Network Deployment Guide for NovoConnect Devices

NovoConnect 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. These include the NovoCast, NovoPro, and NovoEnterprise. For simplicity's sake, the diagrams and examples shown are for the NovoPro device.

To fully take advantage of NovoConnect's capabilities, it should be properly deployed in a school or a corporate network. Some aspects should be carefully considered and planned, for example, Wi-Fi 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 NovoConnect deployment in your network.

1. Network Connection

NovoConnect has three network connection types, Ethernet, Wi-Fi Client, and Wi-Fi Hotspot.

A) **Ethernet** – NovoConnect can be plugged into your Ethernet via its RJ45 port. Namely, you can connect NovoConnect to your organization's backbone network. It is recommended to use an Ethernet connection (when possible) since it gives you better robustness and higher performance.

B) **Wi-Fi** – NovoConnect's built-in 802.11ac Wi-Fi operates at dual bands (2.4/5GHz). With its 2T2R antenna, it can achieve a maximum bandwidth of 300Mbps[1] *(NovoCast currently only support 2.4GHz and has a 1T1R antenna).* This high-performance Wi-Fi module can operate in two modes.

   a) **Client Mode** – NovoConnect can be connected to your organization's Wi-Fi network via its built-in Wi-Fi module.

   b) **Hotspot Mode** – NovoConnect can creates its own Wi-Fi network, allowing users to connect their mobile devices to this ad hoc network.

The following table summarizes their feature differences and typical usage.

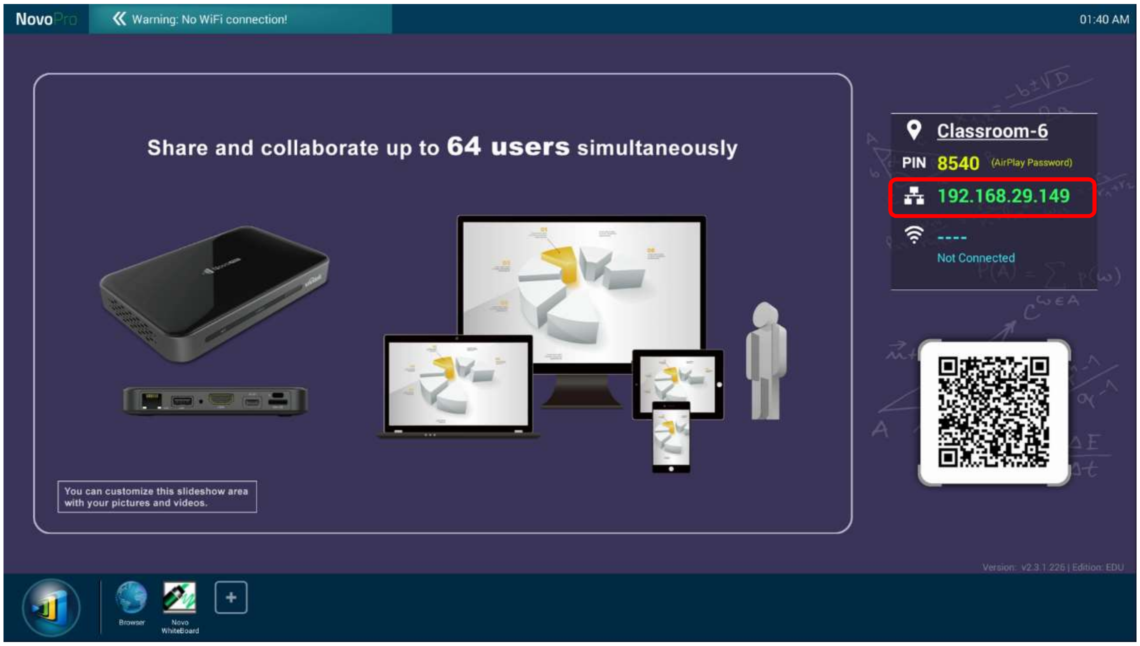
[1] 300Mbps is the maximum value while the actual bandwidth may vary depending on operating environment.

	Ethernet/Wi-Fi Client Mode	Wi-Fi Hotspot Mode
Number of Users Allowed	64 (8 for NovoCast)	8
Internet/Intranet Access	Yes	By default no, but can enable this feature by enabling LAN-Wi-Fi Hotspot routing)
Typical Usage	Pre-configured for School or Corporation	Quick setup for small-group meetings

It is worth mentioning that Ethernet and Wi-Fi connections can coexist on NovoConnect devices. Namely, you can configure NovoConnect devices in Ethernet and Wi-Fi Client mode, or in Ethernet and Wi-Fi Hotspot mode.

1.1. Ethernet

The following homescreen shows the NovoConnect device is in Ethernet mode, where its Ethernet IP Address is highlighted in red.



Warning: No WiFi connection!

Share and collaborate up to 64 users simultaneously

You can customize this slideshow area with your pictures and videos.

Classroom-6

PIN 8540 (AirPlay Password)

192.168.29.149

Not Connected

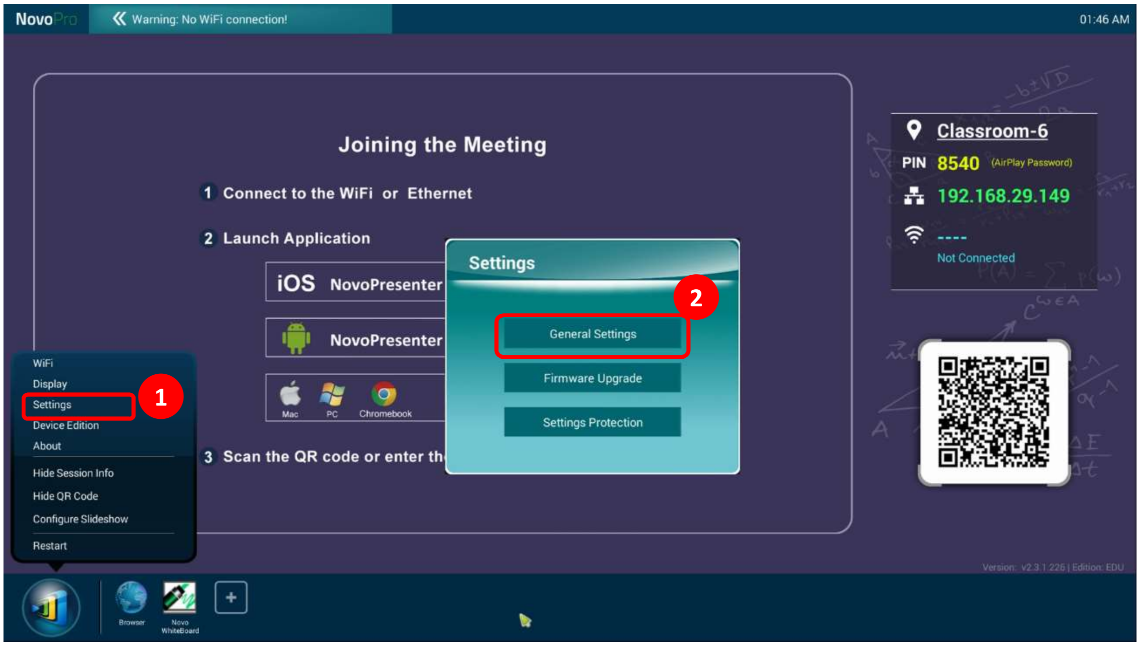
Version: v2.3.1.226 | Edition: EDU

When connecting to a wired network, NovoConnect devices support both DHCP and Static IP connection types.

