Network Deployment Guide for NovoPRO

NovoPRO is a wireless presentation and collaboration system designed to support highly interactive and collaborative meetings or classroom learning activities. Meeting participants, instructors, teachers and students can interact and share digital content via their PCs, tablets, Chromebooks and smartphones — a true BYOD device.

To fully take advantage of NovoPRO's capabilities, it should be properly deployed in a school or corporate's network. Some aspects should be carefully considered and planned, for example, WiFi interference and channel selection, intranet firewall, Bonjour protocol support across different subnets/VLANs, Quality of Service and device management. In this whitepaper, we are going to illustrate these points one by one to facilitate a successful NovoPRO deployment in your network.

1. Network Connection

NovoPRO has three network connection types, Ethernet, WiFi Client, and WiFi Hotspot.

   A) **Ethernet** – NovoPRO can be plugged into your Ethernet via its RJ45 port. Namely, you can connect NovoPRO to your organization's backbone network. It is recommended to use Ethernet connection (when possible) since it gives you better robustness and higher performance.
   B) **WiFi** – NovoPRO's built-in 802.11ac WiFi operates at dual bands (2.4/5GHz). With its 2T2R antenna, it can achieve a maximum bandwidth of 300Mbps[1]. This high-performance WiFi module can operate at two modes.
      a) **Client Mode** – NovoPRO can be connected to your organization's WiFi network via its built-in WiFi module.
      b) **Hotspot Mode** – NovoPRO can creates its own WiFi network, allowing users to connect their mobile devices to this ad hoc network.

The following table summarizes their feature difference and typical usage.

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[1] 300Mbps is the maximum value while the actual bandwidth may vary depending on operating environment.

	Ethernet/WiFi Client Mode	WiFi Hotspot Mode
Number of Users Allowed	64	8
Internet/Intranet Access	Yes	By default no, but can enable this feature specially)
Typical Usage	Pre-configured for School or Corporate	Quick setup for small-group meetings

It is worth mentioning that Ethernet and WiFi connections can coexist on NovoPRO. Namely, you can configure NovoPRO in Ethernet and WiFi Client mode, or in Ethernet and WiFi Hotspot mode.

1.1. Ethernet

The following home screen shows NovoPRO is in Ethernet mode, where its Ethernet IP is highlighted in a red box.
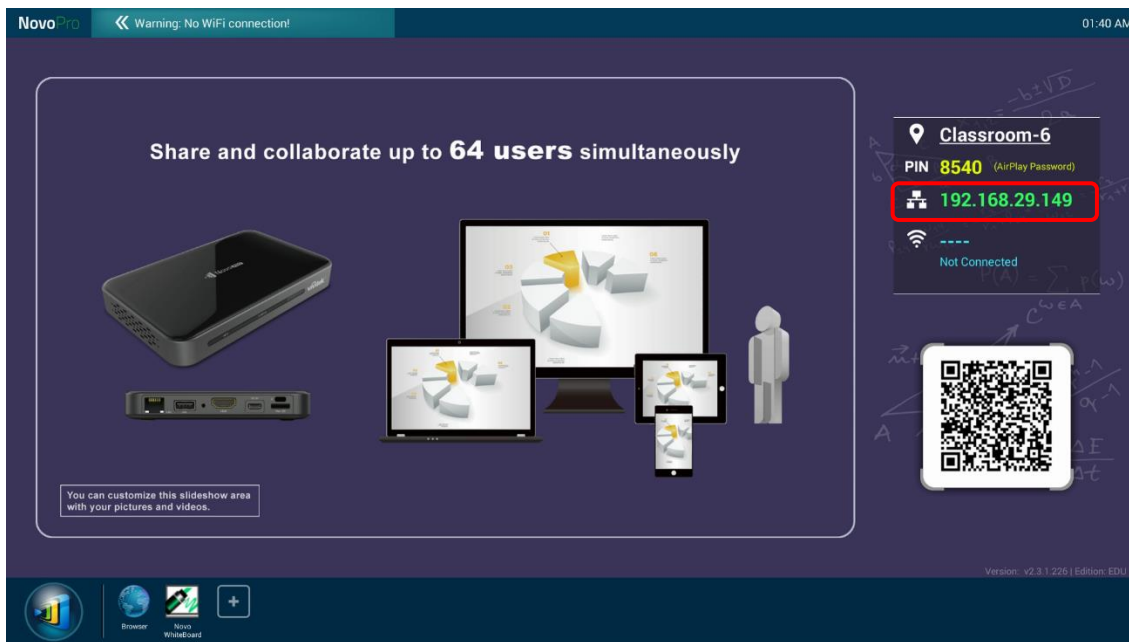

When connecting to a wired network, NovoPRO supports both DHCP and Static IP connection types.

- **DHCP**: NovoPRO obtains its IP address from the DHCP server on the network.
- **Static IP:** NovoPRO is assigned a fixed IP address manually.

"**DHCP**" is the default connection type. However, "**Static IP**" might be more preferable as it makes remote management much easier.

