Six Ways To Deploy Model DI-71X
Ethernet Data Loggers and Data Acquisition Systems

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Introduction

Of all the ways you can connect a data logger or data acquisition system to a PC, none is more flexible, or offers more exciting possibilities than Ethernet. This application note explores six approaches to deploying Ethernet versions of our DI-71X products (DI-710, -715B, -718B). I hope that exposing these ideas in laymen's terms will help you see possibilities in your own unique applications for process monitoring, design qualification, quality control, maintenance and troubleshooting, and more. To concentrate better on this goal I will intentionally avoid a detailed treatment of IP address and network management. Those interested in this level of detail should refer to our application note titled *IP Address Configuration for DI-71X-E Data Loggers*.

Deployment #1

One PC, One DI-71X Unit on a Dedicated Network

This deployment method is well suited for connecting one DI-71X unit to one PC over a dedicated Ethernet network. The DI-71X unit may be located right next to the PC, or as far away as 100 meters, lending a tremendous degree of flexibility to the proximity of the PC relative to the 71X unit. This is the only implementation that requires a CAT-5 crossover cable. All other deployments use standard CAT-5 cables. IP addresses must be manually (statically) assigned.


CAT-5 Crossover Cable
100M Max

Your PC
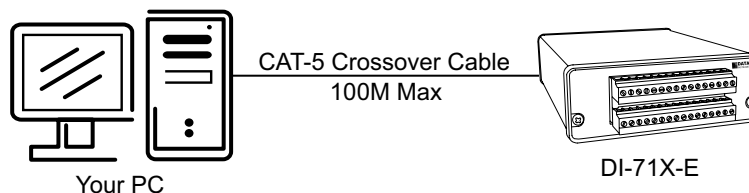
DI-71X-E

Deployment #1 -- This is the simplest way to network one DI-71X unit and one PC.
A static assignment of the 71X's IP address is required.

Deployment #2

One or more PCs, One or more DI-71X Units on a Dedicated Network

A simple extension of Deployment #1, this approach leverages the use of one or more Ethernet hubs to allow you to connect one or more 71X devices or PCs to your dedicated network, extend the range beyond 100 meters, or both. The distance between hubs is limited to 100 meters, but an unlimited number of hubs may be employed, thereby extending without limit the distances between each network segment. Each hub can accommodate one or more 71X units or PCs, depending upon the number of ports built into the hub. This deployment provides a simple and inexpensive method for expanding both the reach and quantity of applied DI-71X units, as well as

the number of PCs that have access to their acquired information. Like Deployment #1, IP addresses must be manually (statically) assigned to each device connected to the network.
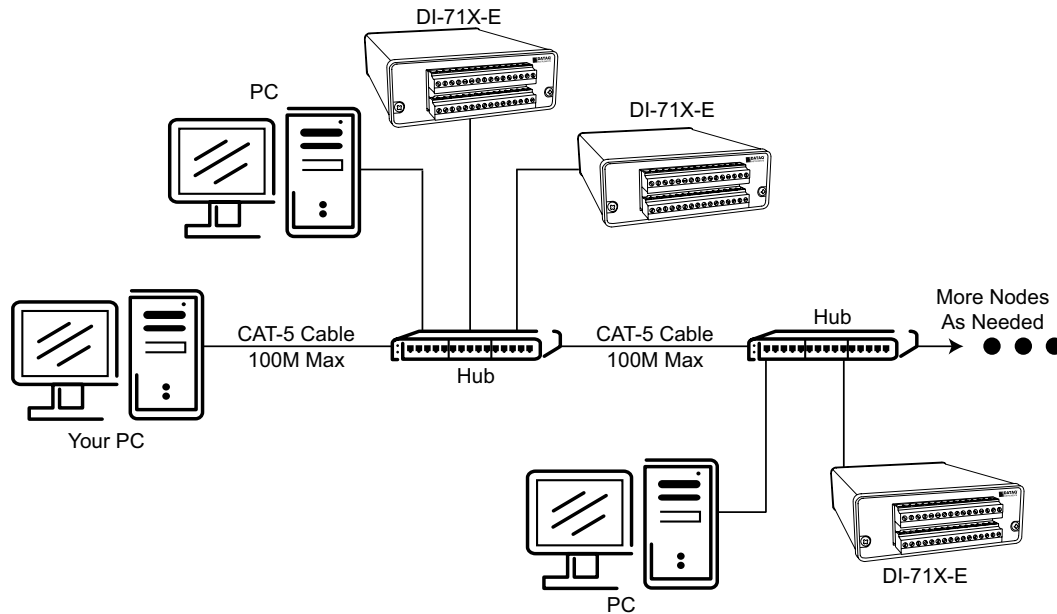

Deployment #2 -- This approach is an expanded version of Deployment #1. By applying multiple hubs, an endless number of computers and DI-71X units may be managed, over an unlimited distance.

