Remote Address Resolution

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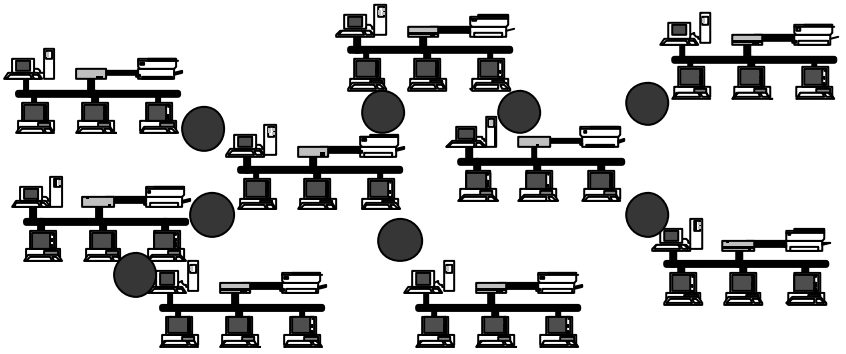
General Proposition

- Given one description of something find out another description
- Examples:
  - Name -> phone number
  - IP address -> MAC address
  - “Domain name” (e.g. peter-lo.com) -> IP address

In completely general terms “Address Resolution” is the translation from one from of addressing to another. When we use a phone book we are “resolving” a name to a phone number.

Broadcasts

- If all use broadcast to start, what is the problem in an internet?



When we considered “Local Address Resolution”, most solutions depended on a broadcast to set the ball rolling. This made sense because if you do not know anyone else’s address you can, at least, send a broadcast.

If you try to use broadcasts in a larger internetwork you end up with problems though..

In general we are going to have to design protocols that do not use broadcasts it we want to discover addresses in a larger network.

Styles of Name Resolution

- Peer to Peer
  - Verbose
  - No maintenance
  - Examples
    - ARP
    - Apple Name Binding Protocol (NBP)
- Client/Server
  - Maintenance
    - Of servers
  - Configuration
    - Of clients

There are two broad approaches to name resolution:

Peer-to-peer

These solutions, such as ARP or Appletalk Name Binding Protocol (NBP) are more or less self-configuring but often use broadcasts and therefore can be said to be ”verbose” - generating excessive network traffic.

Client-Server

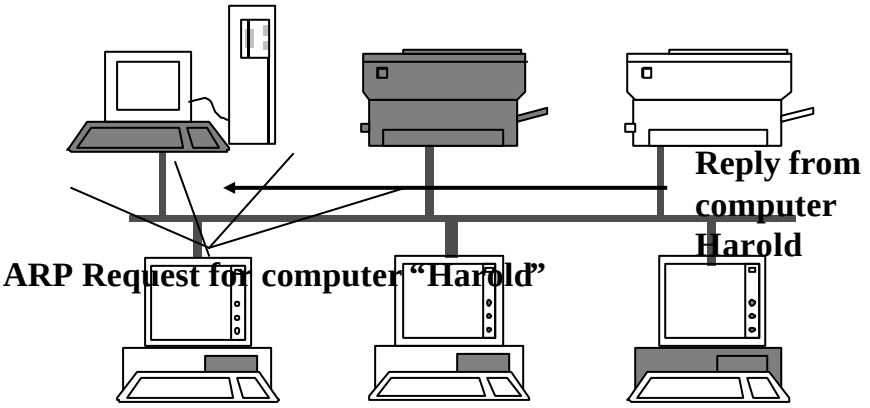
If we introduce a server then there are immediately two problems:

• Who maintains the information on the server?

• How do the clients find the server?

ARP

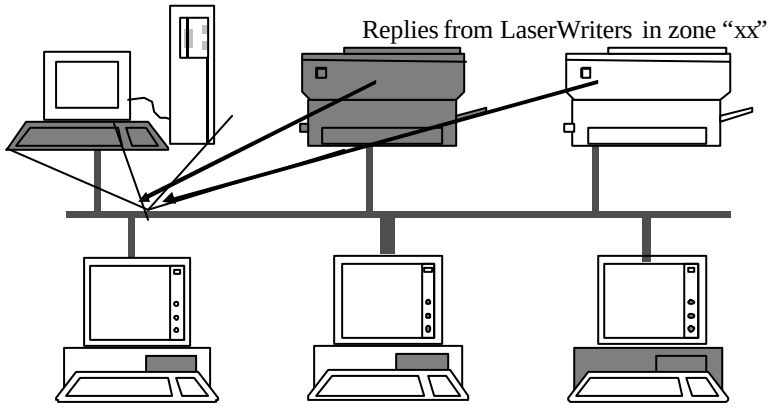
- Resolves a specific address



This slide reminds us that ARP has a significant restriction - it only resolves a specific address. It will translate a swingle address for us but it will not provide a list of who is out there.