The following diagram illustrates how to select one of these two connection types. (Settings → General Settings → Ethernet → Ethernet Configuration).
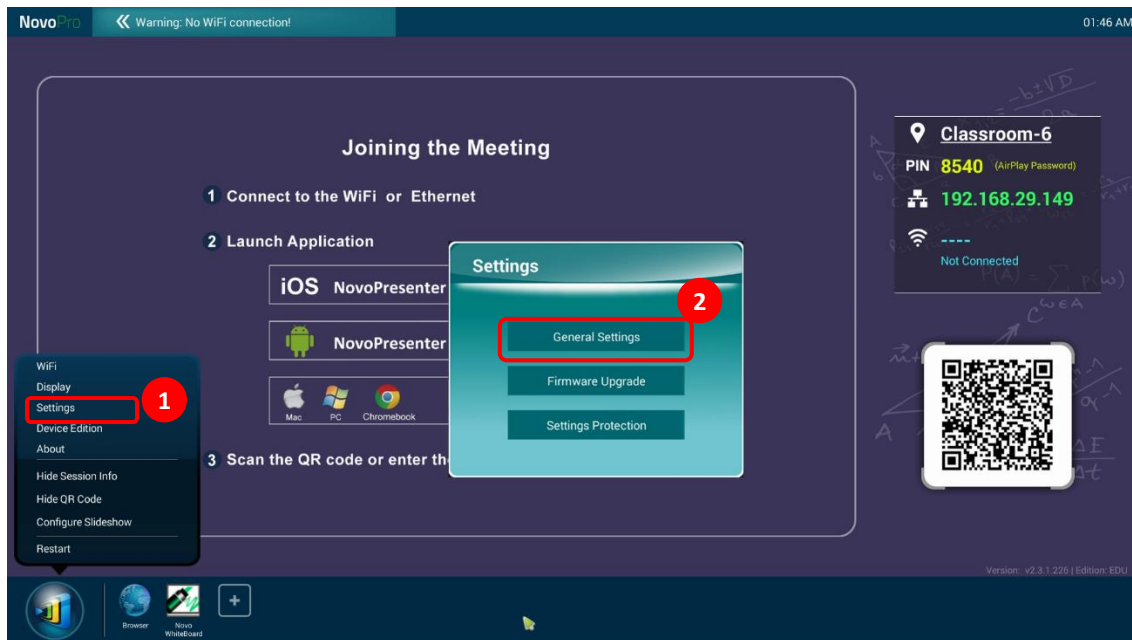
To set up "Static IP" properly, you need to have the following information, as shown in the diagram on the right.

- An unallocated IP address;
- Netmask;
- DNS address;
- Gateway address.
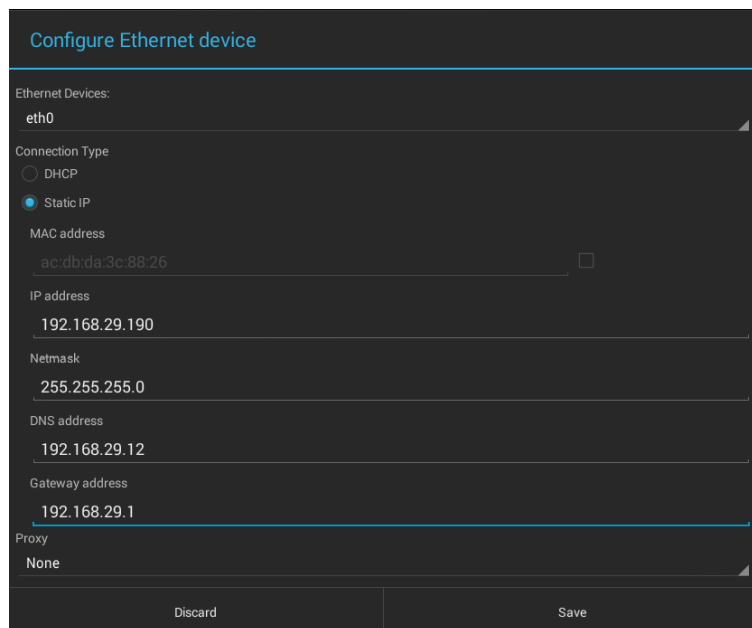
1.2. WiFi Client Mode

In this mode, NovoPRO functions as a client to join an existing WiFi network. As illustrated in the following diagram, to set up the WiFi connection, on NovoPRO home screen, click on button WiFi

→ Connect to WiFi → Configure → Wi-Fi (ON). Then select the desired Wi-Fi SSID (the name associated with the Wi-Fi network) and enter the proper credentials when necessary.

You may notice that you have the choice of using "**DHCP**" or "**Static IP**" in the connection dialog, which is exactly the same as Ethernet connection.
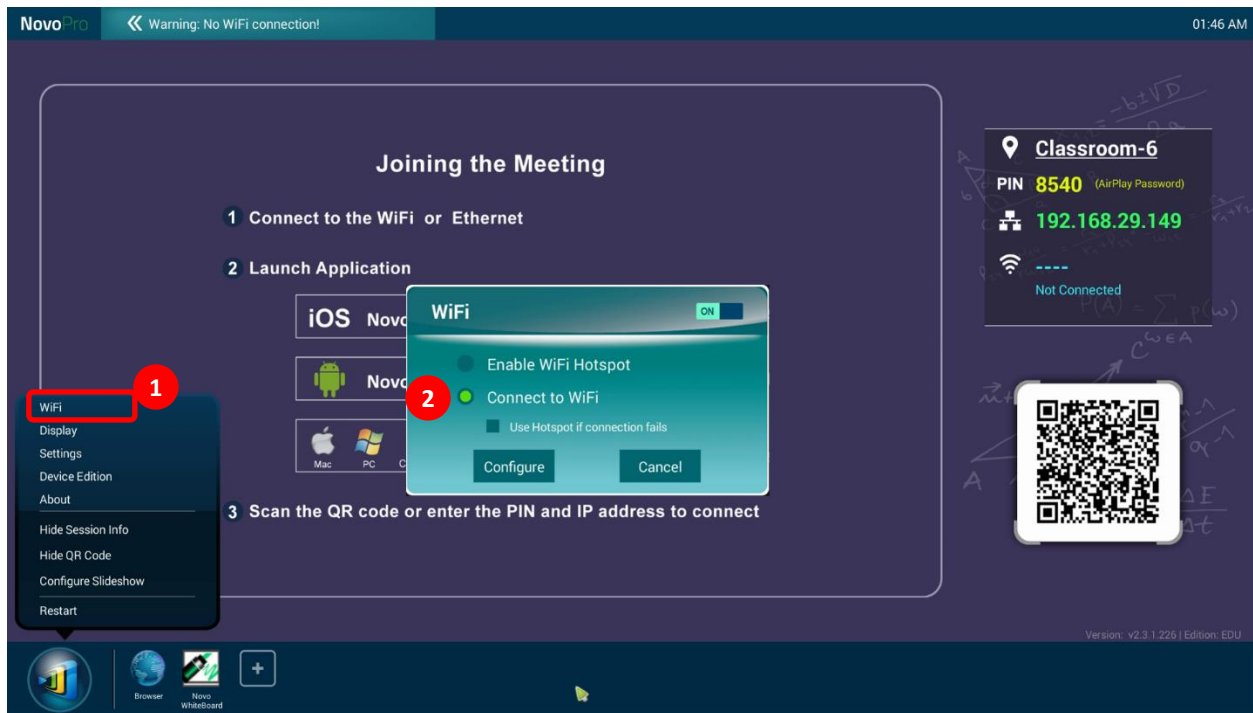
Logging in a WiFi Network via Captive Portal: Some WiFi networks are equipped with a captive portal, which requires users to log in via a web browser before they can access the Internet. When a NovoPRO device is connected to this type of network, users can follow the following steps:

