Powered by DNS

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Chapter 1. Domain Name System

Domain Name System   IP   .
        IP(Internet Protocol),   IP
210.105.79.103   IP   ,   IP
                                , IP   .
                ARPANET   IP Address
    ,   DNS   .

ARPANET   NIC(Network Information Center)
                (HOSTS.TXT)   /etc/hosts   .
                                                        , 1983   Paul
Mockapetris   RFC882, RFC883(RFC1034   )
    ,   ,   , Email   DNS
        .

1.1. DNS Namespace

ARPANET   , DNS
                        Figure 1-1   .

Figure 1-1. Namespace
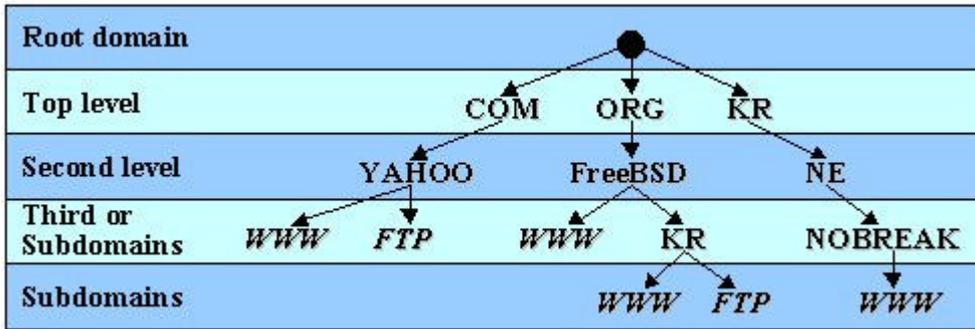
, Root domain( ) Top level
, Top level /
(NS:Name Server) , .

YAHOO.COM COM , WWW.YAHOO.COM YAHOO.COM
, . AV.YAHOO.COM YAHOO.COM
.
.

1.2. Domain Name Resolving

Figure 1-2. **Resolving**
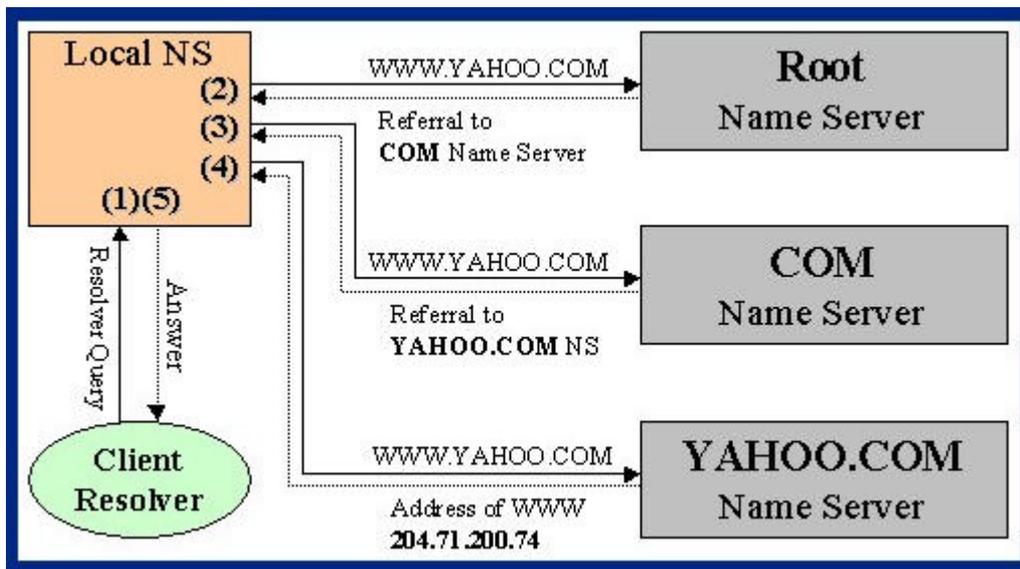
TCP/IP . IP
(Resolving) , Figure 1-2 Resolving .

1. Client WWW.YAHOO.COM Local Name Server(TCP/IP
) .

2. Local NS Root NS(Root NS
) . Root NS WWW.YAHOO.COM
, COM NS .

3. Local NS COM NS , COM NS YAHOO.COM NS . (
( ) COM Root NS (2)
YAHOO.COM NS .)

4. Local NS   YAHOO.COM NS   . YAHOO.COM NS
                  NS   , WWW.YAHOO.COM   IP 204.71.200.74   (authoritative answer)
        . (WWW.YAHOO.COM   IP   resolving   IP
                    '   ,   )
          IP   . (:   )

5.   , Local NS   Client   .