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

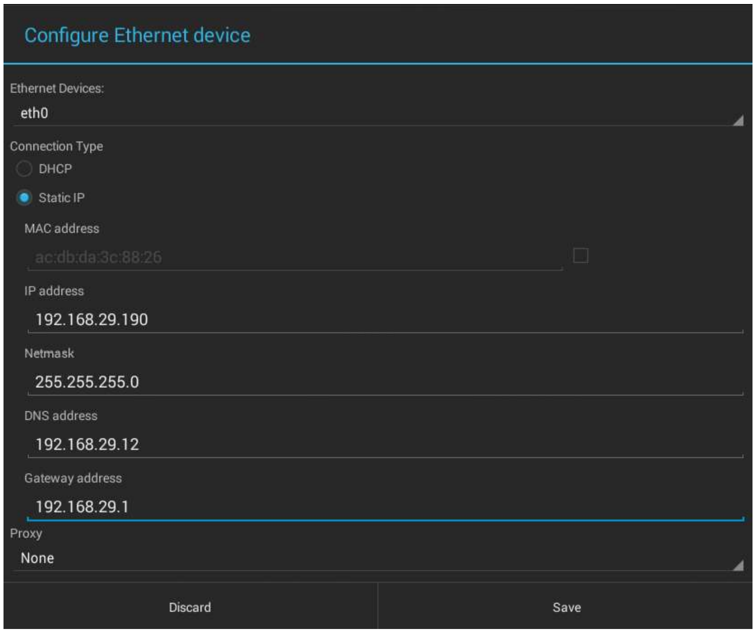
"**DHCP**" is the default connection type. However, "**Static IP**" might be more preferable as it makes remote management much easier.

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.



Configure Ethernet device

Ethernet Devices:
eth0

Connection Type
○ DHCP
● Static IP

MAC address
ac:db:da:3c:88:26 □

IP address
192.168.29.190

Netmask
255.255.255.0

DNS address
192.168.29.12

Gateway address
192.168.29.1

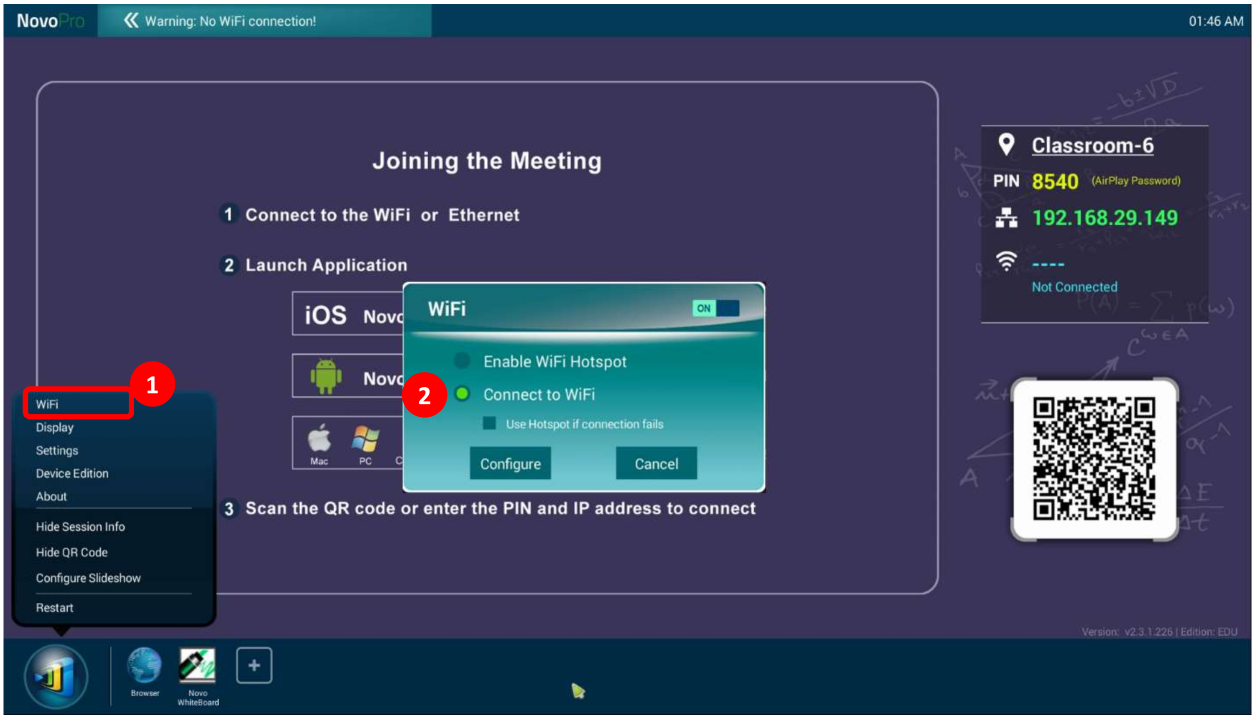
Proxy
None

Discard | Save

1.2. Wi-Fi Client Mode

In this mode, the NovoConnect device functions as a client to join an existing Wi-Fi network. As illustrated in the following diagram, to set up the Wi-Fi connection, on the NovoConnect device homescreen, click on Wi-Fi → Connect to Wi-Fi → 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 an Ethernet connection.



Warning: No WiFi connection!