A. Follow the above configuration steps to connect to the organization's WiFi network;
B. After the WiFi is connected, click on button "Browser" on the home screen (see the picture below);
C. Open this web browser and you will be prompted for login credentials.
D. Enter the proper username and password, and you will be connected to the network;
E. Click the button "Return Back" on the home screen to return to NovoPRO App main interface.
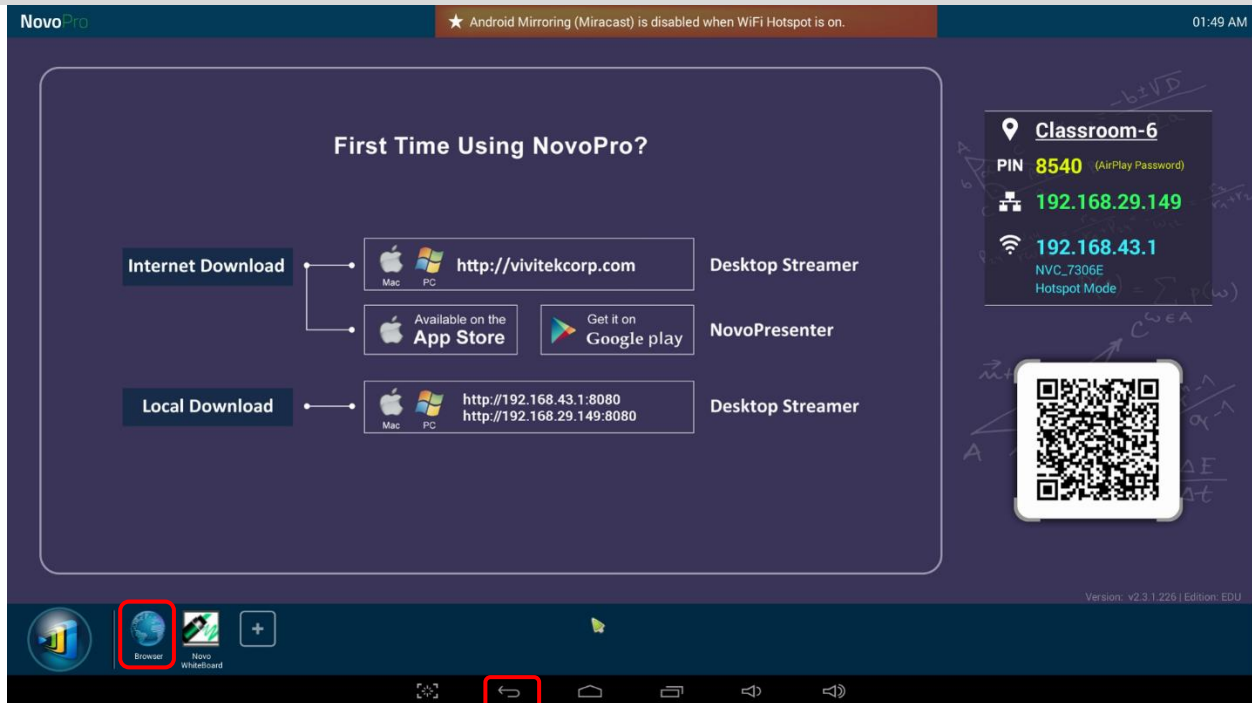
Logging in a WiFi Network with 802.1x Authentication:

When you connect to a WiFi network with 802.1x authentication (for example, radius server), you will need to enter the following fields to set up the connection properly:

- Network SSID → *Your network*
- Security → *802.1x Enterprise*
- Choose the right settings for
    - *EAP method*
    - *Phase 2 authentication*
- Identity → *Your username (such as DOMAIN\John.Smith)*
- Password → *Your password*

Click on button "Connect" to start the connection.
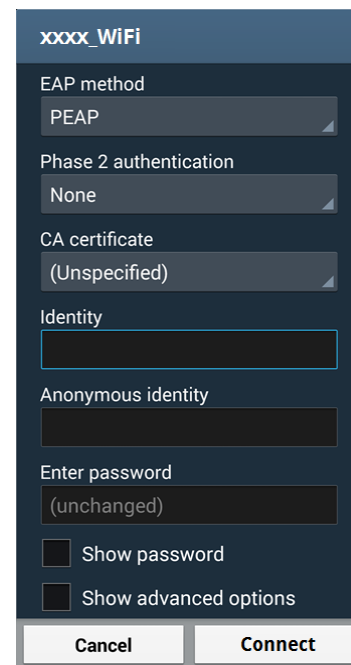

