

Using Bonjour Across Subnets

Version: 1.0
Date: 9/19/06

Author: Geordie Korper

Overview

This paper discusses methods you can use to provide Bonjour discovery services across subnets. It is intended for a technical audience such as system administrators and IT network managers who need to support Mac OS X client computers. Bonjour is Apple Computer's service discovery protocol. ExtremeZ-IP File and Print Server products support advertising their services using Bonjour. First, we will review the various methods that can be used to advertise Bonjour services across subnets. Then we will discuss when to use which method and how to configure some of these services.

There are three ways to provide Bonjour service discovery across subnets: multicast routing, unicast DNS, or a Bonjour proxy for each service on every subnet. Each of these methods has advantages and disadvantages. In most situations, deciding factors will be the upfront effort required to setup the solution and the ongoing maintenance required to support the configuration.

Multicast Routing

The simplest solution is to route the multicast Bonjour information that is already being sent by the server and clients. This is because no changes to the client or server are needed, and this approach will work with any client that understands multicast Bonjour. However, to a certain extent, routing multicast traffic defeats the purpose of having subnets in the first place. In addition, setting up multicast routing will almost certainly require the input of a knowledgeable Network Administrator. For these reasons multicast routing is almost never used in real world deployments.

Multicast routing configuration is beyond the scope of this document because configuration is router-specific.

Unicast DNS Service Discovery

While adding the appropriate records to DNS can be complex, clients will see the Bonjour services automatically. Unfortunately due to design decisions by Apple, this approach generally requires manual updates to DNS records. This is because dynamic updates to DNS from Mac clients will not work with private IP ranges such as 192.168.x.x and 10.x.x.x. In addition, if DNS is hosted on Windows, spaces are not allowed in service names and the names will be converted to lowercase characters when they are sent to the client. Finally discovering Bonjour services using unicast DNS is a feature that is only available in Mac OS 10.4 and later.

Proxy Bonjour Services

The name "Bonjour proxy" can be somewhat confusing to people in that this method does not proxy the Bonjour protocol. Instead this feature allows a computer on another subnet to respond with information about a service *in place of the computer that actually has the service*. The advantage to this method is that with a fairly simple terminal command executed on a Mac, other Macs on the same subnet will be able to discover the service.

The disadvantages to this solution are that the terminal command must be run every time the computer is restarted and that each service that you intend to advertise requires a separate command.

This solution makes the most sense when you have 1 or 2 static services and a single additional subnet. It is also your only choice if you have a significant number of pre-Mac OS 10.4 computers and do not have the expertise to enable multicast routing.

Implementation

Setting up a Bonjour Service Proxy

The Bonjour proxy functionality that is built-in to the `dns-sd` command line program is the simplest solution to set up initially, but it can be difficult to maintain. Important to note is that although the man page for `dns-sd` says it first appeared on Mac OS 10.3 this is not true. It will run on 10.3, but it did not ship with the OS until Mac OS 10.4.

The basic format to create a proxy Bonjour service on a 10.4 Mac is:

```
dns-sd -P <Name> <Type> <Domain> <Port> <Host> <IP> [<TXT>...]
```

If we have an AFP server called “myFileServer” that we want to have show up on another subnet the command would be as follows:

```
dns-sd -P myFileServer _afpovertcp._tcp . 548 myFileServer.local 10.0.0.42 ""
```

If we want to broadcast the existence of a print queue called “QALab” then we can use the following command:

```
dns-sd -P QALab _printer._tcp . 515 QALab.local 10.0.0.13 "txtvers=1" "rp=QALab" "note=3rd Floor Copy Room" "qttotal=1" "ty=HP LaserJet 4000 Series" "product=(HP LaserJet 4000 Series)"
```

As long as those commands are running other Macs on the network will see those services and be able to connect to the actual servers that host the services.

Setting Up Unicast DNS Service Discovery

For the purposes of our DNS examples, we are going to assume you are using Microsoft DNS.

NOTE: If you are using a BIND-based DNS server, then please refer to the documentation at dns-sd.org, which will be more appropriate for your needs.

There are two different approaches to setting up DNS Service Discovery with Microsoft DNS. The first approach would be to delegate the `_dns-sd._udp.example.com` to a more capable DNS server. An explanation of how to do this is also available from the dns-sd.org website.