Apple - Name Binding Protocol

- Builds a list



NBP Request for “LaserWriters” in zone “xx”

The Appletalk Name Binding Protocol (NBP) provides a client with a list of remote nodes because the initial broadcast can be for “all nodes of a certain type”. Instead of a single reply (as in ARP) we might therefore receive a number of answers with which we can build a list.

Server/Client

- Client queries server
  - How to locate the server?
- Server gathers information
  - Builds a catalogue/directory
  - How?

This slide restates the basic questions that arise when we consider a Client/Server approach to address resolution.

Locating the server

- Configured address
  - Not dynamic
    - Dynamic Host Configuration Protocol (DHCP) to the rescue
- Broadcast
  - Same problem in an internet
    - Multicast
      - A special MAC address
        - eg 03 00 00 00 00 01 - NetBIOS
      - A special logical address
        - eg: 225.0.0.1 (224.0.0.0 and bigger)

How might a client find the server?

A configured address

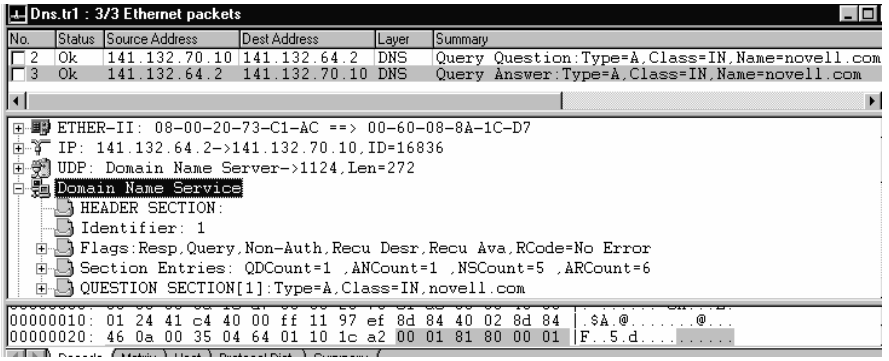
All the clients are configured, in some way, with the address of the server. This would be very labour-intensive were it not for protocols such as DHCP (Dynamic Host Configuration Protocol) which can deliver settings automatically to clients.

Broadcast

The client can directly track down the server using some kind of broadcast. We can refine the "broadcast" concept (send to **everyone**) with the "multicast" which sends to a specified set of nodes. There are multicast MAC addresses and multicast logical addresses.

Domain Name System

- Response/request
  - For specific station
- Sent to configured DNS server

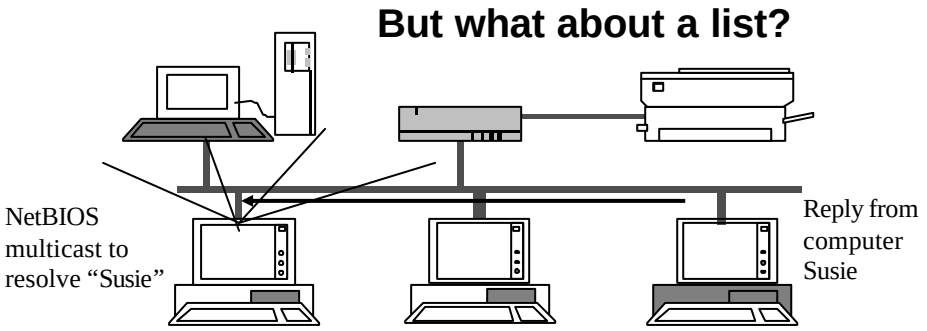


The most widely known form of address resolution is the Domain Name System (DNS) which translates names such as “www.microsoft.com” into a numeric IP address.

All clients are configured to send their DNS requests to a particular, local, DNS server. DNS servers talk to each other in order to resolve addresses that they do not specifically know about.

NetBIOS name resolution

- Resolve a Microsoft computer name
  - eg Win95 “Find Computer”
- Multicast/response
  - For specific station

