKS Interfaces application is not automatically updated when you attach a U60 DIN Network Interface to your computer. If you have the LONWORKS Interfaces application open when you attach a U60, you can refresh the network interface list by selecting **View->Refresh** from the main menu, or by pressing **F5**. You can also close and re-start the LONWORKS Interfaces application.

By default, detached LONWORKS USB interfaces are not displayed by the LONWORKS Interfaces application. To see all LONWORKS USB interfaces, including those that are currently detached, select **View->Show Detached Interfaces** from the main menu. To free the logical name assigned to a network interface, remove the definition as described in the **Removing a USB Network Interface** section below.

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## U60 Buffer Configuration

The following table summarizes the U60 network buffer counts and sizes:

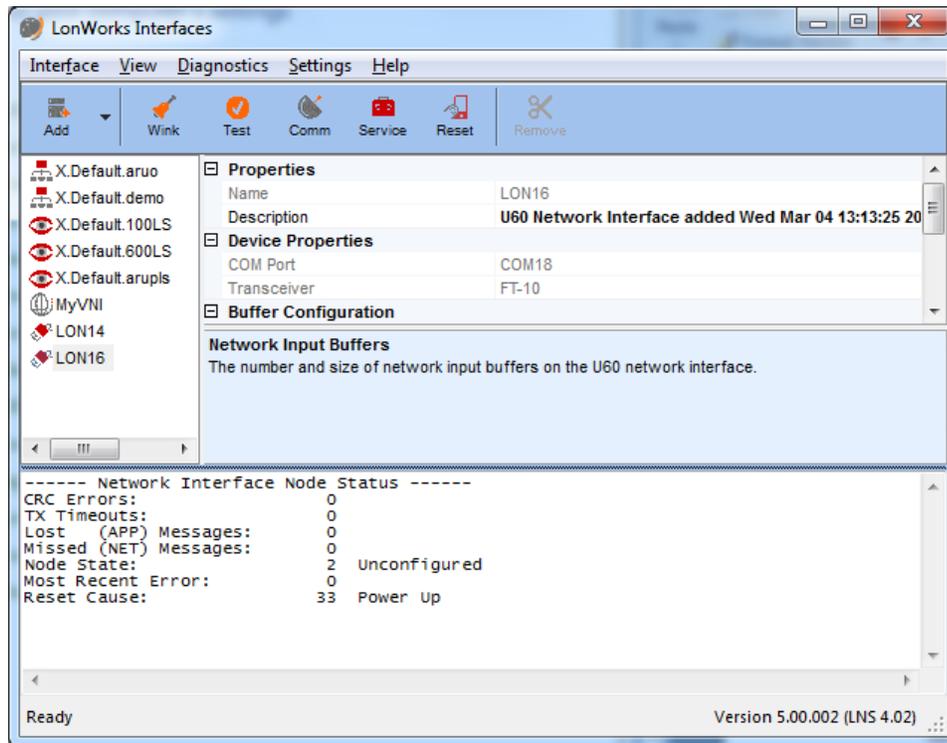
Buffer	Count	Size (bytes)
Application Input	2	255
Application Output (non-priority)	2	255
Application Output (priority)	2	255
Network Input	15	255
Network Output (non-priority)	7	255
Network Output (priority)	3	255

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## Testing or Resetting a U60

To test or reset a U60 DIN Network Interface, follow these steps:

1. Close any applications and servers using the U60 DIN Network Interface. You cannot test or reset a USB interface if it is in use by another application.
2. Open the LONWORKS Interfaces application in Windows Control Panel.
3. Click the network interface name for the network interface to be tested.
4. You can click a button in the tool bar at the top of the window to test or reset the U60 FT DIN.
  - a. Click **Test** to verify communication with the selected network interface. A series of statistics will be retrieved and displayed as shown in the following figure. See the online help for a description of the reported statistics. You can open the online help by clicking **Help -> Help Topics**.



