Enabling iOS Mirroring in a Multiple-subnet Environment

NovoPRO has the capability to mirror users' iPad/iPhone screens (true iOS mirroring). However, due to the fact that iOS mirroring is mainly designed for simple wired/WiFi networks, additional configuration might be needed to enable this feature in an enterprise or campus network.

This whitepaper provides such a solution in details, describing how to deploy NovoPRO in a multiple-subnet network environment. An open-source based and light-weight gateway solution is introduced to effectively resolve this problem.

Technical Explanation

Apple's iOS mirroring technology relies on Bonjour which is Apple's implementation of "zero config" networking. Bonjour enables the automatic discovery of services on the network. For example, an Apple TV advertises itself as being able to receive iOS mirroring streams. An iPad that is looking for iOS mirroring receivers would use Bonjour to discover the Apple TV and present it to the user as an iOS mirroring destination. Both the Apple TV and iPad do all this without any user intervention or configuration.

The above scenario is perfect, but in reality Bonjour service will break down if the Apple TV and iPad are not in the same Layer 2 domain/VLAN. This is because the service discovery mechanism of Bonjour uses link-local scope multicast. These packets will not cross Layer 3 boundaries (different VLANs for example) in the network.

The same failure will happen when a NovoPRO based collaboration solution is deployed at education institutions or enterprises. A NovoPRO device always opens its iOS mirroring service after booting up, but iPad devices sitting on another subnet or VLAN cannot discover such a service from the NovoPRO. Therefore, remote mirroring function cannot be implemented (as illustrated below).
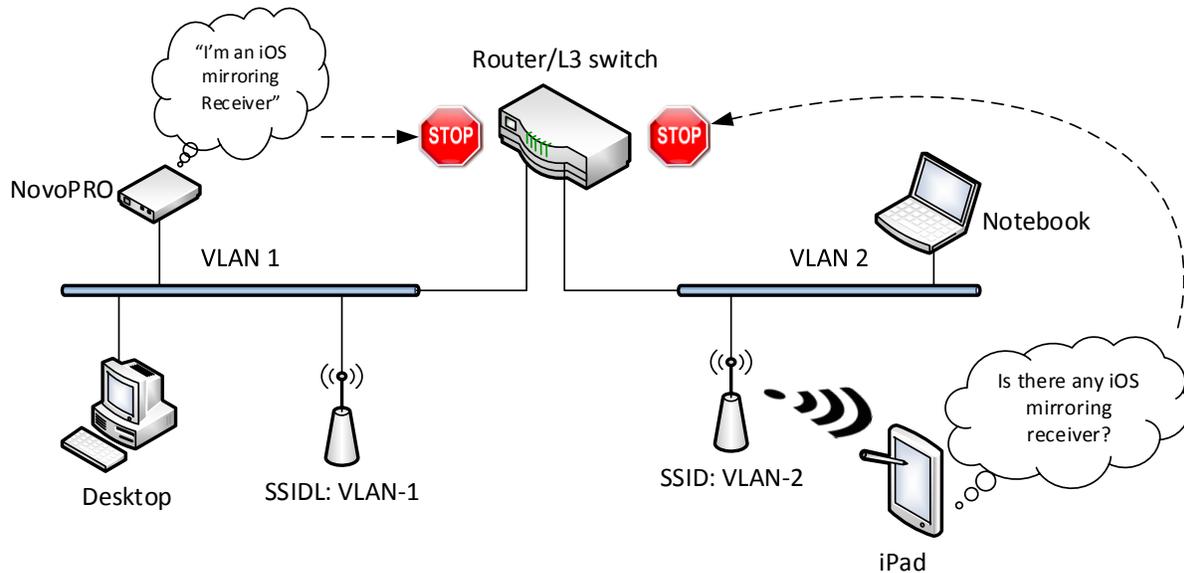
Bonjour Proxy Solution - Avahi

To make Bonjour working across subnets, a Bonjour proxy has to be added in and it can take the service announcements on one subnet and announce them on the other subnets. Bonjour service discovery works just like DNS, and it is actually using multicast DNS (mDNS). The mDNS proxy is such a device with multiple network interfaces, and each interface connects to one subnet/VLAN where iOS mirroring clients or servers live. It does not have to relay traffic between the subnets/VLANs, and it's merely the lookup mechanism. So mDNS proxy can be deployed in the network without changing the network architecture. It also does nothing to change security zoning, doesn't affect the resiliency of the network and doesn't create a bottleneck for network traffic. It's a very simple way to address the need for iOS mirroring in a business or education network.

