

# Keysight Technologies

## Connecting Data Acquisition Systems to a Wireless Network

Application Brief

### Test Challenges:

- Designing heating and air conditioning (HVAC) systems
- Collecting data on a remotely located test device

## Overview

A modern travel router is an excellent supplemental tool for LAN/LXI test instruments, particularly data acquisition (DAQ) systems like the Keysight Technologies, Inc. 34972A. Combining the two allows you to control, configure and gather data from your instrument using a wireless Wi-Fi connection. With Wi-Fi becoming increasingly prevalent in today’s society, the use of a Wi-Fi solution in test and measurement has become much more convenient, easy and desirable.

See our test challenges below to learn how you can use Wi-Fi in conjunction with a 34972A DAQ system, and how to configure your router to be used with an LXI instrument. Also, gain insight into the benefits of new router features and how they can be used with DAQ systems.

<h3>Designing heating and air conditioning (HVAC) systems</h3> <p>Engineers designing HVAC systems often have to collect data from equipment located in remote parts of industrial sites (e.g., on a rooftop or in a basement), and that’s not the only challenge they face. The HVAC systems themselves can create substantial acoustic noise, making the remote area surrounding the equipment an undesirable place to work. Further complicating matters, these remote locations generally don’t have wired LAN installed nearby, which makes it difficult to remotely access any collected data. Despite these challenges, engineers still have to evaluate their new designs by collecting various temperatures, DC voltages and AC voltages from their HVAC system. By simply adding a wireless router to the 34972A system, engineers gain the ability to easily control and access their DAQ system in a more environmentally friendly location.</p>	<h3>Collecting data on a remotely located test device</h3> <p>Collecting data on a remotely located test device is sometimes challenging due to the difficulty associated with placing data acquisition equipment close to the test device and then accessing that equipment with a computer. Wi-Fi allows you to move your PC controller, often a laptop, around to the optimal location without having to use I/O interface cables to connect to your test instrument. If the location of your Device-under-Test (DUT) doesn’t have a wired-LAN connection, such as when performing a DAQ measurement outside a temporary office, you can connect a LXI-enabled instrument to Wi-Fi via an inexpensive travel router that can be powered from the test instrument.</p>
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## Modern routers

Wireless router technology has advanced significantly over the last few years. As Wi-Fi has become more prevalent in today’s society, manufacturers have developed routers that are much more user friendly, inexpensive and lower power. You can now take advantage of these new routers with the 34972A to create a wireless DAQ system that is less cluttered and takes up less space.

As an example, Keysight tried a simple travel router -- a nano router -- with the 34972A; it was very inexpensive and had a small footprint. Its setup and connectivity features are typical of commercial travel routers currently available. As the market evolves, more inexpensive routers will be produced, and might include new router features.

Let’s take a look at some of the basic features you will need to connect your LXI instrument to Wi-Fi.

## Nano router

A Nano router, such as the TP-LINK TL-WR702N, is fairly small. In this case, the TP-LINK TL-WR702N is just 57 mm x 57 mm x 18 mm, with a specified power consumption of only 1 watt, and is powered through a USB cable. You can take advantage of the TL-WR702N with the 34972A by powering it with the USB port on the back of the instrument (Figure 1). With older generation routers, a separate power adapter is required.

In general, the nano router offers the basic functionality you need to use it with the 34972A. Its main features are its small size and inexpensive cost relative to the DAQ system.



Figure 1. Shown here is a nano router on top of a 34972A with a LAN and power cables.

One of the non-documented features of this router is the ability to provide a DHCP address on the wired port. This provides the 34972A with an IP address that is on the same network as wireless devices connected to the Wi-Fi side of the router. One indicator for this feature is the inclusion of Client Mode in the router's data sheet.

The nano router supports both Access Point Mode and Client Mode which are critical to converting your LXI instrument to a wireless connection. These two modes and their use are described in the next section.

## Wirelessly connecting the 34972A to a controller

Two main methods can be used to connect wirelessly with your 34972A using a travel router. Most Wi-Fi travel routers support these methods; however, you will need to verify your router configuration capabilities prior to purchase.

The first method uses the travel router in Access Point (AP) Mode to make a simple ad hoc wireless connection between your computer and the 34972A, as shown in Figure 3. This method is good for a 1-to-1 connection between your PC and instrument.

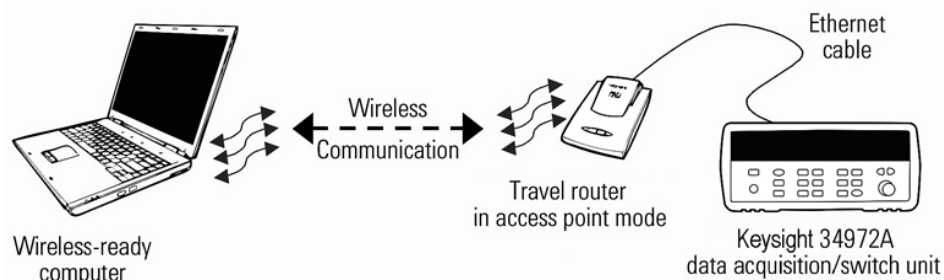


Figure 3. Using an AP Mode topology to wirelessly connect to the 34972A.