Deployment #3

One or more PCs, One or more DI-71X Units on a Local Area Network (LAN)

This a classic network implementation, which is managed typically by a DHCP (Dynamic Host Configuration Protocol) server or router, located on the network. Unlike Deployments #1 and #2, a LAN with DHCP capability does not require that you manually assign IP addresses to each network element. Instead, DHCP automates the process by detecting when a new device is connected, and then assigns the new device a unique IP address. The DHCP process is fast, automatic, completely transparent, and fully supported by DI-71X firmware. Deploying one or multiple 71X units is as easy as plugging them into the LAN at any convenient access point. The

DHCP manager will instantly recognize the units and assign each a unique IP address without any intervention on your part. This is plug and play at its finest.
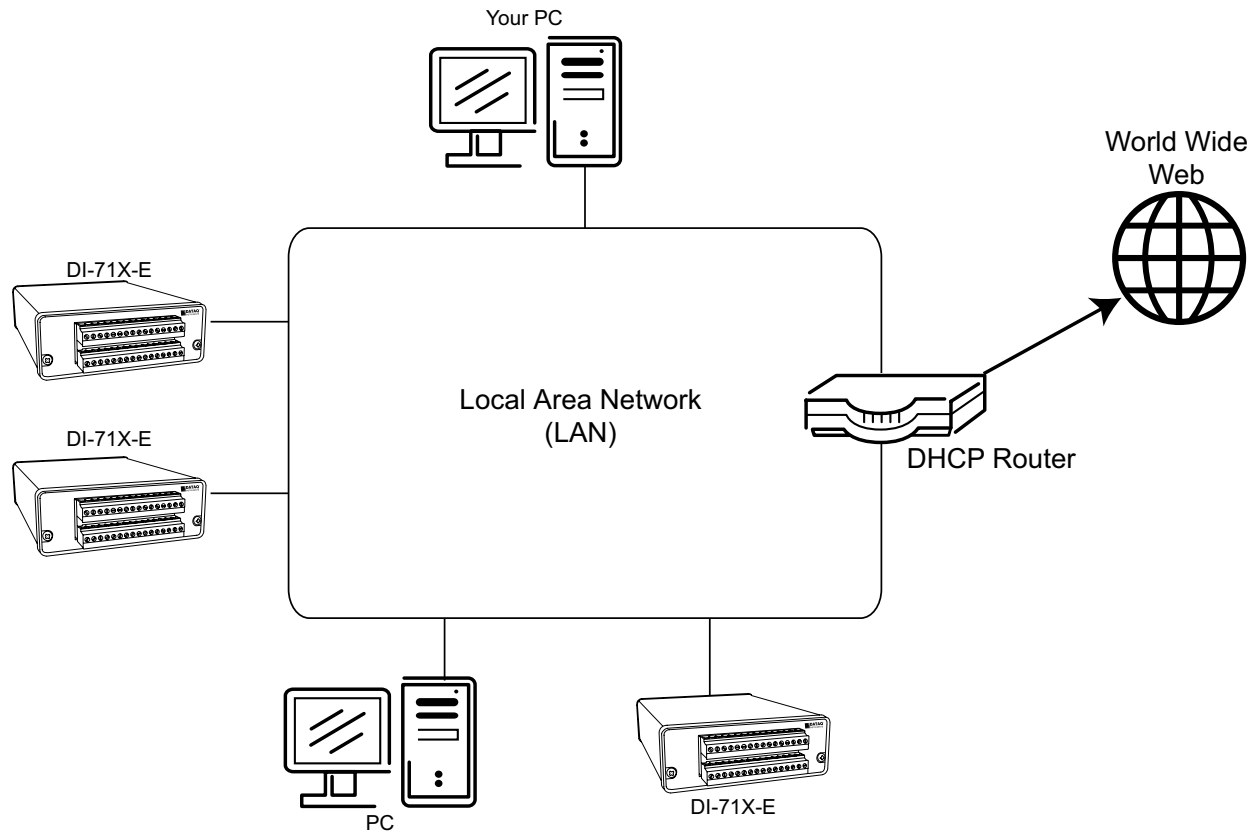

Deployment #3 -- This is the classic application of a LAN where typically a DHCP router assigns IP addresses to devices connected to the network.

