Remote wireless test with LXI

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In our global society we continue to become more and more connected wirelessly to data and information. The basis or foundation of our global connectivity is Ethernet or LAN which is a hard wired networking standard. This wireless connectivity has led to an explosion in low cost wireless devices that provide connection to an Ethernet network from anywhere. In this article we will discuss how we can use these various off the shelf wireless devices with LXI instruments to do wireless remote testing. First we will look at wireless testing from a local perspective, where our instruments are located in our work area or nearby in a lab. From there we will look at wireless test from a long distance perspective where our instruments are located a mile away or across the globe.

When controlling LXI instruments, three basic connection configurations are commonly used. The simplest is connecting the computer or controller directly to the LXI instrument using a LAN cable. The second is creating your own local network using a LAN switch or router which allows control of multiple instruments from the same controller. The controller and the desired instruments are connected via LAN cables to the switch or router. The third method is to connect all the instruments to an existing network such as your company's intranet (if your IT department allows it). In the case of your company's intranet you have the ability to access the LXI instruments from anywhere within the network as long as there is a LAN connection available. In all of these cases the controller communicates with an LXI instrument remotely using a hard-wired LAN connection.

Imagine if all of your instruments had the ability to connect to a WiFi network or act as a WiFi router instead of a wired IO interface. Considering this, here are some ways it could make your testing life easier:

• Set up a simple remote test on the bench reducing the headache of a tangled mess of IO cables.

• Monitor measurements in an environmental chamber or industrial area from the comfort of your desk or the cafeteria.

• Configure and reconfigure distributive measurements around a large DUT like a satellite payload or an aircraft would cut test time.

While the vast majority of instruments do not have WiFi today, you can combine the LAN interface found on LXI instruments with low-cost, off-the-shelf wireless devices to make instruments wireless-friendly.

Let's start by creating a pseudo wireless test setup. We do this by replacing the wired Ethernet switch or router with a WiFi router. In this type of configuration, the LXI instruments are wired to the router and the controller connects to the router's

local WiFi network so it is free to move around wirelessly. To move our test setup from pseudo wireless to full wireless, replace the instrument LAN cables with wireless Ethernet bridges. An Ethernet bridge converts a wired Ethernet signal to another type of communication protocol like WiFi. The Ethernet bridge needs to be configured with the router's WiFi network name and password. Figure 1 shows a complete wireless remote test setup using a WiFi router and Ethernet bridges.

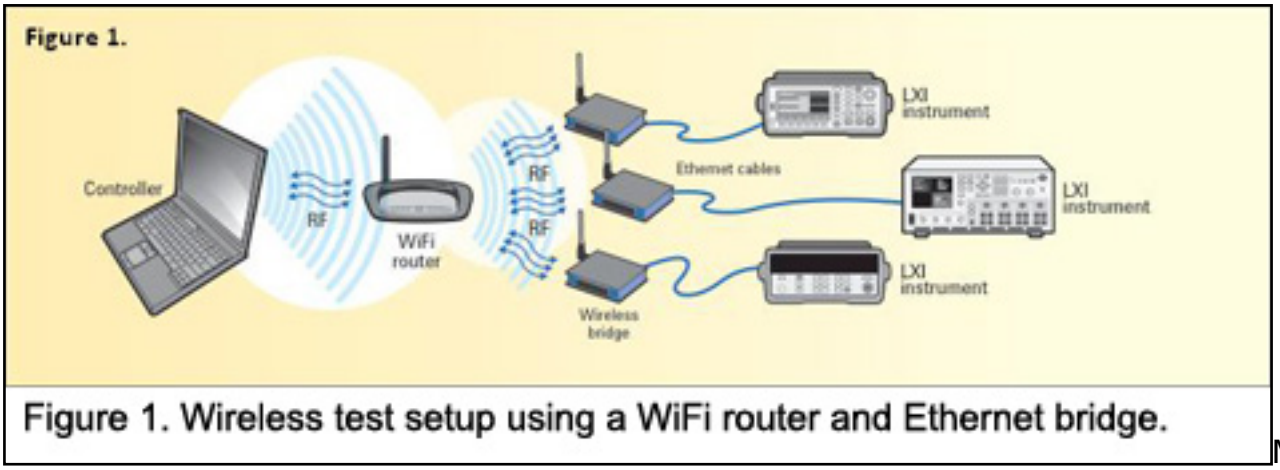

Figure 1. Wireless test setup using a WiFi router and Ethernet bridge.