Joining the Meeting

1 Connect to the WiFi or Ethernet

2 Launch Application

3 Scan the QR code or enter the PIN and IP address to connect

Classroom-6
PIN 8540 (AirPlay Password)
192.168.29.149

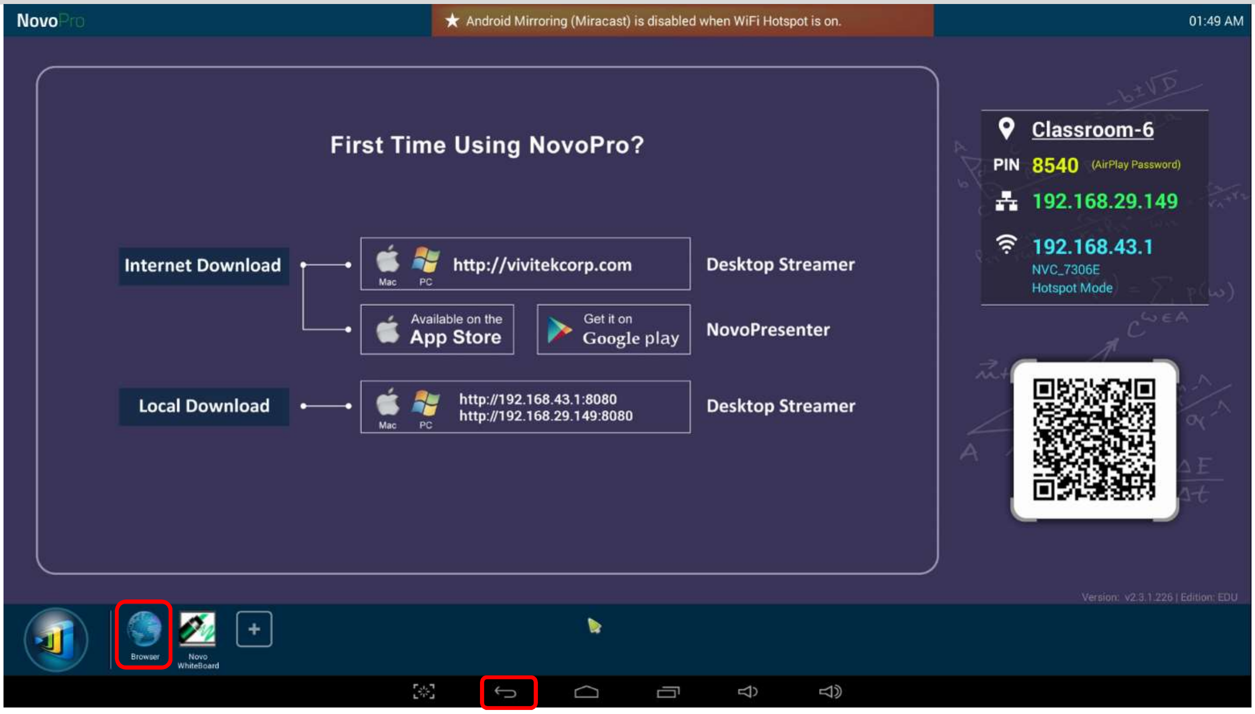
Not Connected

WiFi: ON
○ Enable WiFi Hotspot
● Connect to WiFi
□ Use Hotspot if connection fails

Version: v2.3.1.226 | Edition: EDU

Logging into a Wi-Fi Network via Captive Portal: Some Wi-Fi 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 NovoConnect 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 Wi-Fi network;
B. After the Wi-Fi is connected, click on "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 "Return Back" on the homescreen to return to the NovoConnect device's App main interface.



NovoPro

★ Android Mirroring (Miracast) is disabled when WiFi Hotspot is on.

01:49 AM

First Time Using NovoPro?

Internet Download	http://vivitekcorp.com	Desktop Streamer
	Available on the App Store Get it on Google play	NovoPresenter
Local Download	http://192.168.43.1:8080 http://192.168.29.149:8080	Desktop Streamer

Classroom-6
PIN 8540 (AirPlay Password)
192.168.29.149
192.168.43.1
NVC_7306E
Hotspot Mode

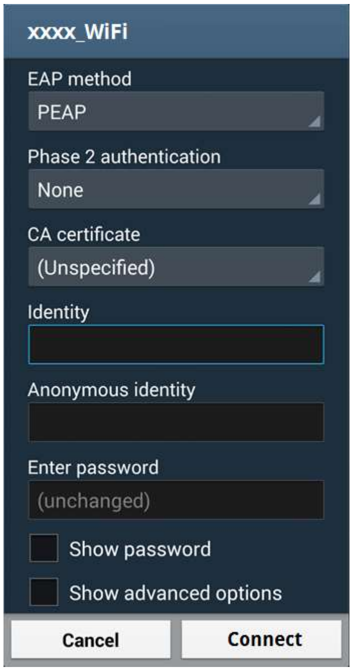
Version: v2.3.1.226 | Edition: EDU

Logging into a Wi-Fi Network with 802.1x Authentication:

When you connect to a Wi-Fi 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 correct 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.



xxxx_WiFi

EAP method: PEAP

Phase 2 authentication: None

CA certificate: (Unspecified)

Identity:

Anonymous identity:

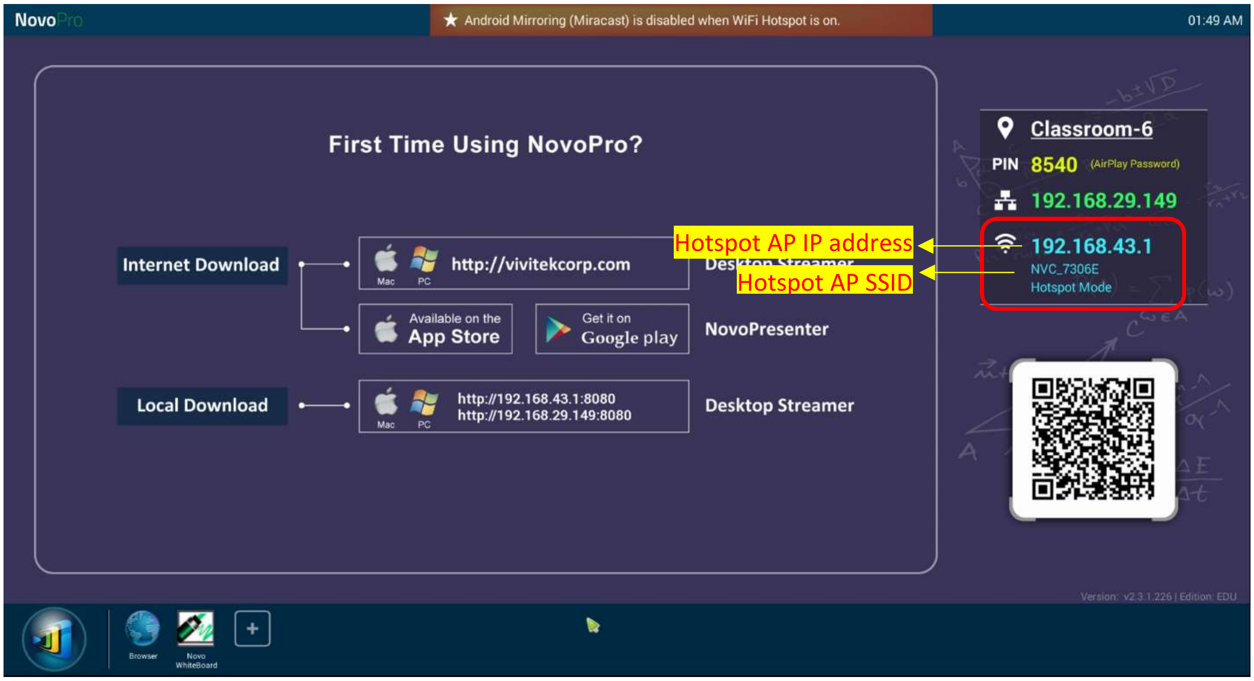
Enter password: (unchanged)