1.3.   WiFi Hotspot Mode

A newly unpacked NovoPRO starts up in Wi-Fi Hotspot mode, where you can start using it without any entanglement with networking setup. The default SSID for this WiFi Hotspot is "NVC_XXXXX" (for example, "NVC_4DF8F" in the following screenshot), where "XXXXX" is a device-generated

text string. Please note that Android mirroring (Miracast) is disabled in this mode. In comparison, AirPlay mirroring has no such limitation.
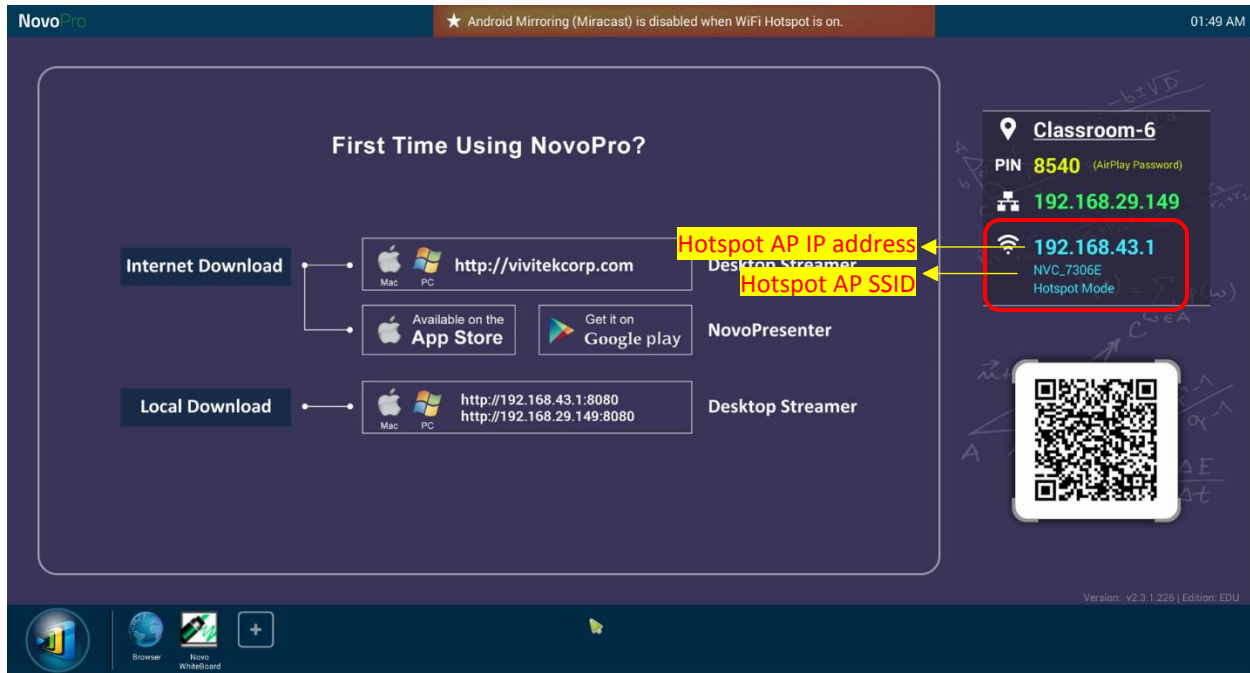
With NovoPRO firmware V2.2 or above, you can also configure Hotspot's RF channel and its routing behavior with LAN. As shown in the figure below,

- You can change the RF channel to avoid unnecessary radio interference, as explained in Section 1.4.
- "Enabling LAN-WiFi-Hotspot routing" gives you the option to either keep LAN and WiFi Hotspot completely isolated, or, allow WiFi Hotspot to piggyback LAN for Internet access.
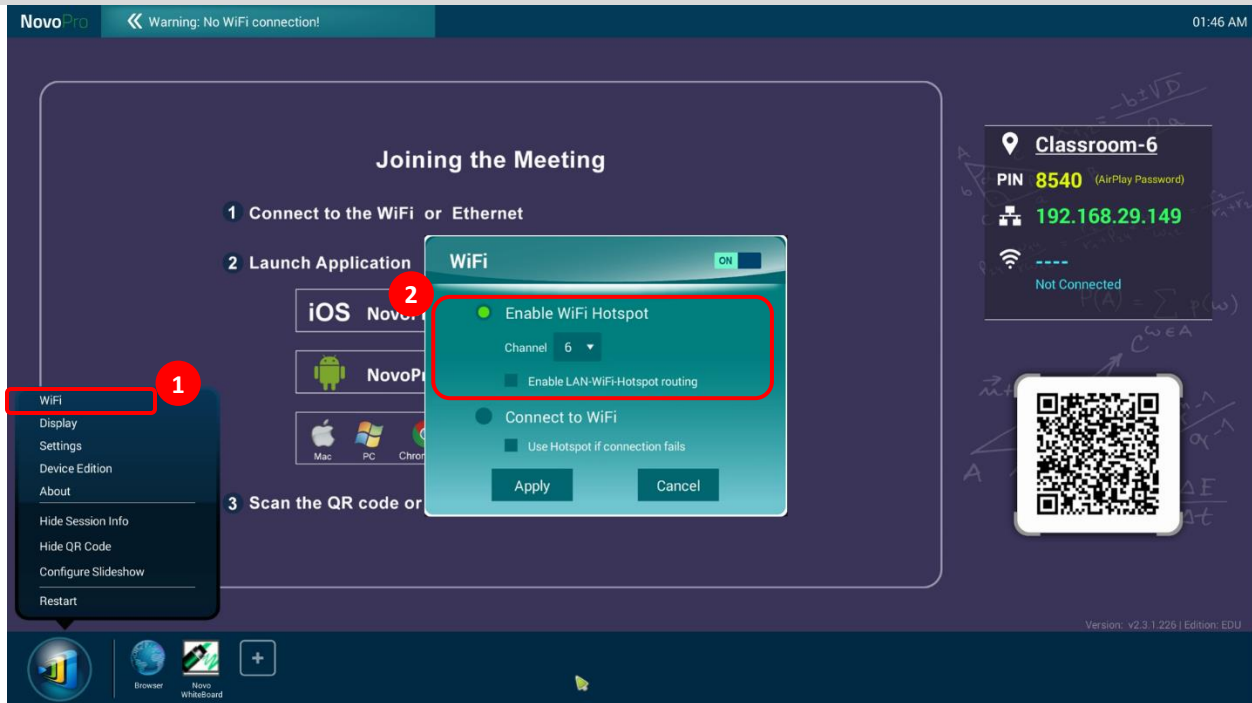
In addition, you can change rename WiFi Hotspot SSID and change its security settings (security protocol and its password.) To do so, click on button <u>Settings</u> → <u>General Settings</u> → <u>More</u> → <u>Tethering & portable hotspot</u>. Then the following "Set up WiFi hotspot" window pops up to allow you to make changes.
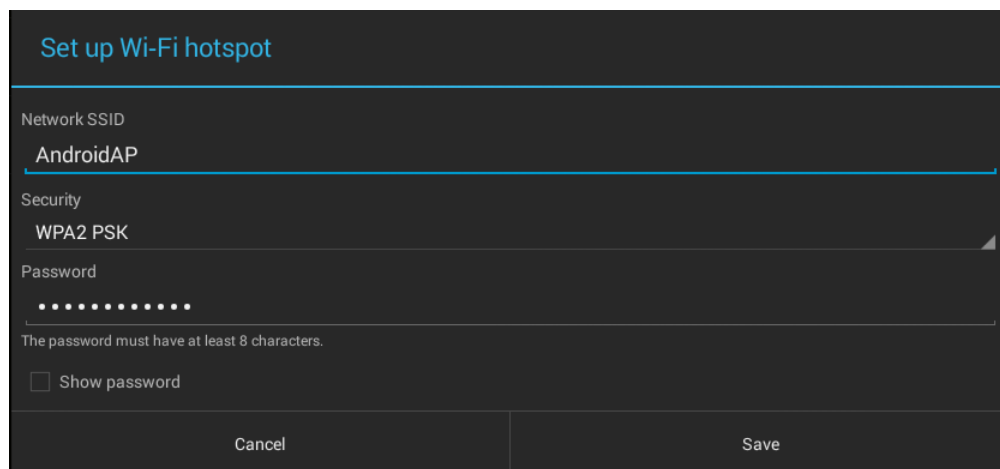
1.4. WiFi Network Optimization