The second method uses the travel router in Client Point Mode to make the 34972A a client so that it can wirelessly communicate with a centralized AP through the travel router (Figure 4). With this technique, you can connect to your 34972A from anywhere on your network. Your computer also communicates with the same central AP, thereby giving you wireless control of the 34972A.

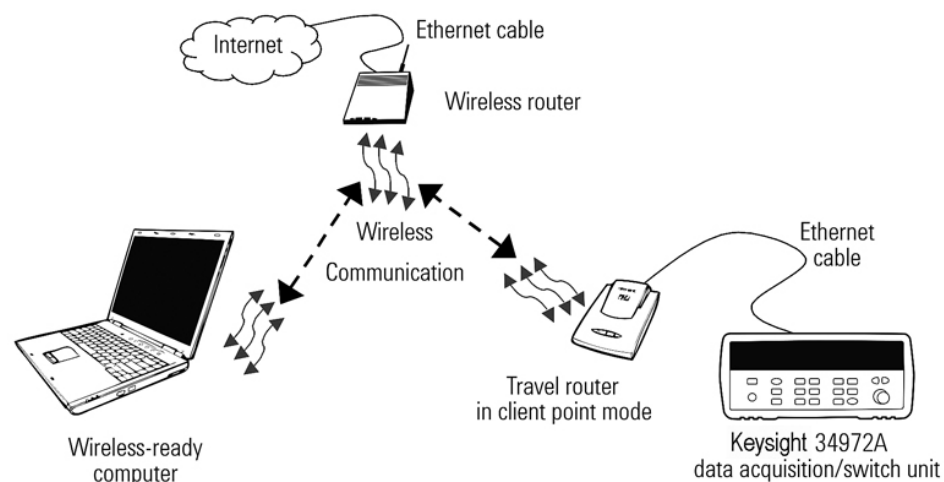


Figure 4. Using a Client Mode topology to wirelessly connect to the 34972A.

## AP Mode

The AP Mode offers the simplest wireless connection method. Your computer communicates directly with the 34972A through the travel router. This method requires no additional WLAN, but as a result, you will not be able to access any other Web sites or instruments with your computer.

## Measurement tip

Most modern travel routers run on very low power, typically 1 watt. Often they use a USB cable/adaptor to power the device. You can power the router by connecting the USB cable to the USB host port in the back of the 34972A, since it allows for loads up to 2.5 watts.

## Configuring AP Mode on a travel router

While the specific configuration for every type of router is different, they share common steps for setting up the different modes. Here are some general steps for setting up AP Mode on a travel router. Consult your router's manual for specifics.

1. On your PC, connect to the router using either a wired connection or through Wi-Fi using your router's SSID (wireless router name).
2. Open an internet browser (Internet explorer, Firefox, Chrome, etc...) and type the router's IP address. This is typically 192.168.0.1 or 192.168.0.100. Some manufacturers set default IP addresses to a non-standard address. Consult your manual for specifics.
3. Log in using the admin credentials.
4. Critical step: Change the Wireless mode to Access Point Mode or AP Mode.
5. Change the LAN settings from DHCP to Static IP. This will change the wired connection between the router and device (e.g., your PC or the LXI instrument) to be a static address.
6. Ensure that your DHCP server is running in the wireless settings.
7. Apply and log out.
8. Disconnect the LAN cable from the PC if you used that connection method in step 1.

### Measurement tip

Most routers actually have AP Mode as the default setting. If this is the case, you only have to set the static IP Mode for the router's LAN settings to communicate with LXI instruments.

## Configuring Client Mode

Client Mode is a slightly more complicated wireless connection method, but it provides additional benefits. In Client Mode, you can use the router as a wireless adapter for wired Ethernet devices. Your computer communicates with a central AP. The 34972A also communicates with the same central AP through the travel router. This method requires the availability of an additional WLAN (a central AP on a wireless network), but as a result, you will be able to access other Web sites and instruments with your computer—assuming the WLAN provides those capabilities. Other computers will also be able to communicate wirelessly with the 34972A simultaneously with your computer.

Configure Client Mode on a travel router:

1. On your PC, connect to the router using a wired connection. Disable Wi-Fi on your PC to avoid conflicts between the PC's wired and wireless connections.
2. Open an internet browser (Internet explorer, Firefox, Chrome, etc...) and type the router's IP address. This is typically 192.168.0.1 or 192.168.0.100. Some manufacturers set default IP addresses to a non-standard address. Consult your manual for specifics.
3. Log in using the admin credentials.
4. Critical step: Change the Wireless mode to Client Mode. This might reboot the router. If it does, follow steps 1–3 again once the router has rebooted.
5. In the wireless client settings, click on a button that says "Survey" or "Wireless Survey." This will look for available wireless connections for your router to connect to. This will connect you to the (wide area network) WAN or Internet.
6. Enter in the security information for your WAN router's Wi-Fi.
7. Apply and log out.
8. Disconnect the LAN cable from the PC.