□ Show password

□ Show advanced options

1.3. Wi-Fi Hotspot Mode

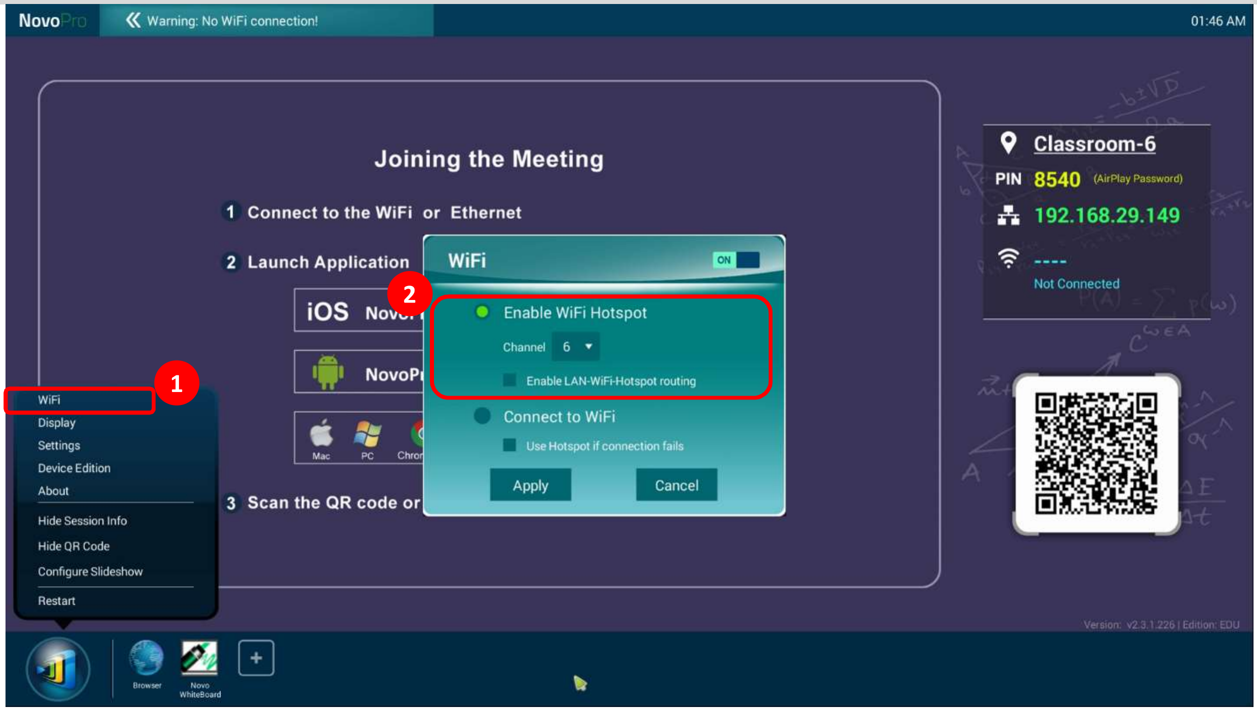
A newly unpacked NovoConnect device starts up in Wi-Fi Hotspot mode, where you can start using it without any entanglement with the network setup. The default SSID for this Wi-Fi Hotspot is “NVC_XXXXX” (for example, “NVC_4DF8F” in the following screenshot), where “XXXXX” is a device-generated text string.



★ Android Mirroring (Miracast) is disabled when WiFi Hotspot is on.

One 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-Wi-Fi-Hotspot routing” gives you the option to either keep LAN and Wi-Fi Hotspot completely isolated, or, allow Wi-Fi Hotspot to piggyback to the LAN for Internet access.



Warning: No WiFi connection!

Joining the Meeting

1 Connect to the WiFi or Ethernet

2 Launch Application

3 Scan the QR code or

WiFi ON

● Enable WiFi Hotspot

Channel 6

☐ Enable LAN-WiFi-Hotspot routing

○ Connect to WiFi

☐ Use Hotspot if connection fails

Classroom-6

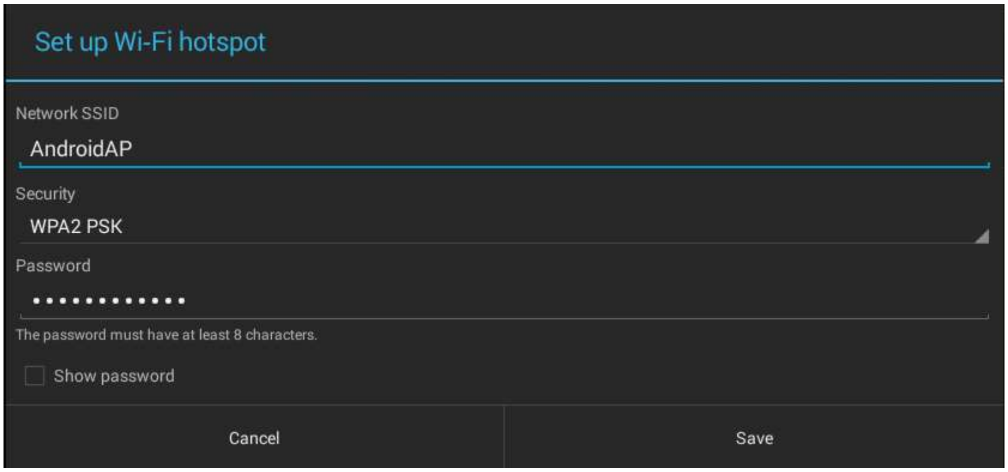
PIN 8540 (AirPlay Password)

192.168.29.149

Not Connected

Version: v2.3.1.226 | Edition: EDU

In addition, you can rename the Wi-Fi Hotspot SSID and change its security settings (security protocol and its password.) To do so, click on Settings → General Settings → More → Tethering & portable hotspot. Then the following "Set up Wi-Fi hotspot" window pops up to allow you to make the necessary changes.



Set up Wi-Fi hotspot

Network SSID

AndroidAP

Security

WPA2 PSK

Password

••••••••••••

The password must have at least 8 characters.

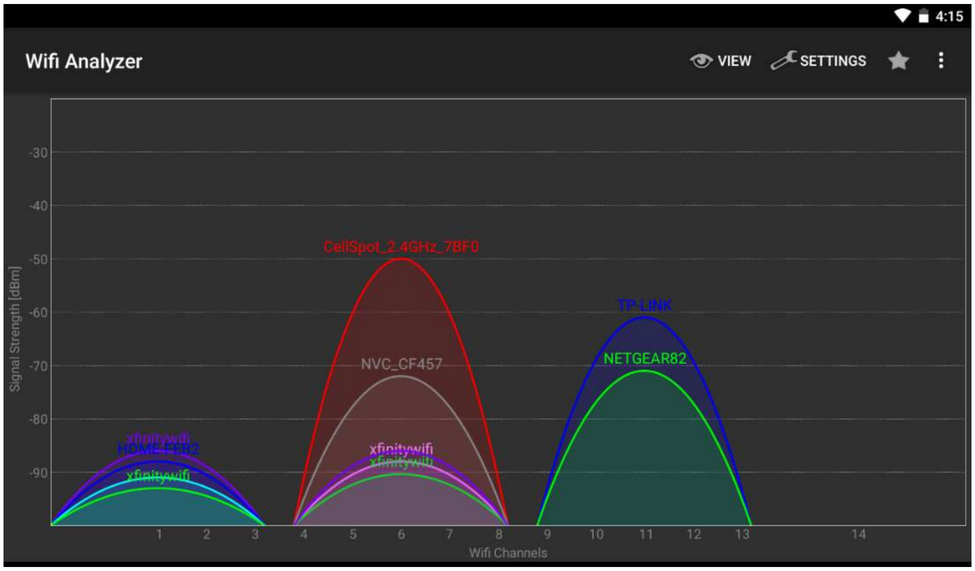
☐ Show password

1.4. Wi-Fi Network Optimization

One of the most common issues users run into when using a NovoConnect device is a loss of connection, which is likely caused by an unstable Wi-Fi connection. Maintaining a stable Wi-Fi connection is always a challenge due to the plain fact that it is wireless, subject to noise interference and the physical environment. To keep a good connection, you should follow some generic Wi-Fi setup guidelines, such as

1) Do not place a NovoConnect device next to electric noise sources, such as an electric fan or power supplies. Especially when you attach a NovoConnect device next to a projector or an LCD monitor, you need to keep an eye on these potential "pollution" sources.
2) Make sure you do not place a NovoConnect device behind metal frames/bars, etc. Metal will greatly degrade Wi-Fi signal strength.
3) NovoConnect device's hotspot mode supports devices within 30 meters (100 feet). If you have an external router, it is recommended to use the NovoConnect device's Wi-Fi 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 Wi-Fi spectrum is. Two popular Apps can give you a very good view of the Wi-Fi spectrum.
    - "Wi-Fi Analyzer" on Android devices;
    - "InSSIDer" tool on Windows OS.