- b. Click **Comm** to confirm the ability of the USB interface to communicate with other devices on the network. The LonWorks Interface application configures the USB interface to receive Service messages from other devices on the network, and waits for messages. When the LonWorks Interfaces application receives a Service message is received, the LonWorks Interfaces application will ping that device every second, using the selected network interface. After the pinging begins, the **Comm** button changes to a **Quit** button. Click **Quit** to quit pinging the device.
- c. Click **Service** to send a Service message to the network.
- d. Click **Reset** to reset the selected interface. When you reset the interface, the statistic counts retrieved with **Test** will be set to 0.

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## Removing a USB Network Interface

You can remove and reattach a U60 interface at any time. When you reattach a U60, it will have the same logical name that it had the first time you attached it. You can remove a LONWORKS USB network interface from the LONWORKS Interfaces application to reuse the logical name reserved for the network interface. To remove a LONWORKS USB network interface from the LONWORKS Interfaces application, follow these steps:

1. Unplug the USB network interface from your computer.
2. Open the LONWORKS Interfaces application in Windows Control Panel.
3. Click **View** in the main menu, and then click **Show Detached Interfaces**.
4. Click the network interface name for the network interface to be removed.
5. Click **Remove** in the toolbar.

You can reattach a USB network interface that you have removed at any time. The first time you reattach a USB network interface after removing it from the LONWORKS Interface application, the interface will be rediscovered and reinstalled as if it is a new network interface.

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## Getting Started with the U60 for Other Controllers and Hosts

You can use the U60 DIN Network Interface to add an FT or RS-485 interface to any host computer, controller, or router with a USB interface. To use the U60 interface with your host computer, controller, or router, you must implement a U60-compatible network driver for your host. Source code for a Linux driver for the U60 is included with the IzoT SDK Premium Edition and is also available for free download from the **Resources** link at [www.echelon.com/products/izot-u60-ft-din-network-interface](http://www.echelon.com/products/izot-u60-ft-din-network-interface). See Chapter 3, *Porting the U60 Driver*, for more information on porting.



## Porting the U60 Driver

You can use the IzoT U60 DIN Network Interface with an IzoT Router or with a Windows computer with the OpenLDV 5, or newer, driver. You can also use the U60 interface with other host computers, controllers, or routers if you port the driver to the new host. This chapter describes how to port the Linux driver for the IzoT U60 DIN Network Interface.

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## Porting the Linux U60 Driver

The Linux U60 driver creates a Linux network device that applications can use to send and receive classic LON and LonTalk/IP packets using a U60 network interface. The driver provides an open, close, read, write interface and can be used as either a network device or a character device. The Linux U60 driver is included with the IzoT SDK images for the Raspberry Pi and BeagleBone Black and is also included in the IzoT Router. Source code for a Linux driver for the U60 is included with the IzoT SDK Premium Edition and is also available for free download from the **Resources** link at [www.echelon.com/products/izot-u60-ft-din-network-interface](http://www.echelon.com/products/izot-u60-ft-din-network-interface). You can port the driver source to other platforms, other versions of Linux, and other operating systems.

The U60 driver requires a unique and valid network device line discipline number. By default, the U60 driver uses line discipline number 28 since 28 is a valid but unassigned line discipline number for Linux kernel 3.8 as used in the IzoT Router. You can use a different line discipline number if 28 is not available or valid for your version of the Linux kernel. The maximum line discipline number is typically defined by the `NR_LDISCS` constant. For Linux kernel 3.8, `NR_LDISCS` is defined as 30.

To compile the U60 driver, you first need a compiled kernel source tree, including standard Linux support for a USB CDC/ACM class interface. The IzoT Router uses the BeagleBone kernel source tree available at <https://github.com/RobertCNelson/linux-dev/releases>.