1.3

    : RFC1035 p7, RFC1032 p2

'A-Z', 'a-z', '0-9', '-'   .   ,
              . ([RFC1035]   ,
[RFC1123 p12]   3com.com   .)   /
        ,   (Each segment)   63   (octet)   .
            (NIC   12   ),   /   .

        ,   (KRNIC, Internic(Network Solutions)   )   ,
                  . KRNIC   63
        , Internic   22   .

                                        Email   RFC822
        .   ,   ,   .

(
(:411.com)   .
)

Chapter 2. Name Server

2.1. Name Server

                    Primary, Secondary, Cache only server   .

Primary server   , Secondary server
back-up copy   . Secondary   Primary
              ,   .

                                Primary, Secondary   , Secondary
                            Primary   .   ,
                2   (Primary * 1, Secondary * n)   . (Resolver
            Primary   Secondary   Primary
)

Cache only server   , resolving   .   ,
                        Primary, Secondary Name server   ,
                        Local DNS server   .   resolving
        (   )   ,
                                                        .   Cache only server
              .

2.2. BIND(Berkeley Internet Name Daemon)

Name server   ,   BIND   db
          BIND   . /usr/sbin   in.named   named   ,
BIND   BIND   . (BIND
)

```
$ dig @ns.nobreak.com txt chaos version.bind | grep VERSION
VERSION.BIND            OS CHAOS TXT     "8.2"
```

           ISC(Internet Software Consortium)   BIND   ,
                                                          ,   , BIND-4   , BIND-8
                                                                   .

BIND   . ISC FTP   ,
                                                   .

```
# make clean depend all install
```

          ,   rc   BIND   .
(FreeBSD: /etc/rc.conf, /etc/rc.network, Solaris: /etc/init.d/inetsvc, Linux: /etc/rc.d/init.d/named)

Windows NT, OS/2, MacOS   BIND   ,   .

          http://www.dns.net/dnsrd/docs/exotic.html

2.3   (Public Domain)

Primary, Secondary   ,
("YourDomain.COM"   Internic, YourDomain.CO.KR   Krnic)   (
)   .   ,   ,
          ,   ,   .
                              .

```
2.      Complete Domain Name.......: NOBREAK.COM
7a.    Primary Server Hostname....: NS.NOBREAK.COM
7b.    Primary Server Netaddress..: 210.105.79.2
8a.    Secondary Server Hostname..: NS2.NOBREAK.COM
8b.    Secondary Server Netaddress: 210.105.79.3
```

"NOBREAK.COM"   ,   .

```
$ nslookup -type=ns nobreak.com
Server:  ns.nobreak.com
Address:  0.0.0.0

nobreak.com      nameserver = ns.nobreak.com
nobreak.com      nameserver = ns2.nobreak.com
ns.nobreak.com internet address = 210.105.79.2
ns2.nobreak.com internet address = 210.105.79.3
```

                                                          ,   .
          ,   .

```
*** local.name.server can't find nobreak.com: Non-existent host/domain
```

2.4. (Inverse Domain)

IP . ISP(Internet
Service Provider) IP .
in-addr.arpa .

    $ nslookup -type=ns 79.105.210.in-addr.arpa (C Class 210.105.79.x)
    Server: ns.nobreak.com
    Address: 0.0.0.0

    79.105.210.in-addr.arpa nameserver = ns.nobreak.com
    79.105.210.in-addr.arpa nameserver = ns2.nobreak.com
    ns.nobreak.com internet address = 210.105.79.2
    ns2.nobreak.com internet address = 210.105.79.3

, , ISP
.

    *** ns.nobreak.com can't find 79.105.210.in-addr.arpa.: Non-existent host/domain

2.5. Name Server

nobreak.com .

Figure 2-1.