Deployment #4

One or more PCs, one or more DI-71X Units, Wireless Wi-Fi Network

This implementation is Deployment #3, but without wires. Where the backbone LAN of that implementation consists of a maze of CAT-5 cable running from each device back to the router/server, Wi-Fi (short for wireless fidelity) does so wirelessly using microwave radio transmissions. All Wi-Fi protocols are supported: 802.11a, 802.11b, 802.11g, and the new 802.11n. The obvious advantage of the Wi-Fi approach is flexibility and mobility. Neither 71X products nor the PCs that manage them need be in the proximity of a LAN access point to communicate. The equipment used and the environment in which it operates defines transmission range, but distances of 100

feet or more are typical. Through the use of repeaters, transmission ranges many times this distance can be achieved.
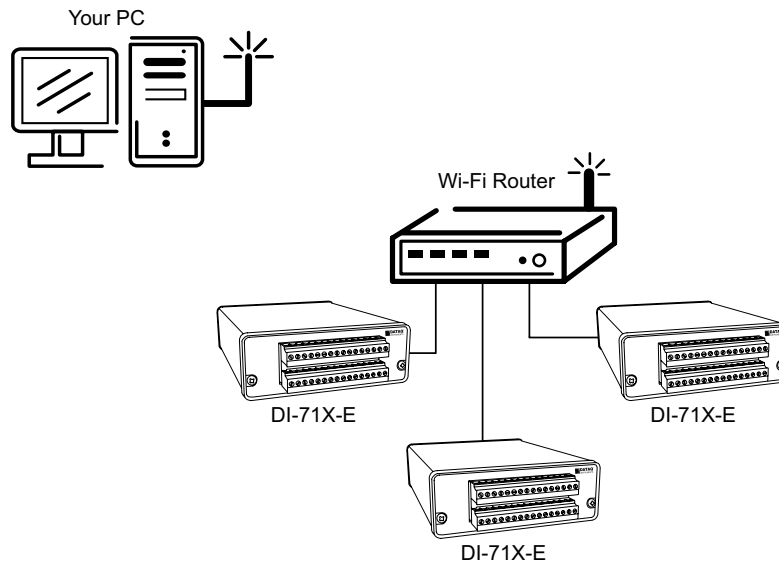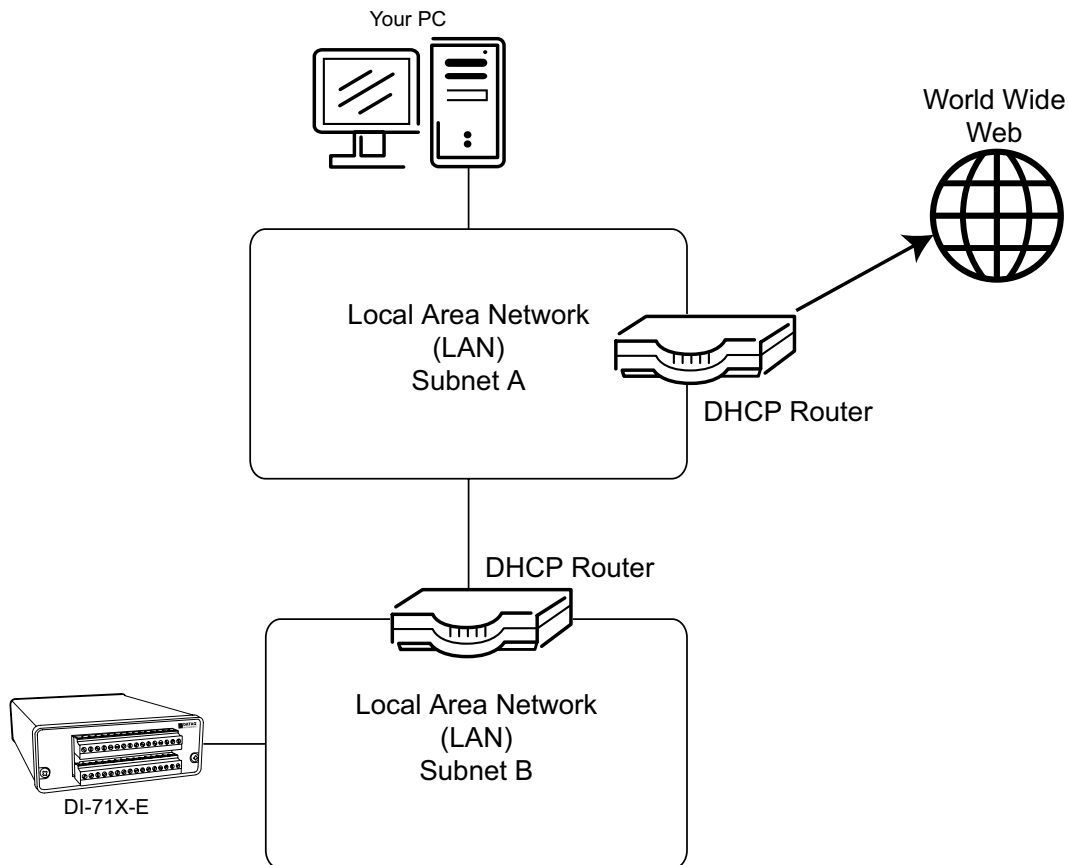