Once you have compiled a kernel tree, run the **make modules** command in the kernel source tree and pass in the directory containing the U50Module source in the `SUBDIRS` environment variable and the directory of the kernel source in the `KDIR` environment variable. Following are example Linux commands to build the driver:

```
KERN=/src/3.8.13-bone47/linux-dev-3.8.13-bone47/KERNEL
U50_DIR=/src/U50Module/
make -C $KERN KDIR=$KERN SUBDIRS=$U50_DIR ARCH=arm CROSS_COMPILE=arm-
linux-gnueabihf- modules
```

The example builds the module as **u50.ko** to your driver directory. For the IzoT Device Stack EX running on a BeagleBone Black, the driver directory is the following:

```
/lib/modules/3.8.13-bone47/kernel/drivers/lon/
```

A udev rule file is required to install the driver. For example, you can create a udev rule file named **90-liftd.rules** in the `/etc/udev/rules.d` directory. Following is an example rule for the U60 (concatenate the two lines):

```
SUBSYSTEM=="tty", ATTRS{idVendor}=="0920", ATTRS{idProduct}=="5550",
RUN+="/usr/bin/lonifd -d /dev/%k"
```

If you modified the line discipline number, you must specify the non-default line discipline number in the rule using the **-l** parameter.

The following example rule includes the **-l** parameter with a non-standard value of 16 for the line discipline number:

```
SUBSYSTEM=="tty", ATTRS{idVendor}=="0920", ATTRS{idProduct}=="5550",
RUN+="/usr/bin/lonifd -l 16 -d /dev/%k"
```

You will also need to build the `lonifd` daemon. Source code and a make file is also included with the U60 driver for the `lonifd` daemon.

Once you have built the driver and `lonifd` daemon, and you have created the udev rule file, you can install the driver in Linux using the `insmod` command.

This will create a Linux network device. If you create a single U60 driver, the name will be `/dev/lon0`. This will not be a character device as was typically used for classic LON drivers. It will instead be a network device that you will access through a socket interface. The benefit of a network device is that it can be easily used with the Linux IP stack for supporting LonTalk/IP, for example when communicating with the BACnet/IP, ICMP (for ping), or SNMP protocols over the U60.

If the U60 driver is initialized correctly, you will see the network interface as one of the devices listed by the Linux **ifconfig** command.

You can bypass the IP stack to use the U60 driver as just a classic LON driver. The following example code opens the U60 socket as a raw character device with a packet socket, bypassing the IP stack:

```
int sockfd = socket(AF_PACKET, SOCK_RAW, htons(0x8950));

struct ifreq ifr = { 0 };
size_t ifnamelen = strlen(ifname);
memcpy(ifr.ifr_name, ifname, ifnamelen);
if (ioctl(socket, SIOCGIFINDEX, &ifr) < 0) {
    return errno;
}

struct sockaddr_ll addr = { 0 };
addr.sll_family = AF_PACKET;
addr.sll_ifindex = ifr.ifr_ifindex;

if (bind(socket, (struct sockaddr*) &addr, sizeof(struct
sockaddr_ll)) < 0) {
    return errno;
}
```

Using this example code, you can read and write the **sockd** device using the same code used for other classic LON drivers.

---

## Host Communications

The U60 communicates with a host over a USB connection using the U60 link-layer protocol (LLP). The driver manages the host end of the U60 LLP, and initializes the

U60 when the driver is opened by an application. The OpenLDV driver for Windows includes a U60 driver, starting with OpenLDV 5.

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## Protocol Processing Selection

The U60 has two protocol processing modes of operation, *Layer 5 mode* and *Layer 2 mode*.