One of the most common issues users run into when using NovoPRO is the loss of connection, which is likely caused by instable WiFi connection. Maintaining a stable WiFi connection is always a challenge due to the plain fact that it is wireless, subject to noise interference and physical environment. To keep a good connection, you might follow generic WiFi setup guideline, such as

1) Don't place NovoPRO next to electric noise sources, such as electric fan or power supplies. Especially when you attach NovoPRO next to a projector or an LCD monitor, you need to keep an eye on these potential "pollution" sources.

2) Make sure you don't place NovoPRO behind metal frames/bars, etc. Metal will greatly degrade WiFi signal strength.

3) NovoPRO's hotspot mode supports devices within 30 meters (100 feet). If you have an external router, it is recommended to use NovoPRO WiFi client mode instead of hotspot mode.

4) Try using 5GHz band as it is more robust than 2.4GHz band.

5) Lastly, you might want to check how crowded the WiFi spectrum is occupied. Two popular Apps can give you a very good view of the WiFi spectrum.
   - "WiFi Analyzer" on Android devices;
   - "InSSIDer" tool on Windows OS.

If too many WiFi Access Points occupy the same RF channel, it can lead to sluggish performance, and, disconnection if it becomes severe. The following example is a screenshot from "WiFi Analyzer" App. As you can tell, WiFi channel 6 is heavily utilized. You might want to change one or some of them to other less-crowded channels.
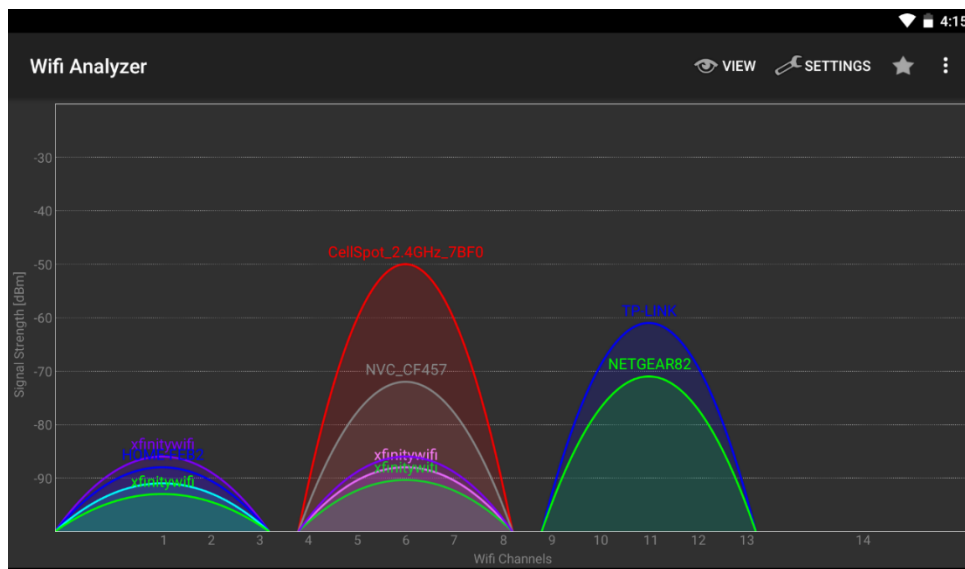
1.5. Dual-network Configuration

NovoPRO can even be set up to support dual networks:

- **Ethernet & WiFi client mode:** connect to your organization's existing wired network and wireless network simultaneously. This function is extremely useful for organizations with "guest" wireless network setup for external visitors.
- **Ethernet & WiFi hotspot mode:** connect to your organization's wired network and run as a WiFi hotspot simultaneously. If needed, "LAN-WiFi-Hotspot routing" function can be

enabled to allow all devices connecting to its hotspot WiFi to have internet/intranet access (via the wired Ethernet connection). You may find this configuration suitable for meeting rooms.