    If too many Wi-Fi 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 the "Wi-Fi Analyzer" App. As you can see, Wi-Fi channel 6 is heavily utilized. You may want to change one or some of them to other less-crowded channels.



1.5. Dual-network Configuration

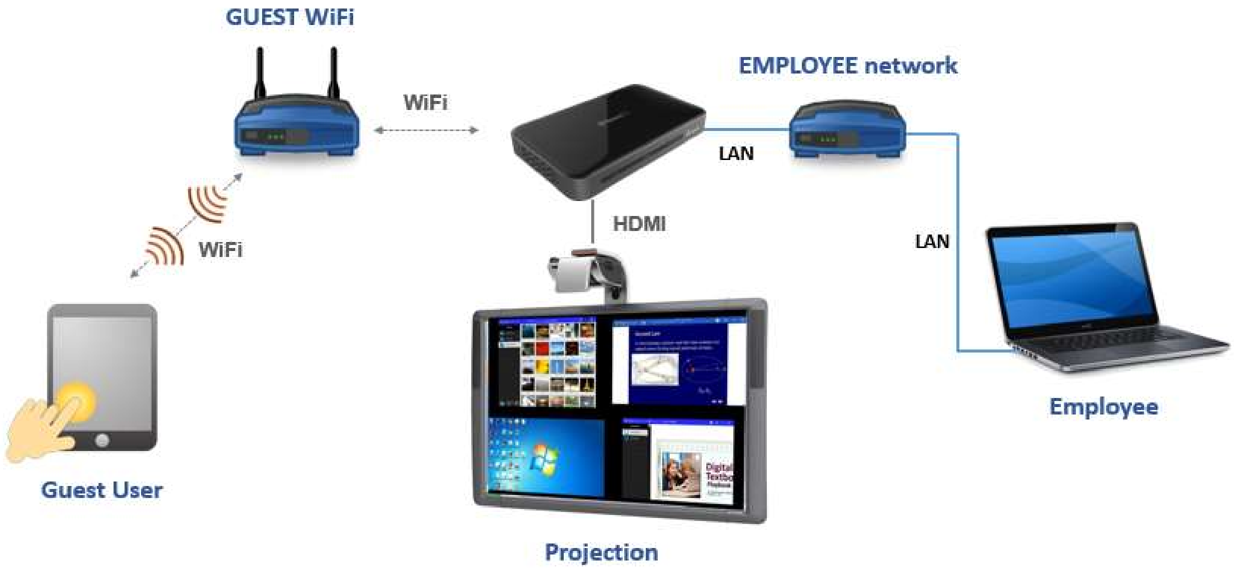
NovoConnect devices can even be set up to support dual networks:

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

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

Ethernet & Wi-Fi client mode

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

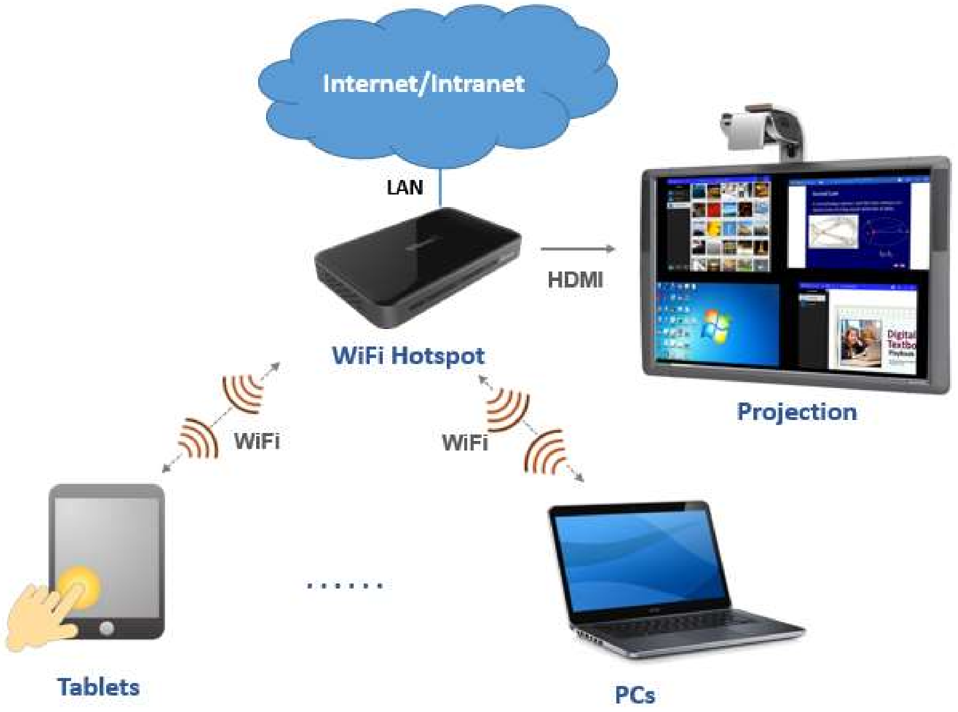


By doing so, the GUEST and EMPLOYEE networks are kept separate, while at the same time, the NovoConnect device is available to both guest users and employees.

Notes on Network Security: Within a NovoConnect device, the Wi-Fi section is completely separated from the Ethernet section, namely, there is NO network routing between these two sections. Therefore, users connecting to the Wi-Fi 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 & Wi-Fi hotspot mode

In this case, the NovoConnect device's RJ45 port is connected to a wired network connecting to the internet/intranet; at the same time, the NovoConnect device is also running in Wi-Fi 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 Wi-Fi Hotspot. Once you enable this routing feature, devices on the Wi-Fi 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's IT administrators to avoid compromising your network security.*
2) *Wi-Fi Hotspot by default is an open network. It is strongly recommended that you change it to a secure Wi-Fi network.*

2. Port Numbers and Intranet Firewall

NovoConnect devices are TCP/IP-network-based devices, and the communications between a NovoConnect 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 NovoConnect devices.

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 **8443**	TCP	IN	Port for local Desktop Streamer application download page
20121	TCP	IN	Port to transfer commands and status reports between the NovoConnect unit and users' devices (For example, laptops/tablets use this port to establish "connection" to the NovoConnect 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 NovoConnect unit can be discoverable by laptops/tablets.)
20125	TCP	IN	Port to transfer preview image
20126	TCP	IN	Port to transfer AV-streaming's command data
20127	TCP	IN	Port to transfer AV-streaming's video data
20128	TCP	IN	Port to transfer AV-streaming's audio data
20129	TCP	IN	Port to transfer Voting/Polling data
20130	TCP	IN	Port for video streaming service
20131	TCP	IN	Port for file transfer service
20140	TCP	IN	Port for mouse streaming
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 NovoConnect device, these ports should not be blocked by your network's firewall.

For NovoEnterprise, a screen-mirror application called NT LiveReceiver is available. This feature displays content from a NovoTouch running the NT LiveScreen application. In order for this feature to work properly, the following ports need to be open.

