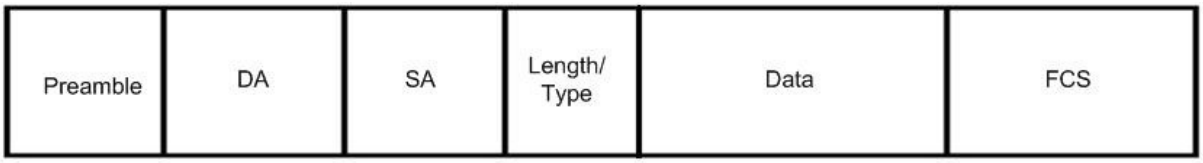
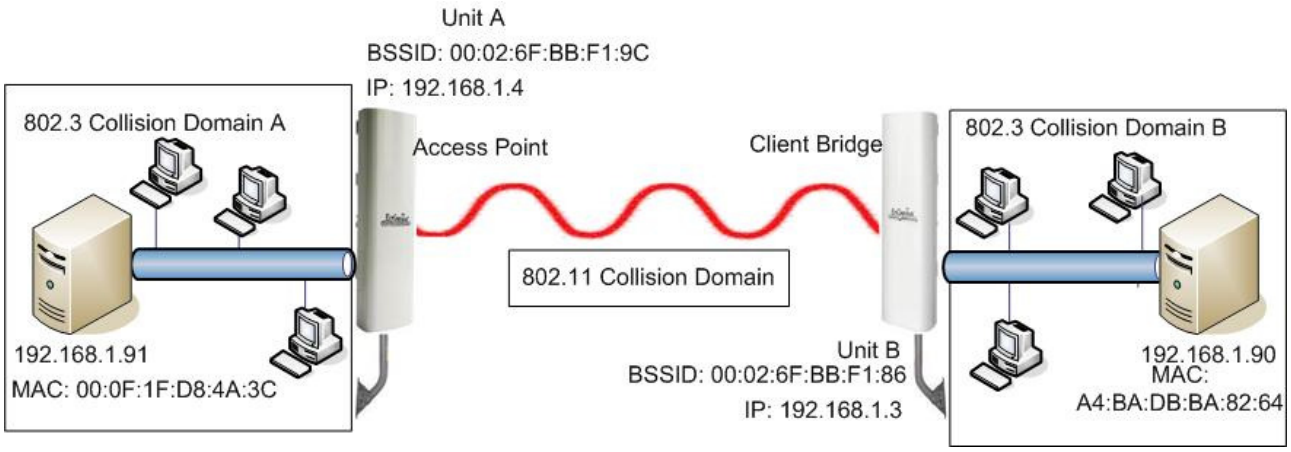
Layer 2.5 Bridging & Transparent Bridging

Our products in Client Bridge mode perform a function called Layer 2.5 Bridging. This feature is also called ARP-NAT from other vendors. The Engenius device acting as a Clint Bridge (CB) inserts it's BSSID as the source for all but a few instances, such as the DHCP discovery broadcast from the wired node behind the CB. Below is a simplification of an Ethernet II frame showing which field from the perspective of the wired node on the AP side would be changed. As you can see if it the Source address field.



Here is the network topography of the AP to CB connection. Note the unit letters and the layer two and three addressing supplied.



Lets see what occurs from 192.168.1.91 prospective when 192.168.1.90 is pinged from 192.168.1.91 when the EnGenius unit A is in AP mode and unit B is in CB mode.

1	0.000000	WwPcbaTe_d8:4a:3c	Broadcast	ARP	42 Who has 192.168.1.90? Tell 192.168.1.91
2	0.004234	SenaoInt_bb:f1:86	WwPcbaTe_d8:4a:3c	ARP	60 192.168.1.90 is at 00:02:6f:bb:f1:86
3	0.004240	192.168.1.91	192.168.1.90	ICMP	74 Echo (ping) request id=0x0200, seq=28675/880, ttl=128
4	0.006840	192.168.1.90	192.168.1.91	ICMP	74 Echo (ping) reply id=0x0200, seq=28675/880, ttl=128

Now lets examine each frame number starting at #1.