Ethernet & WiFi client mode

In this case, NovoPRO's RJ45 port is connected to a wired EMPLOYEE network for employees to securely access it; at the same time NovoPRO's WiFi is connected to a GUEST network to allow visitors to access it. The following graph describes such a network setup scenario.

By doing so, the GUEST and EMPLOYEE networks are kept separated, while at the same time, the NovoPRO device is available to both guest users and employees.

Notes on Network Security: *Within NovoPRO, the WiFi section is completely separated from the Ethernet section, namely, there is NO network routing between these two sections. Therefore, users connecting to the WiFi section will not be able to access any resource on the Ethernet at all, and vice versa. In short, security is not compromised in this configuration.*

Ethernet & WiFi hotspot mode

In this case, NovoPRO's RJ45 port is connected to a wired network connecting to the internet/intranet; at the same time NovoPRO is also running at WiFi hotspot mode allowing PCs and tablets to connect to it wirelessly. The following graph describes such a network setup scenario.

As described in Section 1.3, you can enable the routing between LAN and WiFi Hotspot. Once you enable this routing feature, devices on the WiFi Hotspot side will be able to access intranet or Internet resources via the LAN connection.

Notes on Network Security: *before you enable this routing feature,*

1) *You may consult your organization IT administrators to avoid compromising your network security.*
2) *WiFi Hotspot by default is an open network. It is strongly recommended that you change it to a secure WiFi network.*

2. Port Numbers and Intranet Firewall

NovoPRO is a TCP/IP-network-based device, and the communications between a NovoPRO device and its client devices (e.g. laptops, tablets, etc.) are achieved through several TCP and UDP ports. The following table summarizes all the port numbers being used by NovoPRO.

Port Number	Type	Inbound (IN)/ Outbound (OUT)	Description
80	TCP	IN	Port for local Desktop Streamer application download page
443	TCP	OUT	Port for device firmware upgrade or streaming YouTube video (need Internet access)
8080	TCP	IN	Port for local Desktop Streamer application download page
20121	TCP	IN	Port to transfer commands and status reports between the NovoPRO unit and users' devices (For example, laptops/tablets use this port to establish "connection" to the NovoPRO unit.)
20122	TCP	IN	Port to enable "Remote Mouse" functionality
20123	TCP	IN	Port to transfer screen image
20124	UDP	IN	Port to send discovery message (so that the NovoPRO unit can be discoverable by laptops/tablets.)
20126	TCP	IN	Port to transfer AV-streaming's command data
20127	TCP	IN	Port to transfer AV-streaming's audio data
20128	TCP	IN	Port to transfer AV-streaming's video data
20130	TCP	IN	Port for video streaming service
20131	TCP	IN	Port for file transfer service
20141	UDP	IN	Port for device management
20142	UDP	OUT	Port for device reporting to Remote Manager
20161	TCP	IN	Port for cross annotation
20162	TCP	OUT	Port for device home screen configuration
20192	TCP	OUT	Port for device home screen configuration
20193	TCP	OUT	Port for device firmware upgrade (used by Remote Manager)

To enable successful operations of a NovoPRO device, these ports should not be blocked by your network's firewall.

3. Enabling AirPlay Mirroring Across Subnets/VLANs

NovoPRO supports Apple's AirPlay, which is the native screen mirroring mechanism for iPads, iPhones, and Mac computers. AirPlay mirroring relies on Bonjour service which is Apple's implementation of "zero config" networking. Bonjour enables automatic discovery of services on

the network. However, this discovery service cannot pass through either network subnets or VLANs. As a result, iPad devices sitting on one subnet or VLAN cannot discover such a mirroring service from NovoPRO sitting on another subnet or VLAN.

To make AirPlay mirroring workable across subnets/VLANs, a Bonjour proxy has to be added so that it can take the service announcements on one subnet and announce them on the other subnets. Bonjour service discovery uses multicast DNS (mDNS), similar to DNS.

- An mDNS proxy will have multiple network interfaces, each of which connects to one subnet/VLAN where AirPlay mirroring clients or servers live. It does not relay traffic between subnets/VLANs. Instead it merely provides a lookup mechanism.
- An mDNS proxy can be deployed in existing network without changing the network architecture. It doesn't change security zoning, nor create a bottleneck for network traffic. It's a simple way to facilitate AirPlay mirroring in a business or education network.

Open-source software *Avahi* is such an mDNS proxy. For how to setup Avahi service, please refer to an application note "Enabling iOS Mirroring in a Multiple-subnet Environment" available at NovoPRO webpage (http://novopro.vivitekusa.com).

| Application Notes | Enabling iOS Mirroring in a Multiple-subnet Environment | 768KB | Download Now ▾ |

4. Quality of Service

Bandwidth requirement for smooth user experience with NovoPRO is summarized in the following table.

| Display Resolution	Streaming Mode	Static page	Animation page	High Action movie	4-to-1 Projection
720p	Presentation Mode	Ave: 150kbps Max: 200kbps	Ave: 550kbps Max: 800kbps	Ave: 2.8mbps Max: 4.5mbps	Ave: 5.0mbps
720p	Video Playback Mode	Ave: 320kbps Max: 500kbps	Ave: 1.2mbps Max: 1.5mbps	Ave: 5.5mbps Max: 7.5mbps	Ave: 5.0mbps
1080p	Presentation Mode	Ave: 200kbps Max: 300kbps	Ave: 1.4mbps Max: 1.7mbps	Ave: 6.1mbps Max: 7.7mbps	Ave: 10.0mbps
1080p	Video Playback Mode	Ave: 350kbps Max: 500kbps	Ave: 1.8mbps Max: 2.2mbps	Ave: 5.8mbps Max: 7.2mbps	Ave: 10.0mbps

In general, 2mbps is good for "Presentation" mode while 4~8mbps is sufficient for "Video Playback" mode.