20200	TCP	IN	Port for connection on RTSP over multicast
20202	UDP	OUT	Port for video streaming on RTSP over multicast
20203	UDP	OUT	Port for video/RTCP on RTSP over multicast
20206	UDP	OUT	Port for audio streaming on RTSP over multicast
20207	UDP	OUT	Port for audio/RTCP on RTSP over multicast
20300	TCP	IN/OUT	Port for connection and streaming for Novo/TCP (NT LiveScreen)

3. Enabling AirPlay Mirroring Across Subnets/VLANs

NovoConnect devices 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 the mirroring service from a NovoConnect device 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 reside. It does not relay traffic between subnets/VLANs. Instead, it merely provides a lookup mechanism.
- An mDNS proxy can be deployed in an existing network without changing the network architecture. It does not change security zoning, nor create a bottleneck for network traffic. It is a simple way to facilitate AirPlay mirroring in a business or education network.

Open-source software ***Avahi*** is such an mDNS proxy. For more information on how to setup the Avahi service, please refer to the application note “Enabling iOS Mirroring in a Multiple-subnet Environment” available on NovoPro’s webpage (http://novopro.vivitekusa.com).

Application Notes Enabling iOS Mirroring in a Multiple-subnet Environment 768KB

4. Quality of Service

Bandwidth requirement for a smooth user experience with NovoConnect devices 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: 12mbps Max: 16mbps
720p	Video Playback Mode	Ave: 320kbps Max: 500kbps	Ave: 1.2mbps Max: 1.5mbps	Ave: 5.5mbps Max: 7.5mbps	Ave: 12mbps Max: 16mbps
1080p	Presentation Mode	Ave: 200kbps Max: 300kbps	Ave: 1.4mbps Max: 1.7mbps	Ave: 6.1mbps Max: 7.7mbps	Ave: 12mbps Max: 16mbps
1080p	Video Playback Mode	Ave: 350kbps Max: 500kbps	Ave: 1.8mbps Max: 2.2mbps	Ave: 5.8mbps Max: 7.2mbps	Ave: 12mbps Max: 16mbps

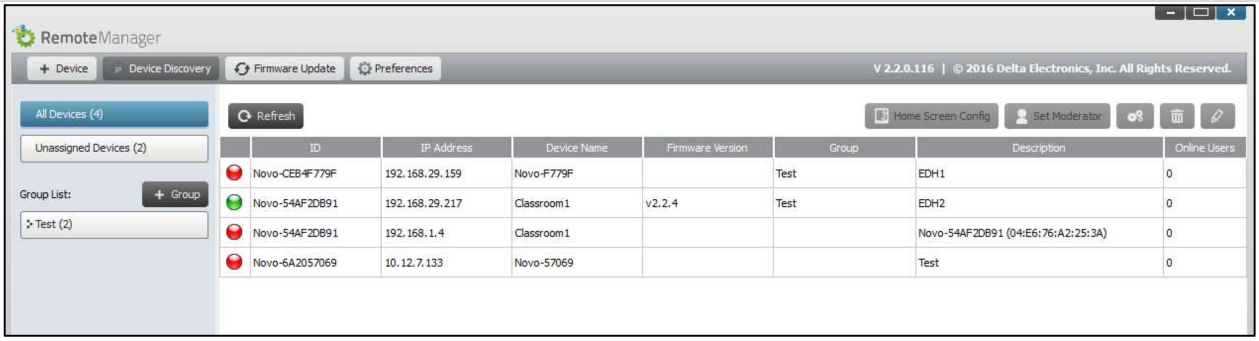
In general, 2mbps is good for “Presentation” mode while 4~8mbps is sufficient for “Video Playback” mode.

- **Wi-Fi:** NovoConnect devices have a high-performance Wi-Fi module (802.11ac with 2T2R). So typically, a NovoConnect device 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 possible.

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

5. Managing Multiple NovoConnect Devices Remotely

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



	ID	IP Address	Device Name	Firmware Version	Group	Description	Online Users
●	Novo-CEB4F779F	192.168.29.159	Novo-F779F		Test	EDH1	0
●	Novo-54AF2DB91	192.168.29.217	Classroom1	v2.2.4	Test	EDH2	0
●	Novo-54AF2DB91	192.168.1.4	Classroom1			Novo-54AF2DB91 (04:E6:76:A2:25:3A)	0
●	Novo-6A2057069	10.12.7.133	Novo-57069			Test	0

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;

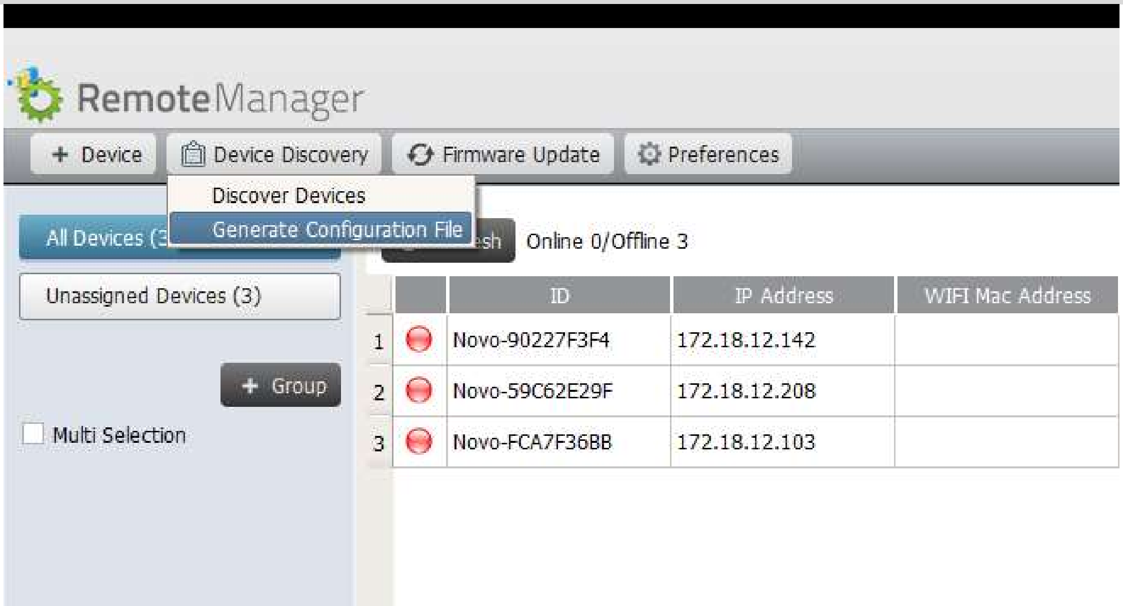
Please refer to the section 4.3 "Remote Manager" of the "NovoPro User Manual" available on NovoPro's webpage (http://novopro.vivitekusa.com) for details.

5.1. Adding NovoConnect devices via Auto Discovery

Before remotely managing a NovoConnect device, it has to be added into the device list of Remote Manager. This can be done manually or via auto discovery. Especially for organizations that deploy a great deal of NovoConnect 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 NovoConnect's settings via a microSD card.