The second option is to manually create the records in Microsoft DNS. If the domain is using Active Directory-integrated DNS, this can be a non-trivial exercise because you must use the GUI to create records that it was not designed to create. However, these issues are not insurmountable, if you follow a specific set of procedures.

Below we will provide screen shots of what it should look like when you are done setting up a Bonjour service using `example.com` as the domain and a printer within it called `PrintQueueName` as examples.

First, the appropriate “PTR” (pointer) records must be set up. These records define the browse domains for service discovery. These records must exist no matter what type of service you are advertising. The 5 PTR records (`b._dns-sd`, `db._dns-sd`, `r._dns-sd`, `dr._dns-sd`, and `lb._dns-sd`) are in the same format (with different names) and would look like the example PTR record for `b._dns-sd._udp` below:

Note that the labels for these fields differ from what we actually are putting in them

Properties

Pointer (PTR) Security

Host IP number:
b

Fully qualified domain name (FQDN):
_dns-sd_udp.example.com

Host name:
example.com Browse...

Delete this record when it becomes stale

Record time stamp:

Time to live (TTL): 0 :1 :0 :0 (DDDD:HH.MM.SS)

OK Cancel Apply

In addition to the PTR records that Mac uses to determine its browse domains, there must be PTR, SRV, and TXT records specific to the services you are advertising. For example the configuration for a print service is shown on the following page.

Overview of a printer_tcp record

The screenshot shows the DNS Manager console for the zone `_printer` in the `tcp.example.com` zone. The left pane shows the tree structure: `BENDER` > `Forward Lookup Zones` > `tcp.example.com` > `_printer`. The right pane displays a table of records:

Name	Type	Data
(same as parent folder)	Pointer (PTR)	PrintQueueName._printer_tcp.example.com.
PrintQueueName	Service Location (SRV)	[0][0][515]PrintServer.example.com.
PrintQueueName	Text (TXT)	btvers=1, rp= PrintQueueName, note=Location ...

PTR record

The `_printer Properties` dialog box, PTR tab, shows the following configuration:

- Host IP number: (same as parent folder)
- Fully qualified domain name (FQDN): `_printer_tcp.example.com`
- Host name: `PrintQueueName._printer_tcp.example.com`
- Delete this record when it becomes stale
- Record time stamp: []
- Time to live (TTL): 0 : 1 : 0 : 0 (DDDD:HH.MM.SS)

SRV record

The `DNS-QALab Properties` dialog box, SRV tab, shows the following configuration:

- Domain: `tcp.example.com`
- Service: `PrintQueueName`
- Protocol: `_printer`
- Priority: 0
- Weight: 0
- Port number: 515
- Host offering this service: `PrintServer.example.com`
- Delete this record when it becomes stale
- Record time stamp: []
- Time to live (TTL): 0 : 1 : 0 : 0 (DDDD:HH.MM.SS)

TXT record

The `DNS-QALab Properties` dialog box, TXT tab, shows the following configuration:

- Record name (uses parent domain if left blank): `PrintQueueName`
- Fully qualified domain name (FQDN): `PrintQueueName._printer_tcp.example.com.`
- Text: `btvers=1
rp=QALab
note=3rd Floor Copy Room
qtotal=1
ty=HP LaserJet 4000 Series
product=(HP LaserJet 4000 Series)`
- Delete this record when it becomes stale
- Record time stamp: []
- Time to live (TTL): 0 : 1 : 0 : 0 (DDDD:HH.MM.SS)

Although it is fairly simple to create records that appear to be the same as the ones on the previous page, getting them exactly right is more challenging than it appears. For example, if you produce a PTR record that does not say “(Same as parent folder)”, but instead has the name of the service, the Mac will not properly retrieve it.

NOTE: We strongly suggest that you follow the steps below one-by-one to or you will end up spending a lot of time figuring out why something isn't quite the way the Mac wants it be!