- **WiFi:** NovoPRO has a high-performance WiFi module (802.11ac with 2T2R). So typically NovoPRO is not the bottleneck in terms of network traffic. It is recommended that your wireless network at least support 802.11g.
- **Ethernet:** With its higher bandwidth and better robustness, Ethernet provides the best performance. Use it whenever it is possible.

Note: even if there is not enough bandwidth, NovoPRO software can still work properly (while it might skip frames every now and then).

## 5. Managing Multiple NovoPRO Devices Remotely

Remote manager is a stand-alone Windows/Mac application that enables administrators to manage multiple NovoPRO devices from a single computer, making it ideal for corporations, schools or other large institutions.
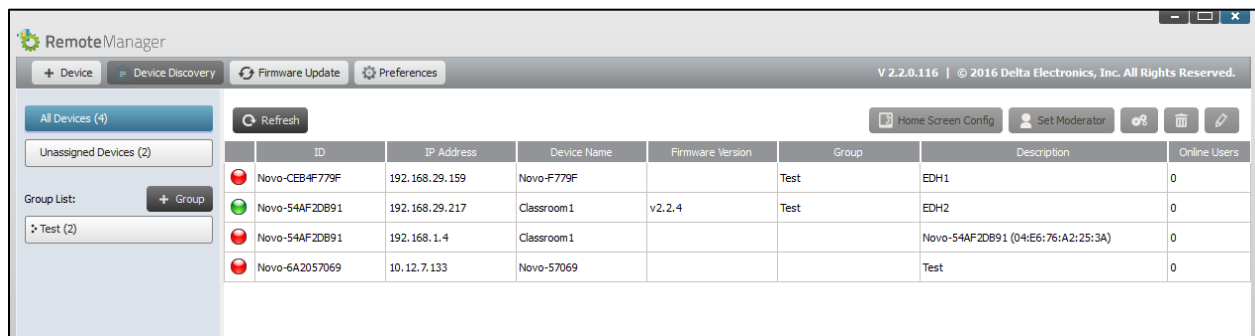
The software allows users to

- Add devices manually or via auto discovery;
- Group devices;
- Manage device settings;
- Configure home-screen slideshow;
- Upgrade firmware;
- Configure moderator credentials;

Please refer to the section 4.3 "Remote Manager" Of "NovoPRO User Manual" available at NovoPRO webpage (http://novopro.vivitekusa.com) for details.
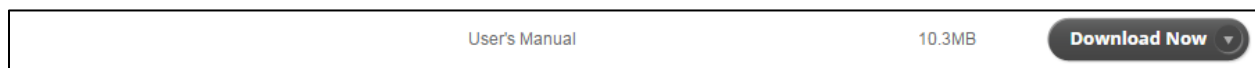

5.1. Adding NovoPROs via Auto Discovery

Before remotely managing a NovoPRO device, it has to been added into the device list of Remote Manager. This can be done manually or via auto discovery. Especially for the organization deployed lots

of NovoPRO devices, adding a device via auto discovery can save a lot of effort. This function allows IT staff to create and install a custom configuration file to automatically configure NovoPRO's settings via a microSD card.

Use Remote Manager tool to generate a "NovoAutoConfig.xml" configuration file

1. Please download and install the latest version of Remote Manager software on the computer used for remotely managing all NovoPRO devices at your organization.
2. Launch Remote Manager, and choose "Device Discovery" and then click "Create AutoConfig File …", as illustrated in the figure below.
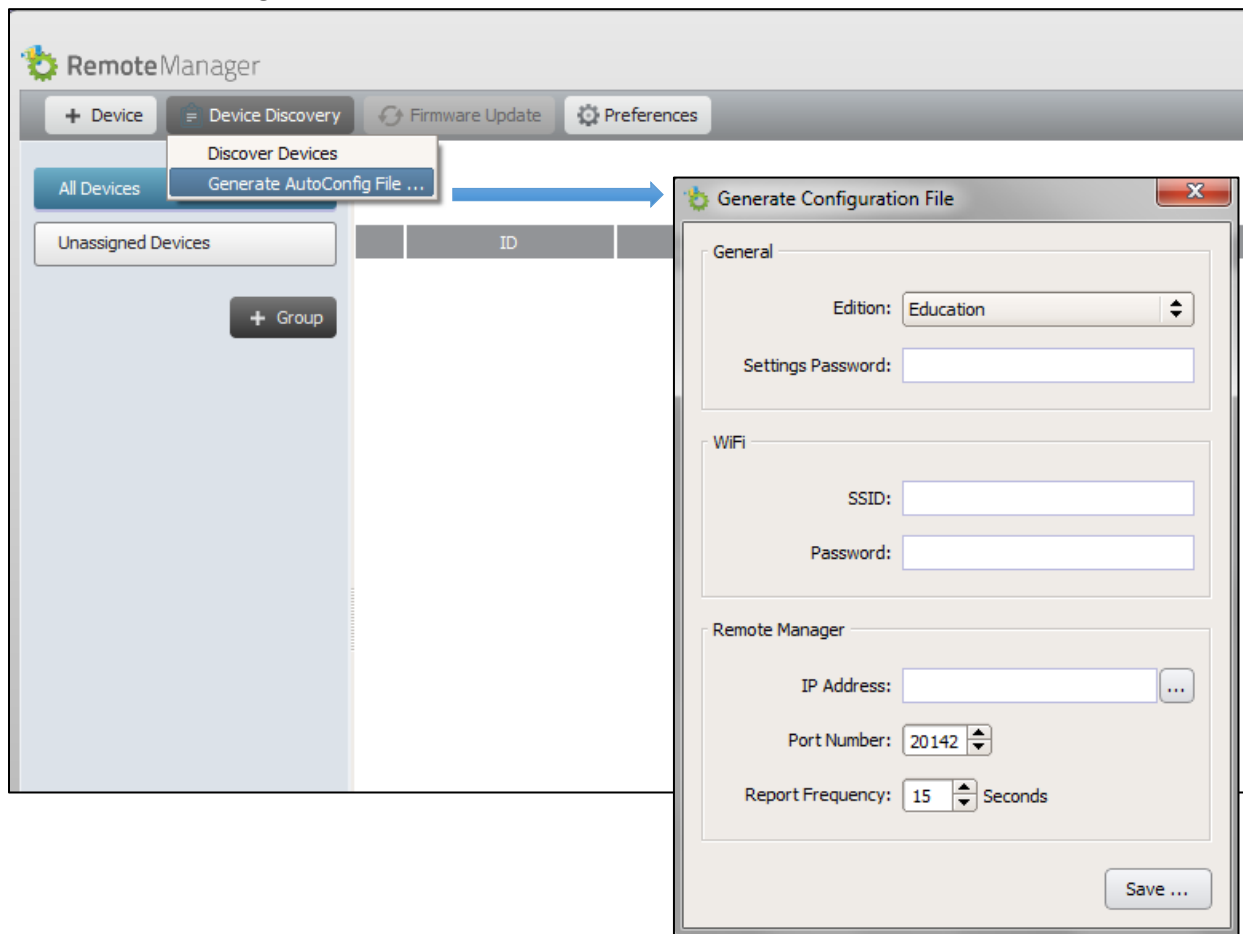