The software being used as a mDNS proxy is called **Avahi**. It is an open source software for service discovery and mDNS services, and can be used to advertise the services from NovoPRO devices.

NovoPRO
(192.168.29.217)

Router/L3 switch

Notebook

VLAN 1
(192.168.29.0/24)

VLAN 2
(192.168.1.0/24)

eth0

wlan0

Desktop

((•))

SSID: VLAN-2

Avahi Proxy

iPad
(192.168.1.4)

SSIDL: VLAN-1

Is there any iOS mirroring receiver?

It is at 192.168.29.217
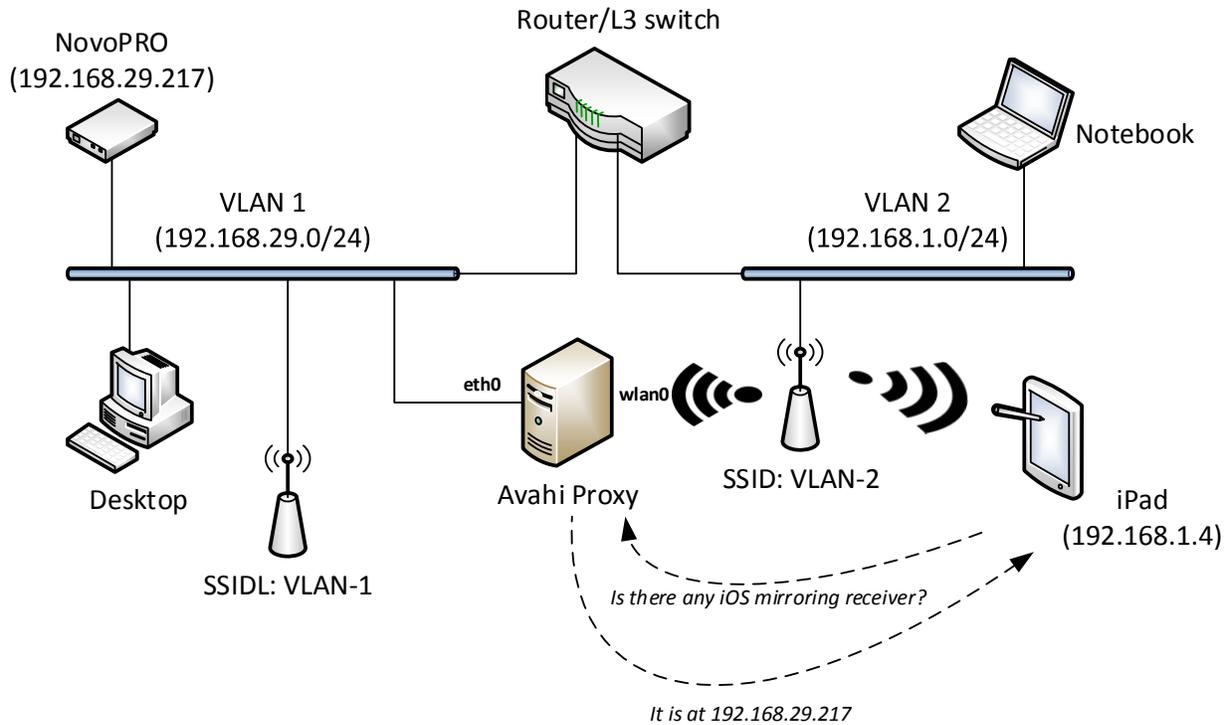
Avahi Setup

Please follow the following steps to setup Avahi:

1. Get a Desktop or Server machine with multiple network interfaces, and each interface connects to one subnet where iOS mirroring clients or servers live.