## Connect and configure the 34972A

1. Wire travel router connections
  - To the LAN/WAN port, connect an Ethernet (RJ-45) cable. The other end of this cable will be connected to the 34972A LAN port.
  - Connect the USB cable from the back of 34972A to the travel router power port to turn it on. See the measurement tip on powering your travel router for more information.
2. Wire 34972A connections
  - To the LAN port, connect an Ethernet (RJ-45) cable. The other end of this cable should be connected to the travel router's LAN/WAN port.
  - An appropriate AC line cord must be used to power the 34972A.
3. Configure the 34972A (default configuration)
  - From the front panel, the following configuration should be verified (press Shift > Interface). Repeatedly press Interface (Sto/Rcl button) to see each subsequent setting. For parameters that can be set, these are the factory default settings. Simply turn the knob to make any necessary changes.
    - LAN INTERFACE
    - LAN ENABLED
    - STAT:CONNECTED (may say LXI FAULT if not connected yet)
    - RESET LAN: NO
    - DHCP ENABLED
    - IP ADDRESS (example: 192.168.10.101)
    - SUBNET MASK (example: 255.255.255.0)
    - GATEWAY (example: 192.168.10.1)
    - DNS SERVER (example: 0:0:0:0)
    - MAC ADDR (example: 00:30:D3:04:1F:9A)
    - NO CHANGE

Wait for the travel router to assign an IP address to the 34972A. You will know this is complete when the above mentioned STAT (status) parameter shows CONNECTED and the 34972A IP address is something other than 0.0.0.0.
4. Turn on your computer's wireless feature and use it to show a list of available wireless networks. Connect to your travel router's wireless SSID (for AP Mode), or your WAN network (Client Mode).
5. Control the 34972A wirelessly
  - You should now be able to access the 34972A wirelessly by using its IP address. You can obtain the IP address from the front panel as described in step 3. You can confirm the wireless connection by opening a browser and entering the 34972A's IP address in the URL field to access the 34972A's built-in Web server (Figure 5).

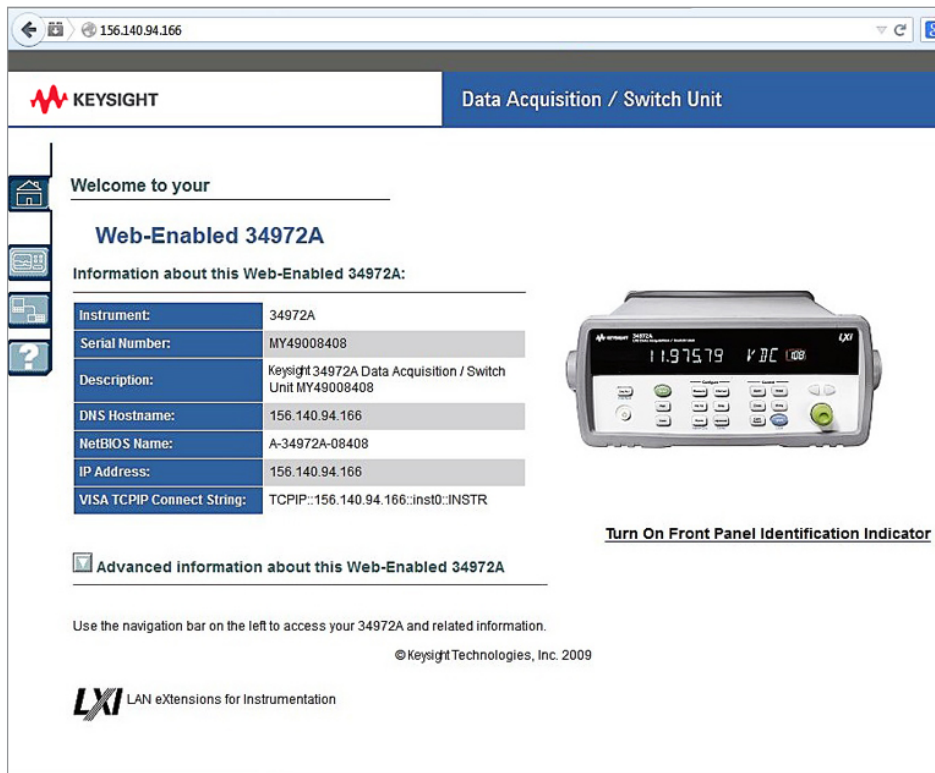


Figure 5. Confirm the wireless connection by opening a browser and entering the 34972A's IP address in the URL field.

This Web server is fully featured, making it easy for you to quickly set up and control the instrument and transfer data from it to your computer. Any program that was written to control the 34972A through the wired LAN port will now work wirelessly through the router using the new IP address.

## Summary

Through the use of simple travel routers, you can connect LXI DAQ systems like the 34972A, or other LXI-enabled test instruments, into a wireless-enabled instrument. Doing so not only gives you the convenience of Wi-Fi, but also simplifies your test wiring and provides you a viable and cost-effective solution for your remote testing needs.

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