Setting up PTR Browse Records

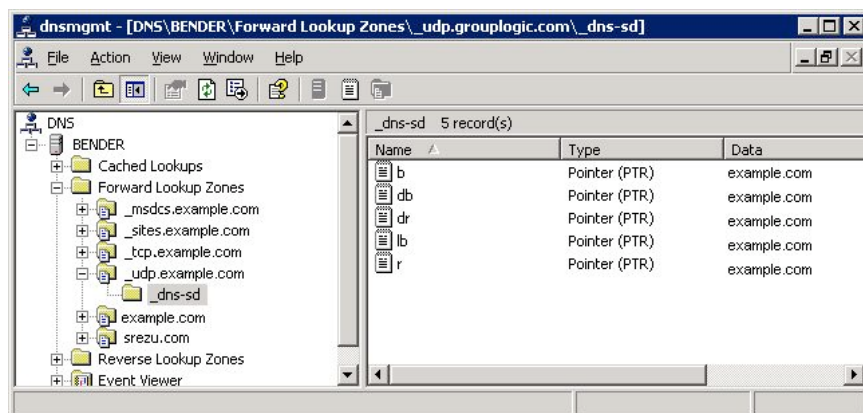
Since an explanation of how browse records work can be found on the dns-sd.org website, we won't repeat it here. However, you may find that “Manually Adding DNS-SD Service Discovery Records to an Existing Name Server” and “Setting up a Bonjour Name Server” provide useful background information.

The instructions below assume that you are using Active Directory integrated DNS; therefore all DNS edits must be made from the DNS Administration application on Windows. The examples below will be using “example.com” as placeholder for your actual domain name. The screens shots and descriptions are based on Windows 2003 but should be the same for other versions of Windows.

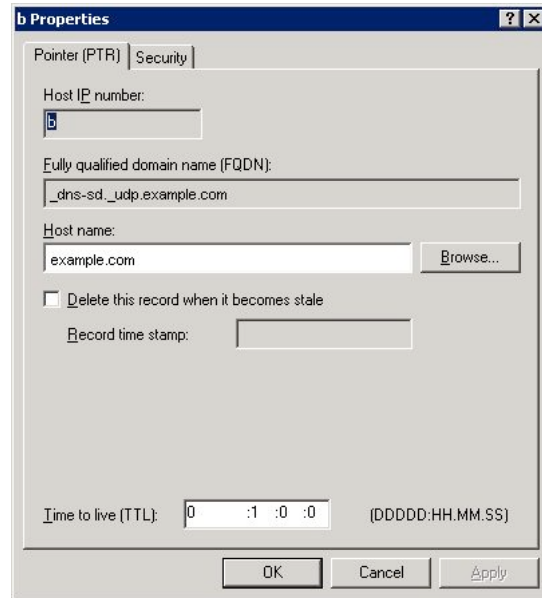
1. Open the “DNS Management” application from the “Administrative Tools” in the “Start” Menu.
2. Click the plus sign next to the “Forward Lookup Zones” folder to reveal the zones related to your domain.
3. Right Click the `_udp.example.com` domain and select “Other New Records”
4. Choose “Pointer (PTR)”
5. Click “Create New Record”
6. Type “b._dns-sd” in the “Host IP” number field.
7. Type `example.com` in the “Host name” field.
8. Click “OK”

Repeat the same steps for `db._dns-sd`, `r._dns-sd`, `dr._dns-sd`, and `lb._dns-sd`.

Click “Done” after you have completed the steps above for all 5 records. The end result will be a `_dns-sd` subfolder below the `_udp.example.com` folder. This folder will contain the PTR records you created and will look like the graphic below:



The details of a specific PTR record will look like this:



Advertising a Bonjour Service

Creating Bonjour services is slightly more complicated because of the way the DNS management GUI works. This section you should do the steps exactly as written. In the instructions below we use a print queue called `PrintQueueName` that is on a server called `PrintServer` in the `example.com` domain. You should replace those names with the actual queue name and hostnames for your print server.

You will need to create a PTR record listing the service name, an SRV record stating on which host the service is located; and a TXT record that provides any additional information. Although a PTR record would usually be the first record you would create, you start by creating the SRV and TXT records (because you need the `._printer` zone created before you can create the PTR inside of it).