3. You need to work with your organization IT staff to get the appropriate value for each item, and click on button "Save…" to save file "NovoAutoConfig.xml" to a microSD card. The following table describes each setting in details.

Key	Value (example)	Explanation
edition*	CORP or EDU	Edition value. It has to be either CORP or EDU. Refer to Section 1.4 for more details about these two editions.
wifi-ssid	(example_wifi)	Wifi network SSID name
wifi-password	(example_wifi_password)	Wifi network password
settings-password	(example_settings_password)	Password used in Settings Protection

remote-manager-ip-address*	(0.0.0.0)	IP address of the computer Remote Manager runs on
remote-manager-port-number*	20142	The port number used by Remote Manager to listen to device reporting. 20142 is the default port number. You may need to change it to match your Remote Manager's setting.
report-time-interval*	15	The time interval (in seconds) for a NovoPRO device to report its existence to Remote Manager.

Note:

(1) Settings marked with "*" are supported in NovoPRO software release V2.2 and above.

(2) Regarding "remote-manager-port-number", you can change this port number of your Remote Manager via menu "Preference", as illustrated in the figure below.
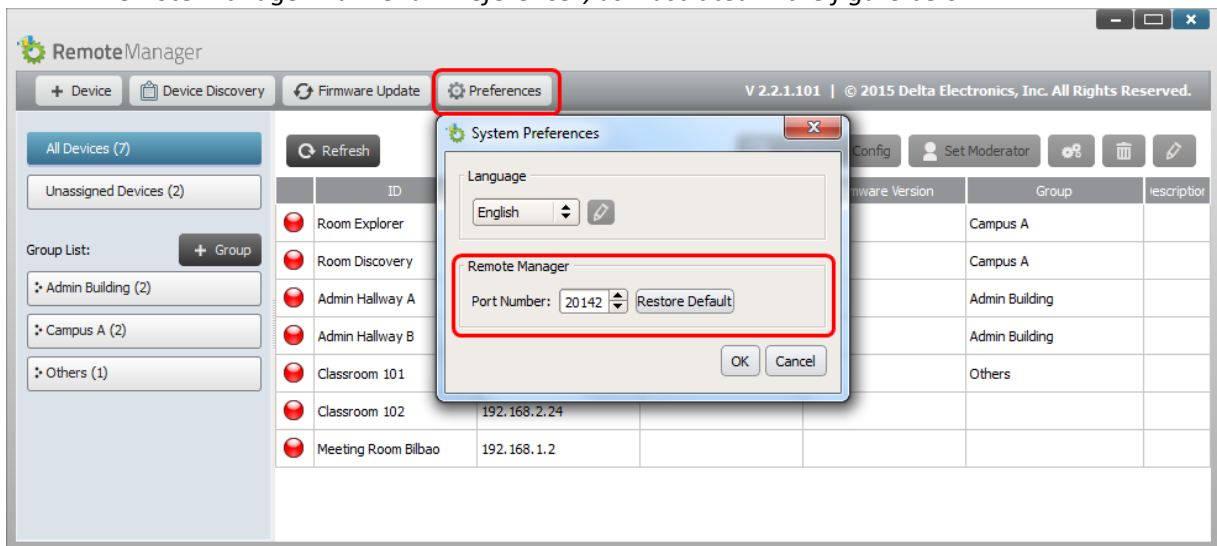
4. An example NovoAutoConfig.xml is as follows:

```xml
<?xml version="1.0" encoding="utf-8"?>
<configuration>
    <NovoPRO>
        <edition>EDU</edition>
        <wifi-ssid>phishnet</wifi-ssid>
        <wifi-password>example_wifi_password</wifi-password>
        <settings-password></settings-password>
        <remote-manager-ip-address>172.18.69.112</remote-manager-ip-address>
        <remote-manager-port-number>20000</remote-manager-port-number>
        <report-time-interval>15</report-time-interval>
    </NovoPRO>
</configuration>
```

Apply the customized NovoPRO settings to a NovoPRO device:

1. Insert the microSD card with NovoAutoConfig.xml file to a NovoPRO device, and then the following pop-up will appear on the home screen of the NovoPRO device. There is a 30-second timeout

window that you can verify the parameters are set with the proper values. Then the device will be configured with those new settings automatically.

2. After the new settings take effect, the NovoPRO device will automatically reports its existence to Remote Manager. You can click on button "Device Discovery" and then button "Discover Devices" to bring up a discovery dialog window, where you will be able to view live NovoPRO devices and add them to the device list of Remote Manager.