As you can see this is an ARP request. It's destination layer 2 address is the entire broadcast domain and it's layer two source address is it's wired NIC card. As you can see it knows the destination's IP address (layer 3), but not the 192.168.1.90's MAC address.

```
⊞ Frame 1: 42 bytes on wire (336 bits), 42 bytes captured (336 bits)
⊟ Ethernet II, Src: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  ⊞ Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  ⊞ Source: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
    Type: ARP (0x0806)
⊟ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IP (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    [Is gratuitous: False]
    Sender MAC address: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
    Sender IP address: 192.168.1.91 (192.168.1.91)
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.90 (192.168.1.90)
```

Layer 2 addressing

Layer 2&3 addressing

Below is a reply to the request.

```
⊞ Frame 2: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
⊟ Ethernet II, Src: SenaoInt_bb:f1:86 (00:02:6f:bb:f1:86), Dst: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
  ⊞ Destination: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
  ⊞ Source: SenaoInt_bb:f1:86 (00:02:6f:bb:f1:86)
    Type: ARP (0x0806)
    Trailer: 00000000000000000000000000000000000000
⊟ Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IP (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    [Is gratuitous: False]
    Sender MAC address: SenaoInt_bb:f1:86 (00:02:6f:bb:f1:86)
    Sender IP address: 192.168.1.90 (192.168.1.90)
    Target MAC address: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
    Target IP address: 192.168.1.91 (192.168.1.91)
```

Layer 2 addressing

Layer 2 & 3 addressing

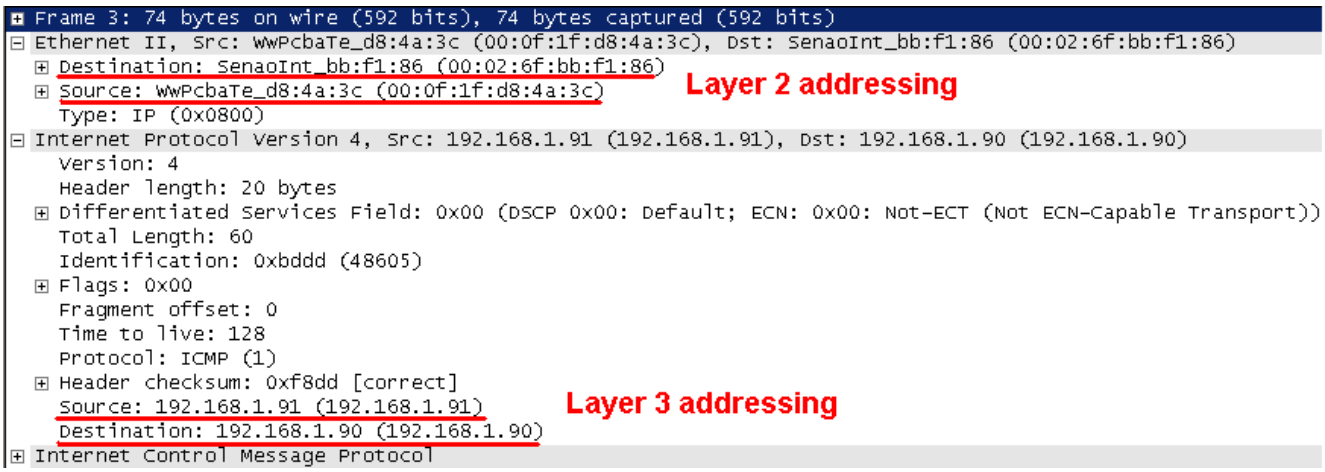
As you can see here the Engenius device stepped in and responded to the ARP request on behalf of 192.168.1.90. Note the layer 2 address that 192.168.1.91 is going to place in it's ARP table for 192.168.1.90. That layer 2 address is the BSSID of the Engenius unit B in CB mode. This is also going to be shown with an ICMP ping request and reply.