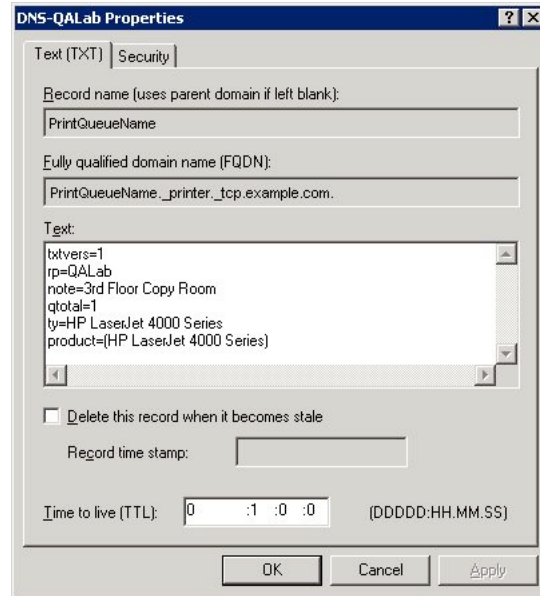
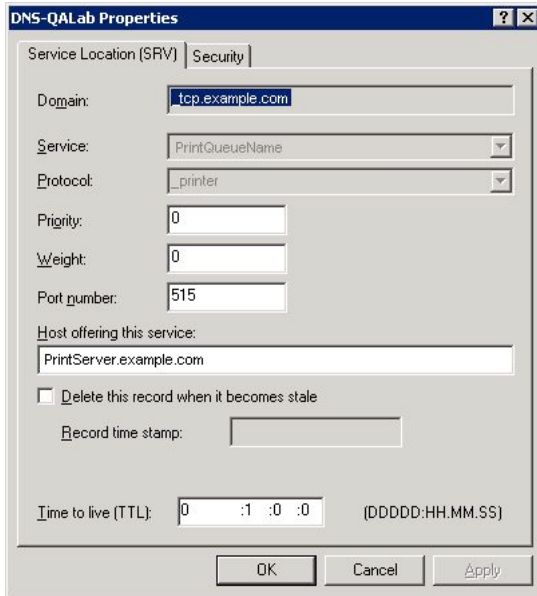
Note that even for services such as `afpovertcp` where the TXT does not contain any additional information, the TXT record must exist even though it is left blank. See the screen shots below.

1. Right click on “`._tcp.example.com`” and select “Other New Records”
2. Choose “Service Location (SRV)”
3. Click “Create New Record”
4. Type “`PrintQueueName._printer`” in the service field.
5. Type “515”(standard lpr port) in the Port number field.
6. Type “`PrintServer.example.com.`” in the “Host offering this service” field.
7. Click “OK”
8. Choose “Text (TXT)”
9. Click “Create New Record”
10. Type “`PrintQueueName._printer`” in the “Record name” field.
11. Type the text below into the “Text” field (including the returns).

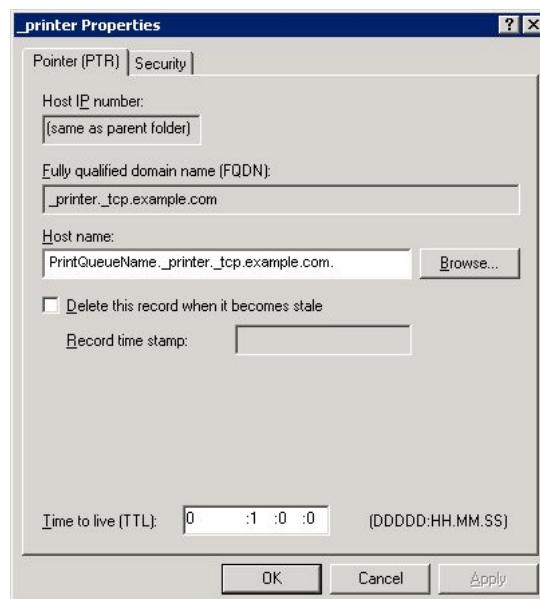
```
txtvers=1
rp=PrintQueueName
note=Location of Print Device
qtotal=1
```

ty=Name of PPD for Printer
product=(Product Name from PPD)