Deployment #4 -- The Wi-Fi router approach to networking is essentially the LAN approach of Deployment #3, but without wires.

Deployment #5

One or more PCs, one or more DI-71X Units, Remote to different LAN subnets

Often, especially in larger implementations, a network may be divided into subnets: separate LANs that serve specific areas or functions. By design, subnets offer limited overlap with other subnets that may coexist. This limitation is built into the system to enhance security and network efficiency, and to facilitate network management. Subnets recognize and reflect the idea that individual departments of an organization have little or no reason for day-to-day access to each other's information. For example, separate subnets may be maintained for the accounting, marketing, manufacturing, engineering, and quality departments respectively. However, the arms length relationship between subnets can usually be overcome to allow a device in one subnet to access another in a different subnet. For example, assume that you work in quality control and you have an intermittent problem with a stamping machine in manufacturing. Further assume that your LAN and the manufacturing LAN are on different subnets. This doesn't prevent you from accessing a DI-71X device installed on the stamping machine in manufacturing from your office in quality. However, it does require that you work with your network administrator to make a minor adjustment to gain that access. Typically your administrator will program the router on the manufacturing LAN to assign a port to the DI-71X, and then forward that port so other subnets, like yours in the quality department, have access to the unit. It's a job that can be accomplished in

literally a minute or less, but network or interdepartmental politics can conspire to make it a longer process.

Your PC

World Wide Web

Local Area Network
(LAN)
Subnet A

DHCP Router

DHCP Router

Local Area Network
(LAN)
Subnet B

DI-71X-E

Deployments #5 -- In many LAN implementations, separate subnets are maintained on a departmental basis. Accessing a DI-71X device from a PC when the two reside on different subnets requires exposing the 71X device to a port on the router that manages its LAN, and then forwarding the port so the PC can treat it as though it resides on its LAN.

Deployment #6

One or more PCs, one or more DI-71X Units, Remote access over the Internet

This option is one of the most exciting, offering unlimited possibilities for DI-71X unit deployment and access. With the Internet as your playground, you can let your imagination run wild: Attach a 71X unit to a machine at the factory, and access data from the convenience of your home, or from an airport or hotel hotspot while you're out of town. Have access to process data at anytime from anywhere in the world, limited only by your ability to secure a connection to the Internet. Interestingly, exposing a 71X unit to the Internet is no more difficult than in Deployment #5. The procedure is just slightly different. You begin by determining the public IP address assigned by your Internet Service Provider (ISP) to whatever device is used to access the Internet, a DSL or cable router for example. From the private side of the router, access one of any number of Web pages that will simply echo your public IP address. I like to use http://www.whatismyipaddress.com/. Next, just like Deployment #5, assign a port on your router to one or more DI-71X units, and make sure those ports are exposed, or forwarded to the public side of