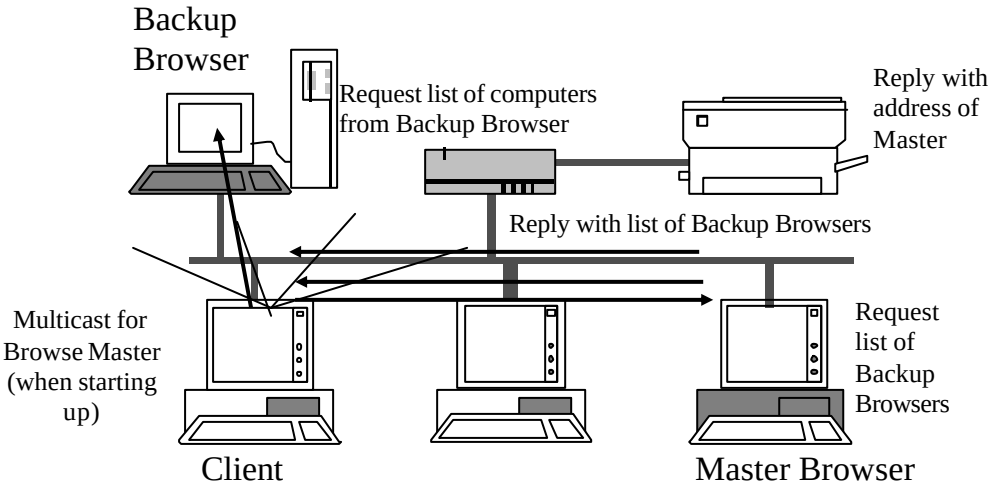


In a Microsoft network, such as you might have set up at home, address resolution is performed using the NETBIOS protocol. The basic mechanism is similar to ARP except that the initial request is in the form of a **multicast** that includes the **name** of the node being sought.

This is what happens when you use “Find/Computer” and like ARP it does not give a list to pick from.

Microsoft Browser Service

eg Win95 Network Neighbourhood



The “Network Neighbourhood”, which displays a list of computers on the network needs a more complex protocol - the Microsoft Browser Service

This depends on .”servers” that are self-configured through an “election” process. There are two types of server:

Browse Master

Oversees the whole process - does not actually give the client any answers but tells the clients where they can go to get their questions answered.

Backup Browsers

There may several of these. They store the actual computer name/address data that is returned to clients when they ask for a list.

Building server lists

- DNS
  - World-wide service
  - Servers speak to other servers
  - Lists trickle through hierarchy
- MS Browser
  - Restricted to a WAN
  - Self configuring

Maintaining the lists of data at the servers may be either:

Manual

In DNS, the administrator of each DNS server maintains the “local” set of information and makes sure that unknown addresses (because they are remote) are passed on to a higher level server.

Local entries are only as up to date as the administrator is active!

Automatic

The Microsoft Browser Service maintains lists within a Wan automatically. However this automation can mean that lists are often not very up to date.

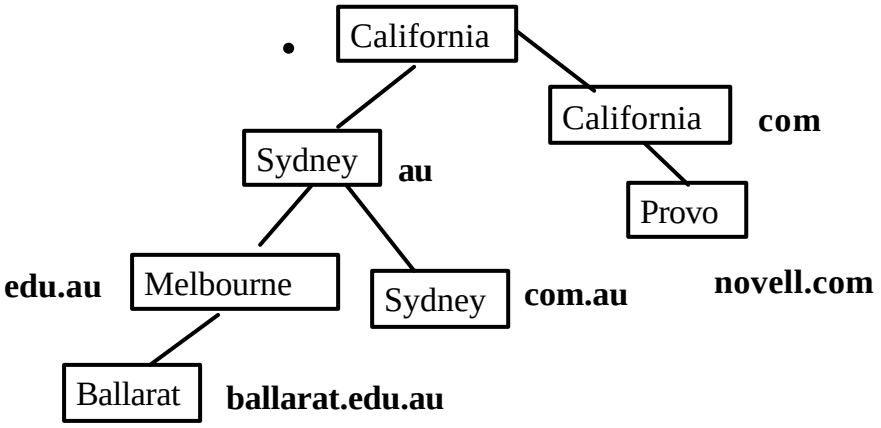
DNS

- A hierarchy (tree) of servers
- Each server may contain some local information
  - For a specific “domain”
    - E.g. ballarat.edu.au
      - Contains info about “krause”
  - Must be manually entered
- Each server is linked to a “parent”
  - To resolve unknown addresses

The hierarchical nature of DNS is spelt out in this and the next few slides.