- In *Layer 5 mode*, Layers 1 to 5 of the ISO/IEC 14908-1 and 14908-2 protocol stack are handled by the U60, and Layer 5 messages are exchanged between the U60 and the host using the U60 LLP. Layer 5 mode requires less code on the host than Layer 2 mode since Layer 5 mode leverages the ISO/IEC 14908-1 Layers 3 through 5 protocol stack implemented by the Neuron firmware. The U60 Layer 5 driver interface to the host application is compatible with the MIP/P20 and MIP/P50 driver interface to the host application. The driver communicates with the U60 using the link-layer protocol (LLP), and the U60 LLP is different from the MIP/P20 and MIP/P50 LLP. The U60 LLP is described in this section.
- In *Layer 2 mode*, Layers 1 and 2 of the ISO/IEC 14908-1 and 14908-2 protocol stack are handled by the U60, and Layer 2 messages are exchanged between the U60 and the host using the LLP. The host must implement Layers 3 through 7 when the U60 is running in Layer 2 mode. You can use Layer 2 mode with the Echelon LonTalk Device Stack EX running on the host to create high performance controllers that support more address table entries and simultaneous transactions than can be supported by the U60 with a Layer 5 interface. The LonTalk Device Stack EX includes a complete implementation of ISO/IEC 14908-1 Layers 3 through 5 that runs on a host and interfaces with a native LON interface such as the U60 module, or interfaces directly with an Ethernet or Wi-Fi interface on the host.

If you are using the OpenLDV 5 driver for Windows or newer, your application can select the protocol processing mode of operation by opening the driver with the **ldv\_open\_cap()** function and specifying the mode with the **nDeviceCaps** parameter. Set **nDeviceCaps** to **LDV\_DEVCAP\_L2** for Layer 2 mode or **LDV\_DEVCAP\_L5** for Layer 5 mode.

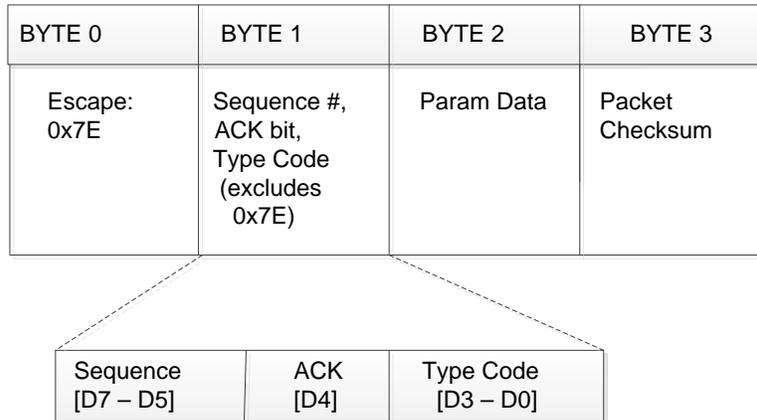
If you are using the U60 driver for Linux, you need to specify the protocol processing mode in the driver source code, and rebuild the driver for your Linux platform. The protocol processing mode is selected in the call to **U50LinkStart()** in the **u50\_dev\_open()** function. Specify the mode in the last parameter in the call to **U50LinkStart()**. Specify **U50\_OPEN\_LAYER2** for Layer 2 mode or **U50\_OPEN\_LAYER5** for Layer 5 mode.

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## Link Layer Protocol (LLP)

The U60 communicates with a host over a USB connection using the U60 link-layer protocol (LLP). The driver manages the host end of the U60 LLP, and initializes the U60 when the driver is opened by an application.

The basic component of the U60 LLP is the code packet, which starts with an 0x7E escape code. If an escape code appears in a normal data stream it is followed by another escape code and interpreted as a single data byte value rather than the start of the code packet. The following figure illustrates the code packet layout.



The second byte contains a 3-bit sequence number in the sequence bits (D7-D5), a single ACK bit (D4), and a 4-bit Type Code bits (D3-D0). You cannot form the escape code by combining a Type Code value with the sequence number (0x0E is not allowed). As a result, you can create 15 different codes. The Type Code values are described in the next section.