Main **Unit B**

System Information

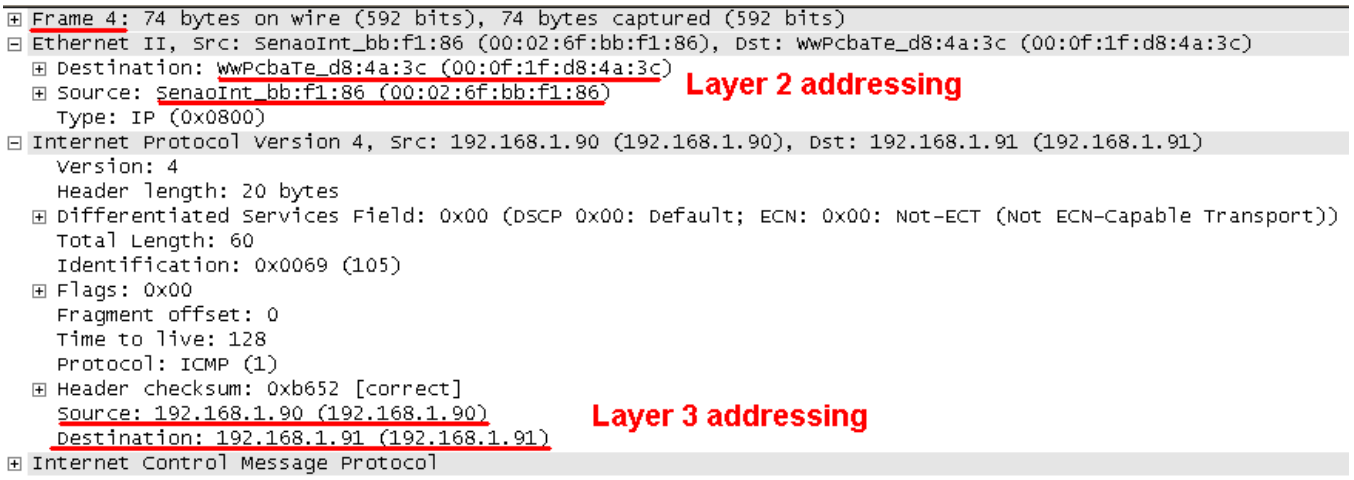
Device Name	ENH500
Ethernet Main MAC Address	00:02:6F:BB:F1:86
Ethernet Secondary MAC Address	00:02:6F:BB:F1:86
Wireless MAC Address	00:02:6F:BB:F1:86
Country	N/A
Current Time	Thu Jan 5 09:15:40 UTC 2012
Firmware Version	1.1.0

Here is the Ping request sent from 192.168.1.91 to 192.168.1.90:



As you can see the layer three addressing is correct, but the layer 2 destination address points to the Engenius unit B in CB mode and not the wired node behind the CB.

Just for completeness I will include the Ping reply.