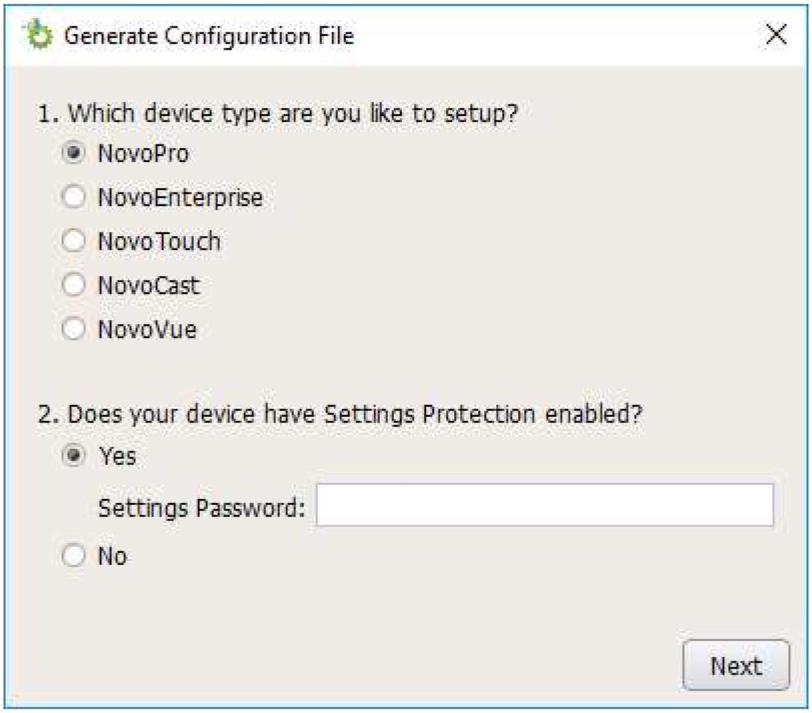
Use the Remote Manager tool to generate a "NovoAutoConfig.xml" configuration file

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



		ID	IP Address	WIFI Mac Address
1	●	Novo-90227F3F4	172.18.12.142	
2	●	Novo-59C62E29F	172.18.12.208	
3	●	Novo-FCA7F36BB	172.18.12.103	

3. Select the appropriate NovoConnect Device that you would like to set up and whether or not Password Protection has been enabled then click next.



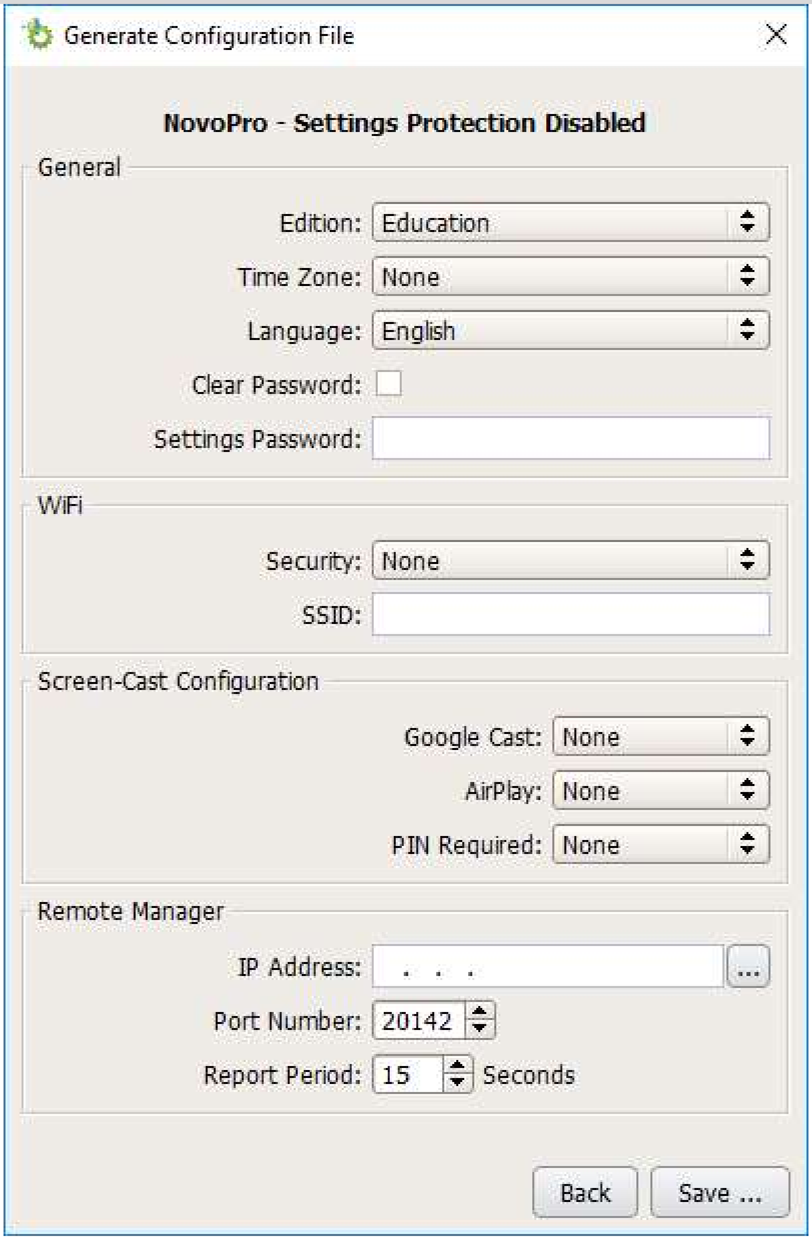
1. Which device type are you like to setup?

● NovoPro
○ NovoEnterprise
○ NovoTouch
○ NovoCast
○ NovoVue

2. Does your device have Settings Protection enabled?

● Yes
Settings Password:
○ No

4. The following window will appear and you need to work with your organization’s IT staff to obtain the appropriate values for each item, and click on “Save…” to save file “NovoAutoConfig.xml” to a microSD card.



Generate Configuration File

NovoPro - Settings Protection Disabled

General

Edition: Education

Time Zone: None

Language: English

Clear Password: □

Settings Password:

WiFi

Security: None

SSID:

Screen-Cast Configuration

Google Cast: None

AirPlay: None

PIN Required: None

Remote Manager

IP Address: . . .

Port Number: 20142

Report Period: 15 Seconds

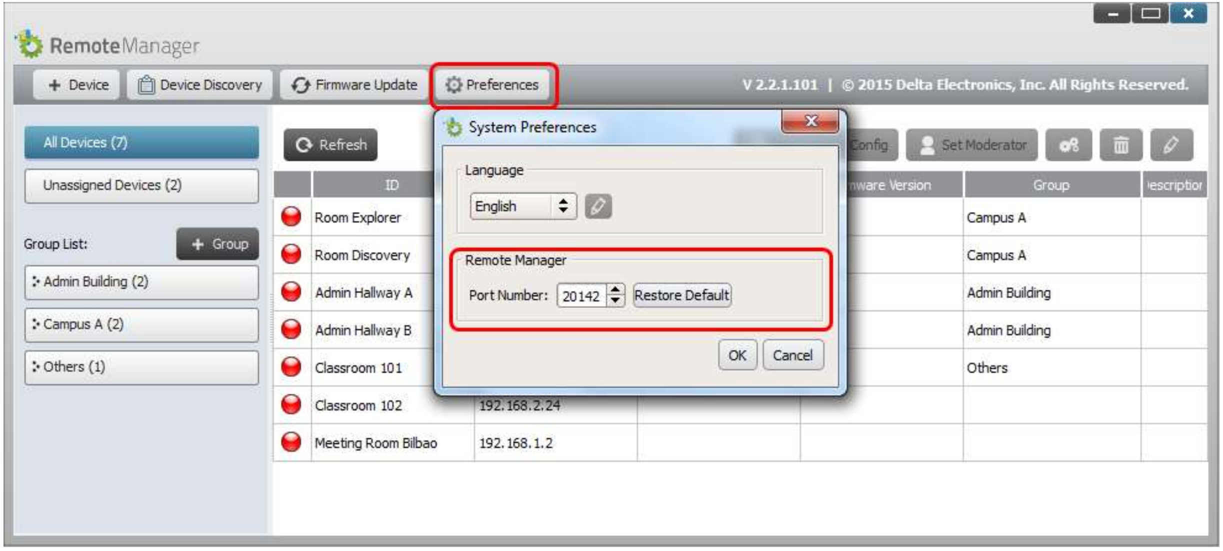
5. The following table describes each setting in details.