The sequence number is cycled through between values ‘1’ and ‘7’, with ‘0’ being an initialization value. When a code packet is received that has the same sequence number as the previous code packet received, the new packet (and any following data) is rejected (this transfer will be acknowledged if necessary). The exception is if the sequence number is zero. The zero sequence number may be used for any idempotent code packet or message.

The third and fourth bytes may contain the escape code value, but they will not be interpreted as escape codes. This may cause minor re-synchronization issues if this packet is broken; however, it ensures a constant code packet size.

The packet checksum is an 8-bit value that, when added to the first three bytes, results in an 8-bit zero result.

The code packet has the following features:

- Asynchronous method of presenting itself at any time (by using an escape sequence)
- Checksum verification
- Data transfer initiation
- Duplication detection using a sequence number—duplicates may be sent when an expected response is lost or broken and does not occur within a time-out period

Data outside of the code packet is restricted to either a *message* or a *multi-byte local network interface command or response* and is always enclosed with a length byte in the front and a checksum at the end. The length byte does not account for the checksum at the end—the inclusion of the checksum is implied. The checksum covers the data that preceded it; therefore, it does include the length byte.

All data outside a code packet must include an escape prefix before any escape data values. For example, if a 0x7E value appears in the sequence it must be followed by another 0x7E (the first 0x7E value is the escape prefix). Checksum bytes and length bytes must be preceded with escape prefixes.

The following table summarizes the layout of the data message used in Layer 5 mode and for the **niNETMGMT** local network interface command (Layer 2 mode is required for the IzoT Device Stack EX). When sending local network interface commands (NI Commands other than **niCOMM** or **niNETMGMT**) that have additional data, the commands are contained in a data message and they are preceded by a **CpMsg** code packet.

BYTE 0	BYTE 1	BYTE 2..N	BYTE N+1
Length (bytes to follow except checksum)	NI Command	SICB starting w/ message header	Message Checksum of bytes 0-N

The following table summarizes the layout of the data message used in Layer 2 mode.

BYTE 0	BYTE 1	BYTE 2..N	BYTE N+1
Length (bytes to follow except checksum)	NI Command	Priority/AltPath/DeltaBacklog byte, NPDU, CRC (2 Bytes)	Message Checksum of bytes 0-N

The U60 supports extended messages that may be up to 1280 bytes in length. For these messages the BYTE 0 length byte will be 0xFF, followed by the MS byte of the 16-bit length, followed by the LS byte of the 16-bit length, followed by the NI command:

BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4..N	BYTE N+1
0xFF	MS byte of length	LS byte of length (bytes to follow except checksum)	NI Command	SICB starting w/ message header	Message Checksum of bytes 0-N

For Layer 2 mode:

BYTE 0	BYTE 1	BYTE 2	BYTE 3	BYTE 4..N	BYTE N+1
0xFF	MS byte of length	LS byte of length (bytes to follow except checksum)	NI Command	Priority/AltPath/DeltaBacklog byte, NPDU, CRC (2 Bytes)	Message Checksum of bytes 0-N

## Type Code Values

The following table lists the values for the Type Code byte. Uplink means that data is transferred from the U60 to the host processor. Downlink means that data is transferred from the host processor to the U60.

Value	Type	Description	Uplink / Downlink
0	<b>CpNull</b>	No data is being sent. Use this value for acknowledge-only packets, or for pinging.	U/D
1	<b>CpFail</b>	The previous transfer was broken or in error. This is typically due to checksum errors or fragmented transfers. The correct response to this command is to resend the previous transfer.	U/D
2	<b>CpMsg</b>	<p>One message follows. A message is any multi-byte network interface transfer and requires an application output buffer or packet buffer in the downlink case. The number of messages is stored in the <b>Param Data</b> field.</p> <p>This value is limited to one in both the downlink and uplink case.</p> <p>The message follows the code packet checksum byte, and consists of a length byte, the NI command, the message itself, and a checksum.</p>	U/D
3	<b>CpMsgReq</b>	<p>Optional. Sent by the host for requesting both the attention of the U60 and requesting an uplink <b>CpMsgAck</b>.</p> <p>The <b>Param Data</b> field contains either a <b>0</b> or a <b>1</b> informing the U60 that the following message is either a non-priority message (0) or a priority message (1). The U60 driver does not use priority messaging; therefore, this value is ignored. This allows the U60 to respond to the <b>CpMsgReq</b> based on actual buffer availability.</p> <p>Alternatively, you can send the entire <b>CpMsg</b> plus message to the U60 and a <b>CpMsgReject</b> may be sent uplink if there are no available buffers.</p>	D
4	<b>CpMsgAck</b>	The U60 is entering the ready-receive state. This is the U60's response to the <b>CpMsgReq</b> .	U