Most WiFi devices today provide multiple functionalities like router, bridge, and repeater. These multi-function WiFi devices have also become miniaturized into what are typically referred to as "pocket routers". One useful feature of pocket routers is that they can be powered from either an AC line power or a USB port. That means if your LXI instrument has a USB port you can use it to power the pocket router, avoiding another AC line connection to your test setup. In your test setup, you can configure one of the multifunction pocket routers as a router and the rest as Ethernet bridges to create a wireless remote test setup.

There are many applications where the device being tested or measurement being monitored is not located locally in the office. For instance, you may need to monitor a solar panel hundreds of yards from the office or you may need to measure vibration on a high-speed rail track at multiple points spaced out miles apart. In both situations, a LAN network infrastructure is not likely to be available. Making frequent trips to the measurement site is tedious and costly. Here are two ways to do wireless long distance remote and distributed test:

- Using a Long-range Ethernet bridge: Consists of two or more transceivers that each connect to an Ethernet network. The transceivers typically use a 900-MHz ISM-band communication protocol. The bridge setup is shown in Figure 2.

- Using a Cellular router: Can connect to the Internet from almost anywhere as long as there is cellular network coverage. The cellular router setup is shown in Figure 3.

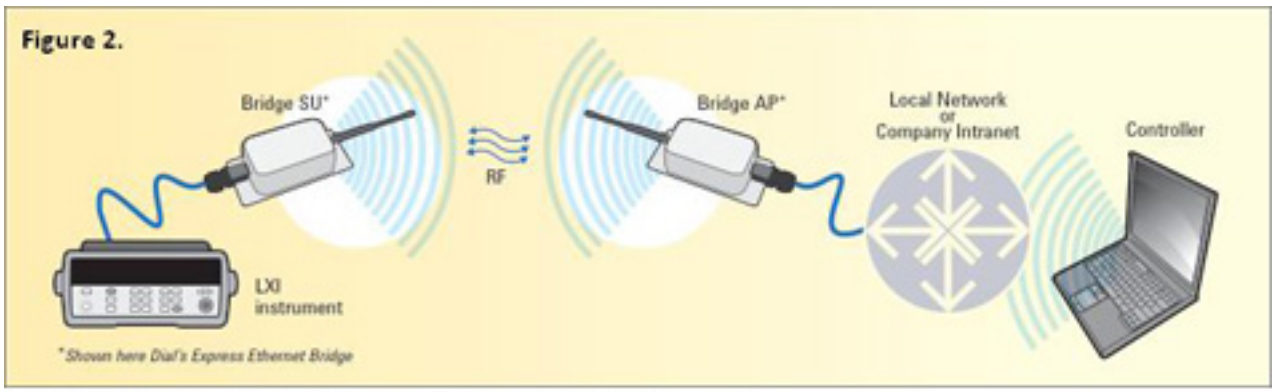

Figure 2. Long-range Ethernet bridge setup.