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.
Time Zone*	Current Time Zone in designated Region	
Wi-Fi-ssid	(example_Wi-Fi)	Wi-Fi network SSID name
Wi-Fi-password	(example_Wi-Fi_password)	Wi-Fi network password
settings-password	(example_settings_password)	Password used in Settings Protection
Screen Cast Configuration*	(Enabled or Disabled)	Enable or Disable Airplay and Google Cast
PIN Required*	(Enabled or Disabled)	Enable or Disable PIN Requirement

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 NovoConnect device to report its existence to Remote Manager.

Note:

1. *Settings marked with "*" are supported in NovoConnect 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.*



System Preferences

Language: English

Remote Manager

Port Number: 20142

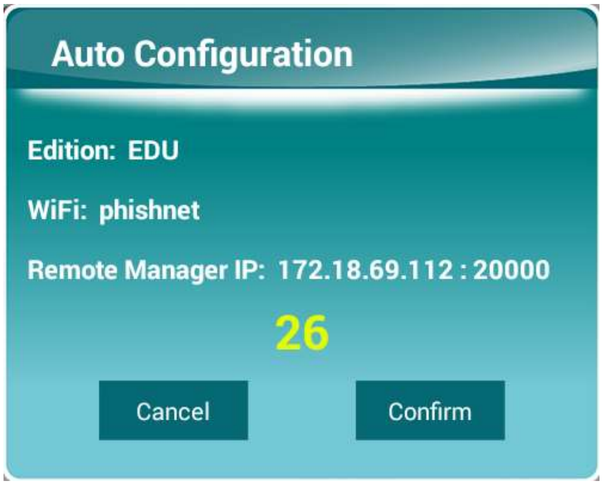
ID		ware Version	Group	escriptior
Room Explorer			Campus A	
Room Discovery			Campus A	
Admin Hallway A			Admin Building	
Admin Hallway B			Admin Building	
Classroom 101			Others	
Classroom 102	192.168.2.24			
Meeting Room Bilbao	192.168.1.2			

6. An example of a NovoAutoConfig.xml file is as follows:

```
▼<configuration>
  ▼<NovoPRO>
     <edition>EDU</edition>
     <wifi-ssid>Delta-Guest</wifi-ssid>
     <wifi-password>DeltaTest</wifi-password>
     <wifi-identity/>
     <settings-password/>
     <pincode-required>disable</pincode-required>
     <enableGoogleCast>true</enableGoogleCast>
     <enableAirplay>true</enableAirplay>
     <remote-manager-ip-address>172.18.13.188</remote-manager-ip-address>
     <remote-manager-port-number>20142</remote-manager-port-number>
     <report-time-interval>15</report-time-interval>
     <timezone>America/Los_Angeles</timezone>
     <language>0</language>
   </NovoPRO>
 </configuration>
```

Apply the customized NovoConnect settings to a NovoConnect device:

1. Insert the microSD card with NovoAutoConfig.xml file to a NovoConnect device, and then the following pop-up will appear on the home screen of the NovoConnect device. There is a 30-second timeout window so you can verify the parameters are set with the proper values. Then the device will be configured with those new settings automatically.



Auto Configuration

Edition: EDU

WiFi: phishnet

Remote Manager IP: 172.18.69.112 : 20000

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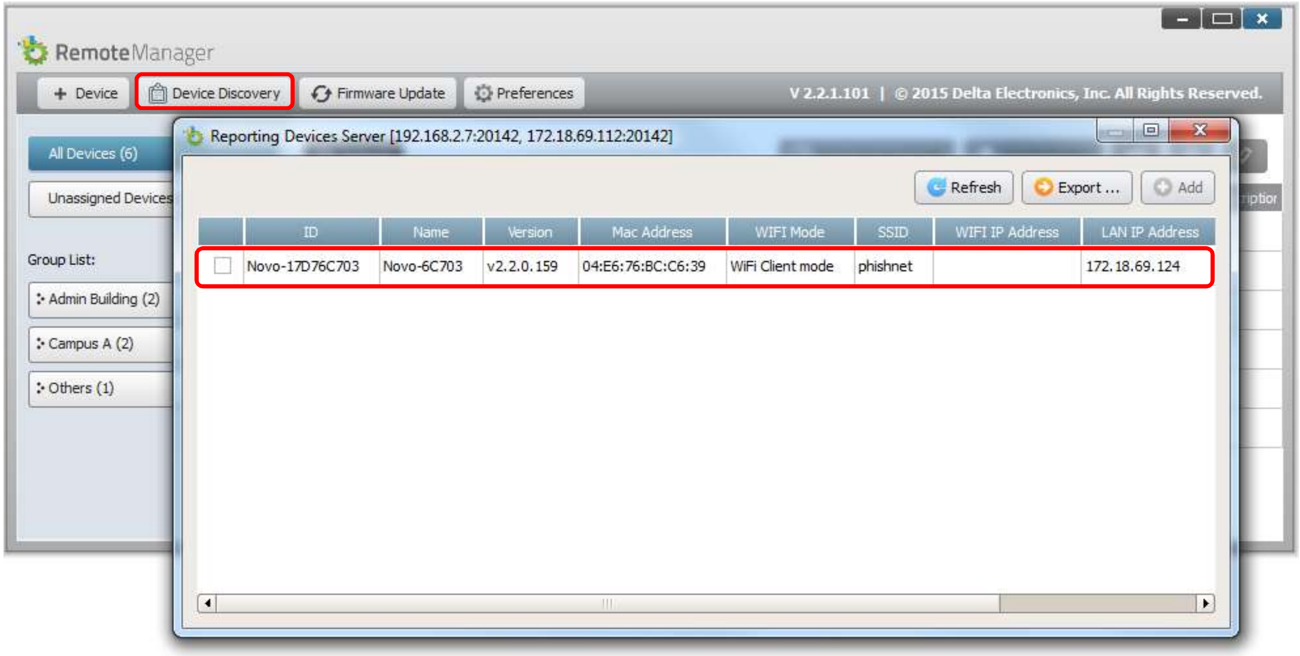
2. After the new settings take effect, the NovoConnect device will automatically report its existence to the Remote Manager. You can click on "Device Discovery" and then "Discover Devices" to bring up a discovery dialog window where you will be able to view live NovoConnect devices and add them to the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



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Reporting Devices Server [192.168.2.7:20142, 172.18.69.112:20142]

	ID	Name	Version	Mac Address	WIFI Mode	SSID	WIFI IP Address	LAN IP Address
□	Novo-17D76C703	Novo-6C703	v2.2.0.159	04:E6:76:BC:C6:39	WiFi Client mode	phishnet		172.18.69.124

Thank you for choosing NovoConnect products as your collaboration solution.