DNS hierarchy

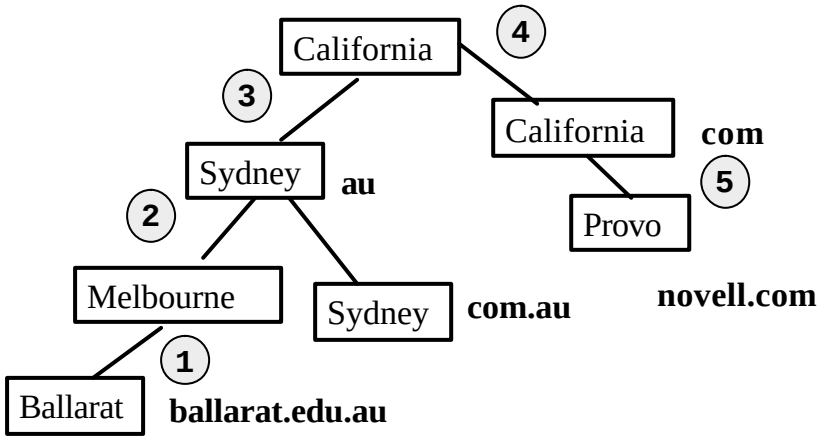
Sydney: Suggested location **com.au:** Authority for domain



Each box represents a DNS server at a specific physical location. Each of these DNS servers has data about the computers in a specific local "domain" The name of the domain is written beside the server - the server is said to be the "authority" for that domain.

As we spread out across the world we see DNS servers that are authorities for domains with shorter and shorter names. Some are the authority for the "root" of the DNS naming hierarchy.

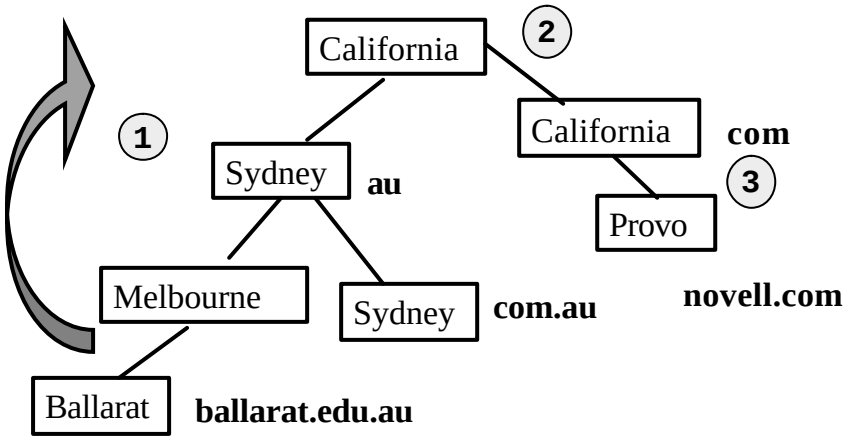
DNS Resolution
Resolve “novell.com”



The resolution of a specific name is shown, with the request being passed up to the top of the tree and then back down to the server that is the authority for that name.

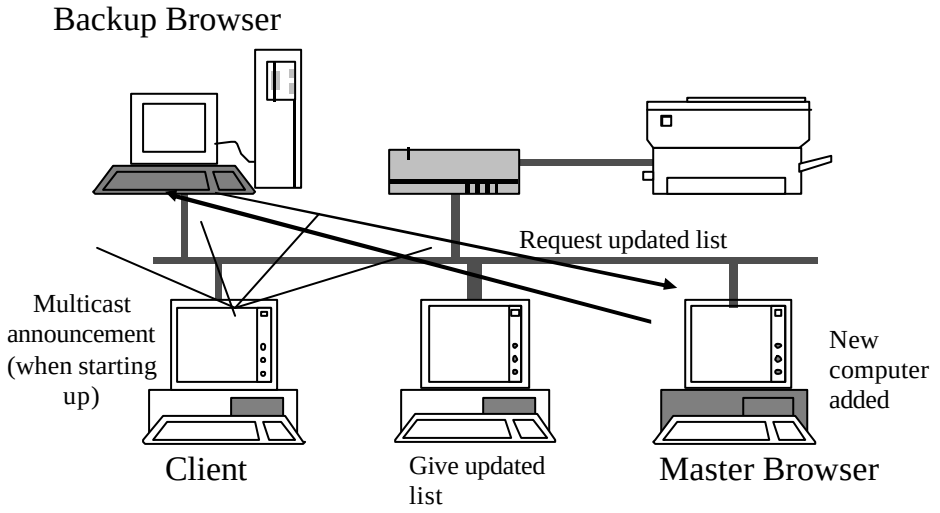
Faster DNS Resolution

Resolve “novell.com.”



Some DNS clients can pass a name with a dot at the end. This tells the local DNS server to go straight to the top - skipping the steps up through the tree.

Microsoft Browser Service



If you are setting up a network at home, using Microsoft Networking, then you may be wondering why it takes so long for computers to show up in the Network Neighbourhood.

This slide shows the steps between a new computer being turned on and that computer appearing in the list stored at the Backup Browser. The timeouts on the various steps can mean that it take up to 36 minutes for a computer to show up in the NN. If a computer shuts down abruptly it may remain in the NN for 51 minutes!

Using Find/Computer is always instantaneous.