5	<b>CpMsgReject</b>	<p>An attempt to transfer a message downlink is rejected because of a lack of buffer space.</p> <p>This code packet will be a response to a downlink <b>CpMsgReq</b> code packet or a response to a <b>CpMsg</b> without the <b>CpMsgReq</b> being sent.</p> <p>This code indicates that the offered downlink traffic is more than the U60 can handle (it has no more APP or NET output buffers).</p> <p>Upon receiving this code, the device driver should repeat the message send process until it succeeds.</p>	U
6	<b>CpNiCmdShort</b>	Sends a single byte local network interface command. The command is stored in the <b>Param Data</b> field.	U/D
7	<b>CpResync</b>	<p>This command is sent by the host to start a new session with the U60. When received it will reset the transmit and receive sequence numbers to zero so that any subsequent sequence numbers will be accepted rather than rejected.</p> <p>This command is also a good way to establish that communications are functioning with the U60.</p> <p>The U60 always responds to this command with a <b>CpNull</b> packet, so the host can determine that the serial link is not simply echoing data.</p>	D

**Notes:**

- Use symmetrical timeouts on the host processor. There is an inter-byte timeout on the client side of 40ms when receiving either a code packet or a message body. There is a timeout of 250ms when waiting for the start of a downlink message **CpMsg** following a **CpMsgReq** / **CpMsgAck** sequence.
- All length fields do not count for escape prefixes. Instead, they reflect the length of the real data stream above the link-layer protocol. All length fields do not account for the checksum.
- Broken code packets (code packets with missing or corrupt bytes) are not responded to at all, and they rely on time-out mechanisms for re-transmission.
- Broken message streams are responded to as soon as the error condition is observed. The response is the **CpFail** code packet.

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## Acknowledgement Rules

The **Ack** bit is used to send a success response to a previous transfer, specifically transfers that send data that is above the LLP (non-LLP data). These are transfers of messages and transfers of local network interface commands.

To reduce traffic, not all data transfers require acknowledgement. The following are the acknowledgement rules:

- If a transfer requires an acknowledgment and there is no other data that needs to be sent, a **CpNull** packet is sent with the **Pass/Ack** bit set. Otherwise, if there is outgoing traffic to be sent the **Ack** bit will be included in the following transfer. This is true for both uplink and downlink data messages.
- Code packets that do not require an acknowledgment via the **Ack** bit are packets that result in an immediate response anyway. The response implies acknowledgment. The following table lists these types of code packets:

Code Packet	Description
<b>CpMsgReq</b>	The U60 will respond with either the <b>CpMsgAck</b> , or a criss-cross could occur and an unrelated code packet will be sent by the U60.
<b>CpMsgAck</b>	The host does not need to acknowledge this message. Instead it provides an implied acknowledgement by sending the <b>CpMsg</b> code packet followed by a message packet

- Data that is sent and requires acknowledgement will persist in the source until the acknowledgment is received. While the persistent data is waiting for acknowledgement, the **Acknowledge Wait** timeout, which is 300ms for the U60 and the driver, causes the persistent data to be re-sent.