NOBREAK.COM (210.105.79.x)
ETHERNET
HUB
ROUTER
NS.NOBREAK.COM
210.105.79.2
NS2.NOBREAK.COM
210.105.79.3
POWER.NOBREAK.COM
210.105.79.103
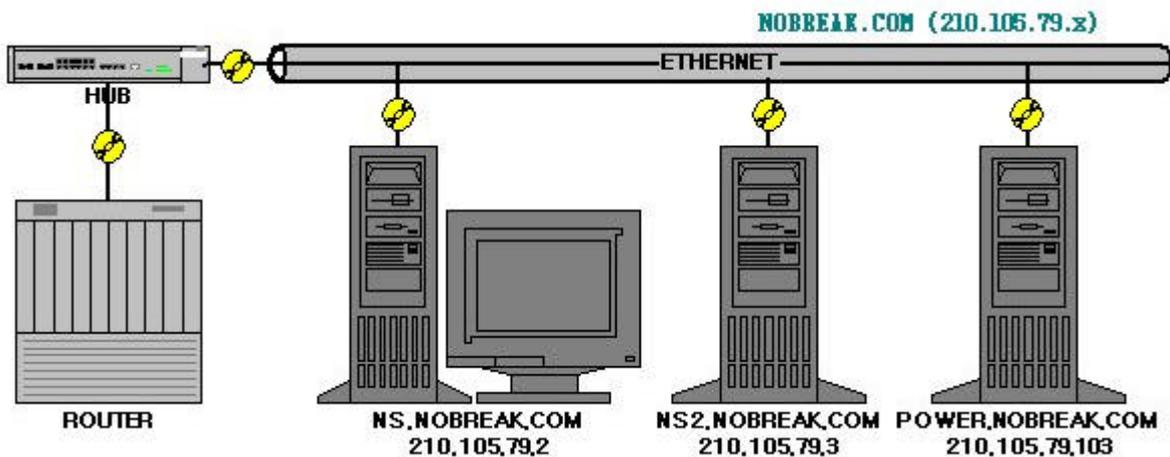
3 . DNS , IP
. ns(primary), ns2(secondary) , IP 1(
129) , 2 NS, 3 NS2 . NOBREAK.COM
Internic , NS.NOBREAK.COM, NS2.NOBREAK.COM .

2.5.1. BIND-4   named.boot

BIND-4   named.boot   BIND   ,
                 Primary/Secondary   .   /etc/named.boot   ,
                                          1   ';'   .   BIND   .

    directory /var/named

directory   .
                    .   /var/named
                                    . (/var/named, /etc/named
   /etc/named.db   )

    cache   . named.root

cache
   . BIND   ,
                    . /var/named/named.root   .

                    Internic   ftp://ftp.rs.internic.net/domain/named.root   .
                                                                              ,
         .   Cron   .

    primary nobreak.com zone-nobreak.com

                           Primary   .   nobreak.com
Primary   ,   /var/named/zone-nobreak.com   .

    secondary nobreak.com 210.105.79.2 sec-nobreak.com

                    Secondary   .   Primary   IP   ,
              Primary   zone   . 210.105.79.2   nobreak.com
                              (Zone Transfer)   /var/named/sec-nobreak.com   .

Figure 2-1   .

    * NS.NOBREAK.COM(Primary NS)   /etc/named.boot
    directory   /var/named
    cache   .   named.root
    primary   0.0.127.in-addr.arpa   zone-0.0.127.in-addr.arpa   ; loopback
    primary   79.105.210.in-addr.arpa   zone-79.105.210.in-addr.arpa ; Reverse ZONE
    primary   nobreak.com   zone-nobreak.com   ; Forward ZONE

0.0.127.in-addr.arpa   loopback   127.0.0.1   . loopback
              , 'primary 0.0.127.in-addr.arpa ...'   .
              C Class IP   210.105.79   nobreak.com   .

    * NS2.NOBREAK.COM(Secondary NS)   /etc/named.boot
    directory   /var/named
    cache   .   named.root
    primary   0.0.127.in-addr.arpa   zone-0.0.127.in-addr.arpa
    secondary 79.105.210.in-addr.arpa   210.105.79.2 sec-79.105.210.in-addr.arpa
    secondary nobreak.com   210.105.79.2 sec-nobreak.com

Secondary   . loopback   Primary   . Secondary   .
(/var/named/zone-0.0.127.in-addr.arpa   )

Secondary   Primary   , sec-79.105.210.in-addr.arpa,
sec-nobreak.com   ,   .

2.5.2. BIND-8 의 named.conf

BIND-4 와 BIND-8 은 설정파일의 구조에서 많은 차이가 있다. BIND-8 에서는
BIND-4 에서보다 , 더 복잡하고 다양한 기능을 제공한다.

named.conf 의 구조는 다음과 같다. 설정파일은 C 언어와 유사한 형태를 취한다.
, BIND-4 에 익숙한 관리자는 처음에 약간 당황할 수도 있다.
BIND-4 와 BIND-8 의 자세한 차이점은 BIND-8
의 문서를 참고하기 바라며,
http://www.isc.org/products/BIND/docs/ 에서 구할 수 있다.