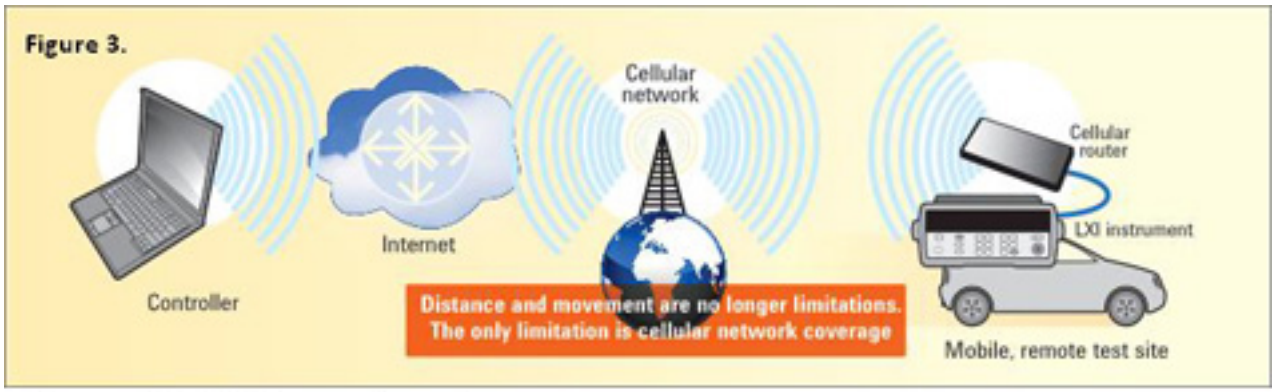

Figure 3. Cellular router setup.

Long-distance Ethernet bridges consist of at least two transceivers that use the 900-MHz ISM band for long-range RF transmission of data. On the other end of each transceiver is an Ethernet port, so the RF transceivers serve as a long-distance bridge. The RF protocol typically employs a type of encryption for securely passing data between the two Ethernet nodes. The line-of-sight range can be up to 15 miles, depending on the surrounding topology and the number of walls or barriers in the signal path. One of the transceivers is set as the access point and is connected to the Ethernet network containing the computer or controller. A second transceiver serves as a slave unit, which you connect to the remote instrument. Multiple slave units, typically up to 16, can be connected to a single access point. This makes it a great solution for distributed test applications with a single controller.

Cellular routers are just like the routers you have at home, except instead of using an Ethernet connection to access the Internet, they use a cellular data connection. Cellular routers offer the greatest distance flexibility and enable you to monitor and control LXI instrumentation across the globe (anywhere a cellular tower is accessible). They also offer the greatest flexibility on the controller side since they can be accessed where there is an Internet connection, such as your home or local cafe. Also, a cellular router is able to maintain its data connection in a moving vehicle. The cellular protocol is robust enough to transfer a data connection from one tower to another while moving at high speeds. One tradeoff of this flexibility may be connection speed. While new 4G networks boast great connection speeds,

they are unlikely to be available in outlying areas.

To connect to the Internet, the cellular router needs a USB mobile broadband device or equivalent. This requires a monthly data plan from a cellular provider. Negotiate a static IP address with your cellular provider for the mobile broadband device to ensure the IP address is not suddenly changed causing you to lose connection to the instrument. Getting a static IP can come with additional costs depending on your cellular provider.

Security can be a concern when you use a cellular router. An LXI instrument acts as a server, and the computer controlling it acts as a client. Consumer routers typically block incoming connection requests for security reasons because they assume every device on their local network is a client. Since the LXI instrument connected to the router is a server, we need to use the router's DMZ or port-forwarding settings so the computer can access it. DMZ tells the router to send all incoming connection requests to a specified IP address (the LXI instrument) on the router’s local network. DMZ has one drawback: Anybody who knows the IP address of your mobile broadband device can access the instrument. Also, using DMZ allows you to access only one instrument on the router’s network. Port forwarding means you open a specific network port or range of ports to a specified IP address on the router’s network. That means you can access multiple instruments from the same router. It’s more secure because to access the instrument you have to know its IP address as well as the open port.

With the explosion of low-cost, off-the-shelf wireless devices that access LAN networks, we can migrate from wired to wireless remote test setups. For local or in the office remote test applications we can use multi-function WiFi devices or, even more convenient, pocket routers to cut the IO wire. Long-range Ethernet bridges and cellular routers make great solutions for performing long distance remote wireless test. Ethernet bridges are a good fit for distributive test where the instruments are spread out miles apart because multiple slave units can be added as needed and controlled from a single access point unit. Cellular routers provide the ultimate long distance reach because they can be accessed anywhere there is cellular network coverage.