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## Sequence Number Cycling and Duplicate Detection

The sequence number is used to reject duplicate non-LLP data. Duplicate LLP data does not affect the LLP; therefore, the sequence number is only cycled for each transfer of non-LLP data. For example, two consecutive **CpMsgReq** packets have no effect—the second **CpMsgReq** packet reinstates the ready-receive state and the **CpMsgAck** is re-sent.

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## U60 Command Set

Uplink local network interface commands that must also convey additional data (for example, the **niL2MODE** response command) will always result in a data message that is at least 3 bytes in length. This is because the host driver expects at least 4 bytes of data (3 bytes plus checksum) to appear following a code packet.

Uplink means that data is transferred from the U60 to the host processor. Downlink means that data is transferred from the host processor to the U60. The following table lists the U60 commands you can use in your U60 driver.

Value	Name	Description	Uplink / Downlink
0x1x	niCOMM	Passes completion events to the host processor.	
0x2x	niNETMGMT	Performs local network management or network diagnostic commands on the U60.	
0x31	niERROR niCRC	The Layer 2 mode U60 will send this command uplink whenever it senses a CRC error (0x31).	U
0x50	niRESET	When sent downlink this will reset the U60. Following any reset the U60 will send this command uplink.	U/D
0x60	niFLUSH_CANCEL	Exits the Flush state.	D
0x70	niONLINE	Sets the U60 state to Soft-online.	D
0x80	niOFFLINE	Sets the U60 state to Soft-offline. No messaging can be handled in this state.	D

Value	Name	Description	Uplink / Downlink
0x90	niFLUSH	Sets the U60 to the Flush state.	D
0xA0	niFLUSH_IGNORE	Sets the U60 to the Flush Ignore Comm state.	D
0xCx	niIO_SET	Directly controls the U60's four I/O pins, IO0 – IO3, for general purpose I/O control from the U60. The L.S. 4 bits are used to control these pins. These pins are not accessible on a standard U60 module or U60 DIN.	D

<b>0xD0</b>	<b>niMODE_L5</b>	Sets the U60 to Layer 5 mode. If already in this mode the U60 will reply with this command. Otherwise the U60 will reset and resume in the new mode. This change is persistent across resets. This command is issued by the U60 driver.	U/D
<b>0xD1</b>	<b>niMODE_L2</b>	Sets the U60 to Layer 2 mode. If already in this mode the U60 will reply with this command. Otherwise the U60 will reset and resume in the new mode. This change is persistent across resets. This command is issued by the U60 driver.	U/D
<b>0xE0</b>	<b>niSSTATUS</b>	Provides status information.  When sent downlink, the U60 responds with the <b>niSSTATUS</b> command followed by the following 4 bytes of data:  [TXID Value],  [MIP Version],  [1 (Layer 2 Mode) or 0 (Layer 5 Mode)],  [Serial checksum error count]	U/D
<b>0xE6</b>	<b>niSERVICE</b>	In Layer 5 mode, sends a Service Pin message. Ignored in Layer 2 mode.	D

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## Product Query Network Management Command

The U60 supports the **Product Query** network management command from the host only. The code for this command is the Network Management Escape code [0x7D] followed by the sub-command and command values of [0x01], [0x01]. The response includes **PRODUCT** and **MODEL** values based on whether the U60 is currently in Layer 2 or Layer 5 mode. The App Version is 3.1 (31); the TXID is 4 for a TP/FT-10 channel and the TXID is 11 for a TP/RS-485 channel.



# Appendix A

## Troubleshooting Windows Computer Installations

The USB Network Interface software installed by the OpenLDV 5 installer is auto-configuring. In the unlikely event that a problem occurs during installation, this appendix describes how to diagnose and fix the problem. If you have a problem that is not fixed using the solutions in this appendix, contact Echelon Support at [support@echelon.com](mailto:support@echelon.com).