Primary 네임서버의 설정은 다음과 같다.

```
* NS.NOBREAK.COM(Primary NS) 의 /etc/named.conf
//               주석문 . BIND 8     ';' 을 사용하기 때문에, 주의해야 한다.
options {
        directory "/var/named";              // Zone
        dump-file "/var/tmp/named_dump.db"; // Dump
        statistics-file "/var/tmp/named.stats"; //
        pid-file  "/var/run/named.pid";          //        ID
};
logging {   //                                                    .
        category lame-servers { null; };
        category cname { null; };
        category response-checks { null; };
        category notify { null; };
};

zone "." IN{                      //
        type hint;
        file "named.root";
};
zone "0.0.127.in-addr.arpa" IN{     // localhost        Primary
        type master;
        file "zone-0.0.127.in-addr.arpa";
};
zone "79.105.210.in-addr.arpa" IN{ //       IP              Reverse Zone
        type master;
        file "zone-79.105.210.in-addr.arpa";
};
zone "nobreak.com" IN{                //       nobreak.com       Forward Zone
        type master;
        file "zone-nobreak.com";
};
```

Secondary 네임서버의 설정은 다음과 같다.

```
* NS2.NOBREAK.COM(Secondary NS)   /etc/named.conf
options {
        directory "/var/named";
};
logging {
        category lame-servers { null; };
        category cname { null; };
};

zone "." IN{
        type hint;
        file "named.root";
};
zone "0.0.127.in-addr.arpa" IN{     // localhost        Primary
        type master;
        file "zone-0.0.127.in-addr.arpa";
};
```

```
zone "79.105.210.in-addr.arpa" IN {  // Reverse Zone        Secondary
        type slave;
        file "sec-79.105.210.in-addr.arpa";
        masters { 210.105.79.2; };  // Primary NS    IP
};
zone "nobreak.com" IN {                // nobreak.com    Secondary
        type slave;
        file "sec-nobreak.com";
        masters { 210.105.79.2; };
};
```

2.5.3.   (Resource Record)

Zone   Forward, Reverse   . Forward Zone   IP
              , Reverse Zone   IP   . named.boot
              loopback, 79.105.210.in-addr.arpa, nobreak.com   Primary
          .   zone-0.0.127.in-addr.arpa   zone-79.105.210.in-addr.arpa   Reverse Zone
, zone-nobreak.com   Forward Zone   . Zone   BIND-4   BIND-8   .

        Figure 2-1   Forward Zone   zone-nobreak.com   .

2.5.3.1. SOA   (Start Of Authority)

Zone   SOA   . SOA   , nobreak.com
    (authoritative)   ,   .

```
nobreak.com  IN  SOA  ns.nobreak.com  hostmaster.nobreak.com (
                1998122800  ; Serial
                21600       ; Refresh ( 6 hours)
                1800        ; Retry    (30 minutes)
                1209600     ; Expire   (14 days)
                86400)      ; Minimum ( 1 day)
```

1   Zone   .   .
      '@'   .

    @   IN SOA ns.nobreak.com hostmaster.nobreak.com (

IN(Internet)   . HS, HESIOD, CHAOS   ,
            IN   .

SOA   Primary   Email   . hostmaster.nobreak.com.   Email
        ,   Email   '@'   . Email
(Responsible Person)   . Namespace
                        lamers   Email
        .

                              Serial, Refresh, Retry, Expire, Minimum 5   ( )   ,   .
Minimum   4   Secondary   .   ' ',   ,
    M(Minute), H(Hour), D(Day), W(Week)   30M, 8H, 2D, 1W   .

   • Serial: Serial   Secondary   Zone   . Secondary
              Serial   Primary   Serial   Zone   . Zone
                  Serial   , Secondary
        . Secondary   Serial   Zone
      Serial   .

   • Serial   YYYYMMDDNN
```

. YYYYMMDDNN                              4294                                        .

- Refresh: Primary     Zone                                              Secondary                                    .
                  Zone                                      , 3H(10800)                         . Zone
                        6H(21600) - 12H                      .

- Retry: Secondary        , Primary                                    ,                                    . Refresh
                    ,                       30M(1800) - 1H                    .

- Expire: Secondary    Expire                                Primary                                  ,
                                                ,                                                    .
                    .        1W - 2W(1209600)                  .

- Minimum:                          Zone                                              ,                              (
                  )                    . TTL(Time To Live)
            .                                  ,
        Minimum                    .                  SOA          1D(86400)
    ,                                                    1H - 3H                                        . 0
                      .

---

### 2.5.3.2. NS(Name Server)

NS                                                                        .