2. Obtain the Ubuntu server or desktop edition from the following link:

   - http://www.ubuntu.com/download/desktop (desktop) or
   - http://www.ubuntu.com/download/server (server)

3. Boot the machine using the above ISO image, and follow the onscreen instructions in order to install the Ubuntu software onto your device.
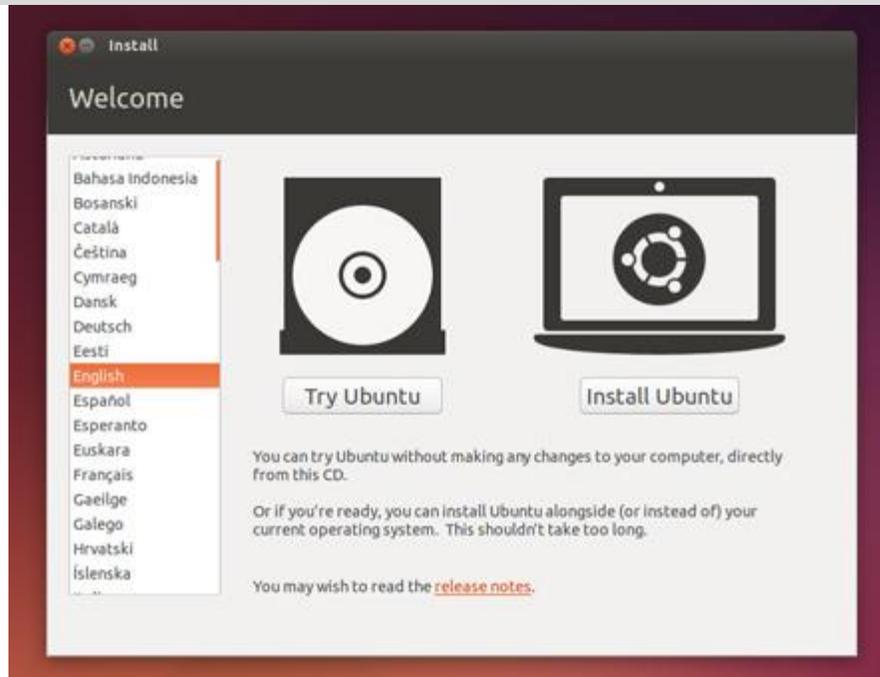
Note: Ubuntu Desktop is used as the example OS of this document.

4. Launch Terminal application, issue "ifconfig" command to confirm the device has network connectivity to each subnet/VLAN.

```
ubuntu@ubuntu:~$ ifconfig
eth0      Link encap:Ethernet   HWaddr 60:eb:69:96:84:2e
          inet addr:192.168.29.121  Bcast:192.168.29.255  Mask:255.255.255.0
          inet6 addr: fe80::62eb:69ff:fe96:842e/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:2607 errors:0 dropped:0 overruns:0 frame:0
          TX packets:1779 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:441295 (441.2 KB)  TX bytes:286894 (286.8 KB)
          Interrupt:16

wlan0     Link encap:Ethernet   HWaddr 00:26:c7:ec:45:82
          inet addr:192.168.1.3  Bcast:192.168.1.255  Mask:255.255.255.0
          inet6 addr: fe80::226:c7ff:feec:4582/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:795 errors:0 dropped:0 overruns:0 frame:0
          TX packets:359 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:156264 (156.2 KB)  TX bytes:148139 (148.1 KB)
```

In the above example, there are two network connections: a LAN connection and a WLAN connection. They are on different subnets 192.168.1.0/24 and 192.168.29.0/24 respectively.

5. Add the Avahi daemon package to the OS via the following command, if it does not come with the OS installation.

```
ubuntu@ubuntu:~$ sudo apt-get install avahi-daemon
```

6. Edit the Avahi configuration file, and enable the reflector functionality in the Avahi daemon.

```
ubuntu@ubuntu:~$ sudo vi /etc/avahi/avachi-daemon.conf
```

7. Within the configuration file, change the "`enable-reflector`" option under "`reflector`" section to "`yes`", and add all allowed interfaces to "`allow-interfaces`" option under "`server`" section.

```
[server]
allow-interfaces=eth0,wlan0

[reflector]
enable-reflector=yes
```

8. Restart Avahi service.

```
ubuntu@ubuntu:~$ sudo /etc/init.d/avahi-daemon restart
```

9. List the current Bonjour capable devices on all subnets/VLANs connected to the proxy using "`avahibrowse –all –t`" command:

```
ubuntu@ubuntu:~$ avahibrowse –all -t

+   wlan0 IPv4 Novo-71AC0                    _iOS mirroring._tcp
local
+    eth0 IPv4 Novo-71AC0                    _iOS mirroring._tcp
local
```