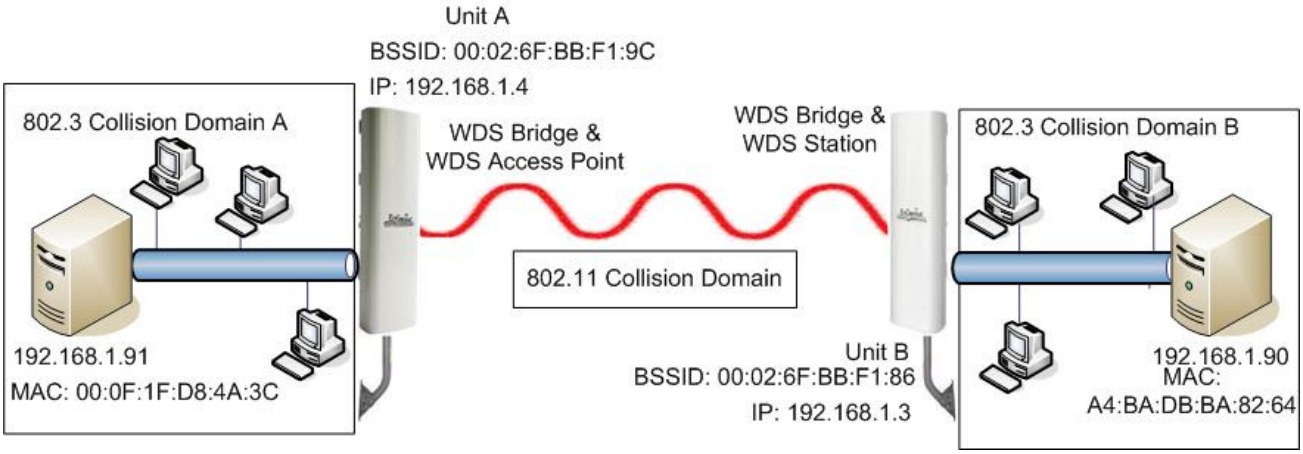


Now this may not cause problems for a majority of network traffic, but it will not work on some network traffic. Some network traffic this does not work on is

-VoIP
-IP cameras
-Some DHCP servers, depending the how the DHCP server stores it's key bindings.

If you have network traffic that needs Transparent Bridging, then you need to change the mode of operation on unit A and unit B to WDS Bridge mode or WDS-AP to WDS-STA.

Below is the same physical network topology as the one above, the only difference is that we change unit A to be WDS Bridge or WDS-AP, and unit B to be WDS Bridge or WDS-STA.



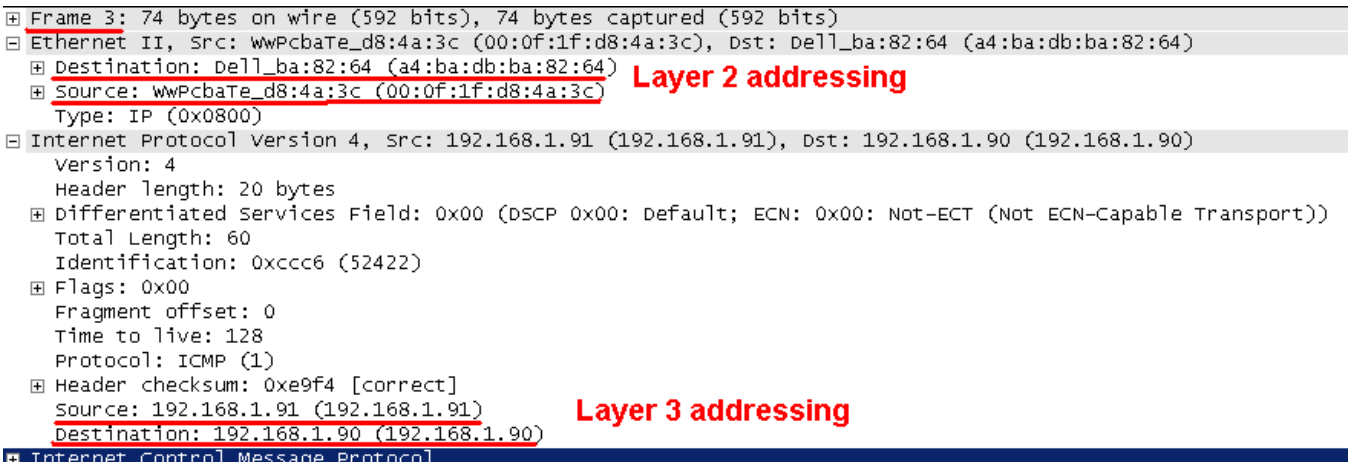
Let's start with the same network traffic as above. As you can see in this is the same as Frame one from above:

```
⊞ Frame 1: 42 bytes on wire (336 bits), 42 bytes captured (336 bits)
⊟ Ethernet II, Src: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  ⊞ Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  ⊞ Source: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)        Layer 2 addressing
    Type: ARP (0x0806)
⊟ Address Resolution Protocol (request)
    Hardware type: Ethernet (1)
    Protocol type: IP (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: request (1)
    [Is gratuitous: False]
    Sender MAC address: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)   Layer 2 & 3 addressing
    Sender IP address: 192.168.1.91 (192.168.1.91)
    Target MAC address: 00:00:00_00:00:00 (00:00:00:00:00:00)
    Target IP address: 192.168.1.90 (192.168.1.90)
```