the router. You're done. Any computer on the public side of the Internet now has access to the DI-71X units, at the determined public IP address and assigned ports.
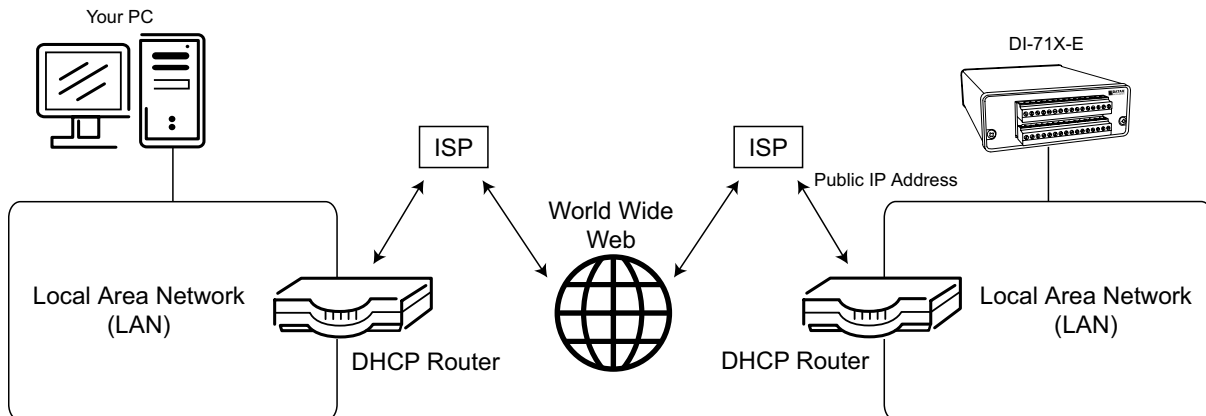
Deployment #6 -- Properly managed, any DI-71X device can be accessed from any location in the world through the Internet.

The Stand-alone Advantage

DI-71X Ethernet products offer three ways to deliver acquired data to a PC: The SD memory card may be physically removed from the 71X unit and placed in an SD memory reader connected to the PC; the PC can upload data stored to the SD memory of the 71X unit over the Ethernet connection; the PC can run a dedicated WinDaq data acquisition software application for each connected DI-71X device, which will use the PC's hard drive to store acquired data.

The first option, moving data to the PC by physically accessing the SD memory doesn't involve a network, so I'm going to ignore that for now. The other two do involve network operations, so it's important to bear in mind the limitations of the network itself. Ethernet is a democratic standard. It does not support a mechanism to lend more importance to any one device connected to it versus all the others. In general terms, this doesn't present a problem. It really doesn't matter, for instance, if you wait a few extra seconds for your browser to display a web page because a client on the network is backing up a file to the server. However, this indifference changes completely if a data acquisition device like a 71X unit is trying to communicate acquired data to a PC for storage using WinDaq software, and can't. Data is lost, and can't be recovered. Network latencies can become especially chronic and unpredictable when attempting to communicate with a 71X device in real time over the Internet. A better solution is the stand-alone option available with all DI-71X products.

The stand-alone option employs a removable SD memory card built right into 71X hardware to which the unit stores data autonomously. This process does not require any intervention on the part of a PC or any other network device. Data uploads from the 71X's SD memory to the PC can occur only after data recording has stopped, which removes all possibility of network latencies causing a drop out. Unpredictable latencies simply cause the 71X to wait for network traffic to clear, and then it resumes sending data from the point that it was interrupted. In this sense, the stand-alone option is fully consistent with the expectations of a network protocol that, by design, treats all devices equally. Stand-alone solutions are not without their own quirks, though.

One is the transfer rate from the SD memory to the PC over the network. DI-71X units have a maximum transfer rate of approximately 3,300 samples per second. You shouldn't think about conveniently uploading multi-megabyte files using this approach. However, most stand-alone applications employ a slow sample rate, so modest data files sizes can span very long record times. Further, the 71X upload manager allows you to upload either the entire file, or any subset of a file by specifying a date and time range. Refer to Table 1 for a comparison of sample upload time, to total record time for different sample throughput rates.

Sample Throughput Rate	Total Record Time	Total Upload Time (seconds)
6.18 samples per hour	1 day	0.04
	10 days	0.45
	100 days	4
1 sample per second	1 hour	1
	10 hours	11
	100 hours	109
	1 day	26
	2 days	52
	4 days	105
	8 days	209
	16 days	419
10 samples per second	1 hour	11
	2 hours	22
	4 hours	44
	8 hours	87
	16 hours	175
	32 hours	349
100 samples per second	1 hour	109
	2 hours	218
	4 hours	436
	8 hours	873
	32 hours	3491
1000 samples per second	1 hour	1091
	2 hours	2182
	4 hours	4364
	8 hours	8727
	32 hours	34909

Table-1
Total time to upload data stored to an SD memory by a DI-71X unit using an Ethernet interface,
as a function of sample throughput rate and total record time.