Troubleshoot Bonjour Service

In order to troubleshoot Bonjour connectivity issues, a free iPhone or iPad application "Bonjour Browser" can be downloaded from Apple's App Store. It is useful in viewing available devices. In this example, an iOS mirroring capable NovoPRO device is found here:
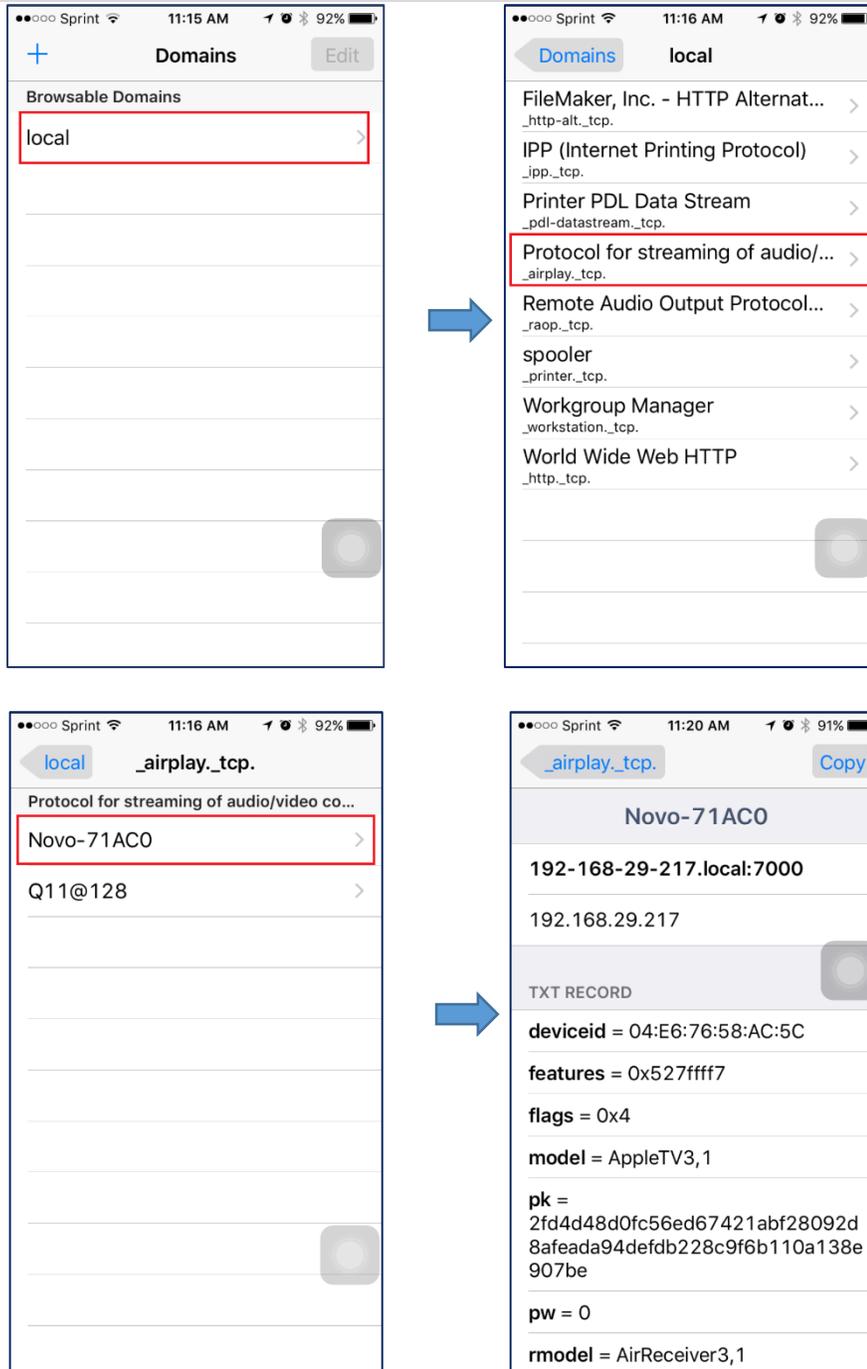
Security Consideration

The desktop or server machine equipped with Avahi service can be thought as a network device when it is deployed into an enterprise or education institution network. So please consult the IT manager to make sure it complies with the existing IT regulation. In addition, as a network device, the desktop or server machine should be carefully checked to make sure only Avahi service is

opened for usage and unused services and ports are all closed. The desktop or server machine should be also applied the latest OS patches to make sure it is secure and robust.