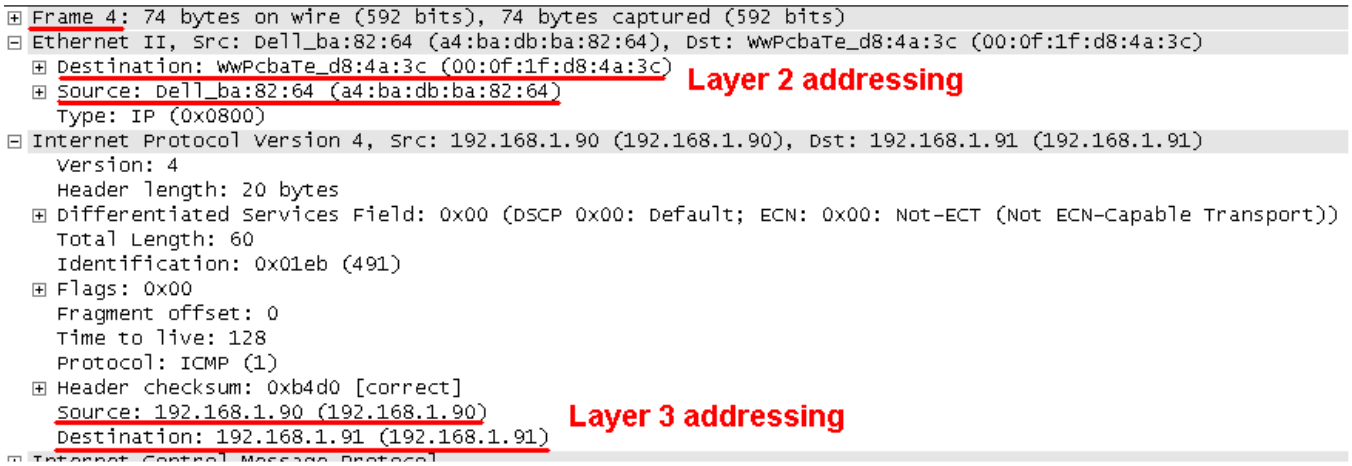
Frame two now is different from Frame 2 above. As you can see the actual wired client behind unit B responded and not unit B on behalf of the wired client resting behind unit B.

```
⊞ Frame 2: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
⊟ Ethernet II, Src: Dell_ba:82:64 (a4:ba:db:ba:82:64), Dst: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
  ⊞ Destination: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
  ⊞ Source: Dell_ba:82:64 (a4:ba:db:ba:82:64)        Layer 2 addressing
    Type: ARP (0x0806)
    Trailer: 000000000000000000000000000000000000
⊟ Address Resolution Protocol (reply)
    Hardware type: Ethernet (1)
    Protocol type: IP (0x0800)
    Hardware size: 6
    Protocol size: 4
    Opcode: reply (2)
    [Is gratuitous: False]
    Sender MAC address: Dell_ba:82:64 (a4:ba:db:ba:82:64)      Layer 3 addressing
    Sender IP address: 192.168.1.90 (192.168.1.90)
    Target MAC address: WwPcbaTe_d8:4a:3c (00:0f:1f:d8:4a:3c)
    Target IP address: 192.168.1.91 (192.168.1.91)
```

This change is also reflected in the Ping request and reply. As you can see from Frame 3 below the destination layer two address is what you normally would expect to see.



And the reversal of layer two addresses is seen in the reply



Conclusion

As seen above AP to CB does not provide transparent Bridging. If there is a network need for transparent bridging then the only way to achieve that from our products is to change the mode of operation on both units.