**1. I inserted my U60 network interface into a USB port on my computer, but the Found New Hardware Wizard did not open and the computer has not detected the device. What should I do?**

- Verify that you are running Microsoft Windows 8, Windows 7, Windows XP, Windows 2000, or Windows Server 2003.
- Verify that you have a USB 1.1, 2.0, or 3.0 host controller on your computer.
- Verify that other USB devices that you may have work on this computer.
- Verify that the OpenLDV 5 or newer software has been installed on this computer. You can do so by opening the Programs and Features application in the Windows Control Panel, and checking that the Echelon OpenLDV 5 item exists (or a newer version).
- Disconnect all extension cables and external hubs, and connect the U60 interface directly into a USB port on the computer using the supplied cable.
- Try inserting the USB interface into a different USB port.
- Remove all other USB devices from the computer.
- Unplug and re-insert the USB interface.
- Reboot the computer.
- Verify that the Service LED briefly flashes on and off when you insert the USB interface into the USB port. If it doesn't, then no power is being supplied to the interface.
- Update your computer with Windows Update. Check that all of the optional software and hardware updates are installed. Windows Update does not automatically select the software and hardware updates for installation. Windows Update is available [here](#)
- Repair the OpenLDV software installation. You can do so by opening the Programs and Features application in the Windows Control Panel, selecting Echelon OpenLDV 5 (or a newer version) and then clicking Repair. Follow the instructions to repair the software, and then re-insert the USB interface.
- Check [www.echelon.com/downloads](http://www.echelon.com/downloads) for an updated version of the OpenLDV driver.

**2. I opened the LONWORKS Interfaces application in the Windows Control Panel and the U60 interface is listed on the interfaces pane. However, it does not respond to the test command. What do I do?**

- In the Windows Control Panel, click Device Manager. Then, check to see if there are any devices marked with a yellow exclamation point. Fix all items in Device Manager that are marked with a yellow question mark, as there may be driver conflicts preventing the USB subsystem or the U60 DIN Network Interface from functioning properly. If the Device Manager lists Echelon USB Network Interface under the Ports (COM & LPT) heading, open the USB Network Interface item. If the status indicates that the driver is not working properly, first try repairing the OpenLDV software. If that doesn't work, download the latest version of the OpenLDV driver from Echelon's web site. Both of these options are described above.
- Unplug and re-insert the U60 network interface.
- If the Device Manager does not list Echelon USB Network Interface under the Ports (COM & LPT), check [www.echelon.com/downloads](http://www.echelon.com/downloads) for an updated version of the OpenLDV driver.

**3. I opened the LONWORKS Interfaces application in the Windows Control Panel and there is not an entry for the U60 in the interfaces pane, but the Echelon USB Network Interface is listed in the Ports (COM & LPT) section of the Device Manager. What do I do?**

- Open the Device Manager, then expand the Ports (COM & LPT) item and double-click Echelon USB Network Interface to open the Properties dialog. Re-check the LONWORKS Interface application in Control Panel. The missing entry should have been re-created.
- In the LONWORKS Interfaces Control Panel application, try selecting **View->Refresh** from the main menu, or by pressing **F5**.

- If the U60 network interface does not function properly after performing the actions described above, perform the suggested steps in the other items in this Troubleshooting section before contacting Echelon Support.

#### **4. Windows displays a message saying it cannot install the driver**

The USB interface was plugged into the computer *before* the OpenLDV software was installed.

- To prevent installation errors, install the OpenLDV 5 software before connecting the U60 network interface to your computer. If you have not previously installed the software before attaching the U60, Windows will inform you that it could not install the device and the U60 Network Interface will show up under Other Devices in the Device Manager Control Panel application. Remove the U60, install the latest version of the OpenLDV software that is available at [www.echelon.com/downloads](http://www.echelon.com/downloads), then re-connect the U60 and check the LONWORKS Interfaces application to ensure the U60 is listed in the interfaces pane.
- If the USB interface does not function properly after performing the action described above, perform the suggested steps in the other items in this Troubleshooting section before contacting Echelon Support.