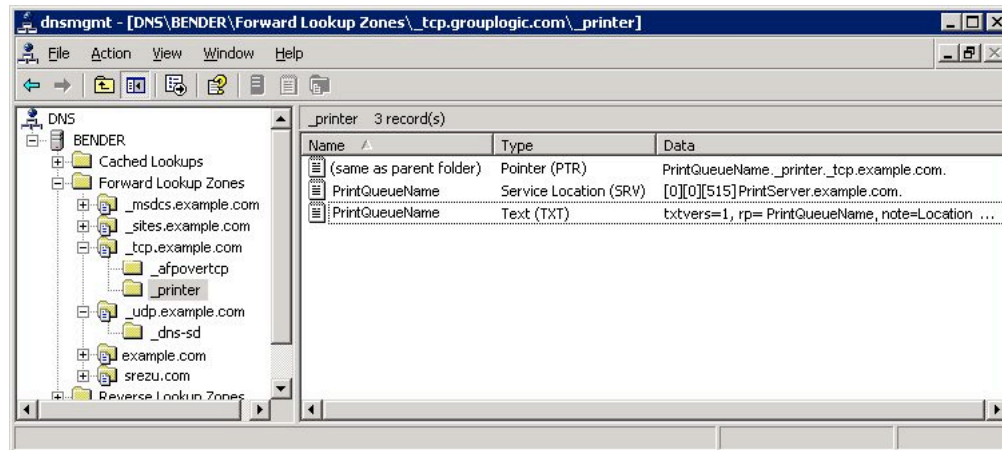
12. Click “OK”
13. Click “Done”
14. Verify the results look like the following by double clicking on the newly created records:



15. Right click on the newly created “_printer” folder within “_tcp.example.com” and select ”Other New Records”
16. Choose “Pointer (PTR)”
17. Click “Create New Record”
18. Leave the “Host IP number” field blank.
19. Type “*PrintQueueName._printer._tcp.example.com.*” in the “Host name” field.
20. Click “OK”
21. Click “Done”
22. Verify the results look like the following by double clicking on the newly created record:



The completed configuration should look like the following:



Now, anyone who has the "example.com" search domain as their default domain (either supplied by DHCP, or by putting the domain in the Network pane of System Preferences) will see a new printer in the add printer dialog. As mentioned previously, Microsoft DNS does not allow spaces and converts all characters to lowercase, so the queue above will be displayed as "printqueuenam".

Verifying the configuration from a Mac client in the subnet

In order to determine if you can see the printer in the Printer Setup Utility, you can use either the dns-sd or standard DNS query tools to check things out:

Using dns-sd to browse for printers:

```
[geordiemac:~] gkorper$ dns-sd -B _printer._tcp .
Browsing for _printer._tcp
Timestamp    A/R  Flags if Domain          Service Type          Instance Name
16:05:47.814 Add   3  5  local.           _printer._tcp.       Main Office
16:05:47.814 Add   3  5  local.           _printer._tcp.       Reception
16:05:47.814 Add   3  5  local.           _printer._tcp.       QALab
16:05:47.845 Add   2  0  example.com.    _printer._tcp.       printqueuenam
^C
```

Using dns-sd to list the specifics for a printer service:

```
[geordiemac:~] gkorper$ dns-sd -L printqueuenam _printer._tcp example.com
Lookup printqueuenam._printer._tcp.example.com
16:06:09.107 printqueuenam._printer._tcp.example.com. can be reached at
servername.example.com.:515 TXT \0x09txtvers=1\0x08rp=PrintQueueName\0x18note=3rd Floor Copy
^C
```

Using the host command to retrieve the PTR, SRV, and TXT records directly:

```
[geordiemac:~] gkorper$ host -t PTR _printer._tcp.example.com
_printer._tcp.example.com domain name pointer printqueuenam._printer._tcp.example.com.

[geordiemac:~] gkorper$ host -t SRV printqueuenam._printer._tcp.example.com
printqueuenam._printer._tcp.example.com SRV 0 0 515 bender.example.com.

[geordiemac:~] gkorper$ host -t TXT printqueuenam._printer._tcp.example.com
printqueuenam._printer._tcp.example.com text "txtvers=1" "rp=PrintQueueName" "note=3rd Floor
Copy Room" "qtotal=1" "ty=HP LaserJet 4000 Series" "product=(HP LaserJet 4000 Series)"
```