```
nobreak.com    IN  NS      ns.nobreak.com
               IN  NS      ns2.nobreak.com
```

      NS   ,   . Namespace
                  NS   ,   ,
                                    .   .

2.5.3.3. A(Address) & CNAME(Canonical Name)

A   IP   .   . mail   power   A   IP   .
(mail   mail.nobreak.com.   .)

```
; Host addresses
mail.nobreak.com   IN  A     210.105.79.2
power              IN  A     210.105.79.103
; Aliases
www                IN  CNAME power.nobreak.com
ftp                IN  CNAME www
```

CNAME   .   power.nobreak.com,
www.nobreak.com, ftp.nobreak.com   IP 210.105.79.103   . ftp   CNAME
   CNAME   ,   DNS   ,   .
CNAME   , CNAME
                  .   , MX, NS   CNAME
            .   . CNAME   BIND
          ,   CNAME
          .   ,   CNAME
              . (: CNAME   )

```
ftp                    IN  CNAME www ; (X) CNAME
                       IN  MX    mail ;            .

power                  IN  MX 10 mail ; (X) MX    CNAME
mail                   IN  CNAME ns   ;                            .
```

2.5.3.4. MX(Mail eXchanger)

MX   ,
account@nobreak.com   mail.nobreak.com.   .
mail.nobreak.com.   ,   power.nobreak.com
   . MX Priority_Number   , Priority_Number   . MX
              .

```
    nobreak.com        IN  MX  10  mail.nobreak.com
                       IN  MX  20  power.nobreak.com
    mail.nobreak.com   IN  A       210.105.79.2
    power.nobreak.com  IN  A       210.105.79.103
```

          MX   CNAME   .   MTA(Mail
Transfer Agent: sendmail)   ,   .
      MTA   ,
      .   .

```
    nobreak.com        IN  MX  10  mail.nobreak.com   ; (X)
    mail.nobreak.com   IN  CNAME   power.nobreak.com
    power.nobreak.com  IN  A       210.105.79.103
```

2.5.3.5. PTR(Pointer)

PTR   IP   , Reverse Zone   .   IP
210.105.79.2   .

```
    2.79.105.210.in-addr.arpa.   IN  PTR  ns.nobreak.com
```

Forward Zone   A(CNAME)   IP   , PTR
                  ,   IP   .

2.5.3.6.

Zone   ,
          .   .
RFC1035, RFC1183, RFC2163   .

```
    power          IN  A       210.105.79.103
                   IN  HINFO   "Sun Sparc Ultra 5"  "Solaris 2.6"
                   IN  TXT     "Nobreak's Primary Server"
                   IN  TXT     "WWW,FTP is now available"
                   IN  RP      hostmaster.nobreak.com  hostinfo.nobreak.com
    hostinfo       IN  TXT     "Seung-young Kim, +82-42-864-4440/1"
```

HINFO(Host INFOrmation)   (CPU   , OS   )
        .   .

TXT(TeXT)   . RP(Responsible Person)
              , Email   (@   ) ,   (TXT
)   . HINFO   .

2.5.4. Zone

Figure 2-1   Forward Zone zone- nobreak. com
.

```
* nobreak. com              Forward Zone       /var/named/zone- nobreak. com
@               IN      SOA     ns. nobreak. com  hostmaster. nobreak. com (
                                1998122801  ; Serial
                                21600       ; Refresh ( 6 hours)
                                1800        ; Retry   (30 minutes)
                                1209600     ; Expire  (14 days)
                                86400)      ; Minimum( 1 day)
                IN      NS      ns. nobreak. com
                IN      NS      ns2. nobreak. com
                IN      MX 10   mail            ;

mail            IN      A       210. 105. 79. 2

; Hosts Here - This is comments
router          IN      A       210. 105. 79. 1
ns              IN      A       210. 105. 79. 2
ns2             IN      A       210. 105. 79. 3
power           IN      A       210. 105. 79. 103
                IN      HINFO   "Sun Sparc Ultra 5"         "Solaris 2.6"
                IN      TXT     "Nobreak Technologies, Inc."
www             IN      CNAME   power
```

        Reverse Zone zone- 79.105.210.in- addr. arpa   .

```
* Reverse Zone        /var/named/zone- 79. 105. 210. in- addr. arpa
@               IN      SOA     ns. nobreak. com  hostmaster. nobreak. com (
                                1998122801  ; Serial
                                21600       ; Refresh ( 6 hours)
                                1800        ; Retry   (30 minutes)
                                1209600     ; Expire  (14 days)
                                86400)      ; Minimum( 1 day)
                IN      NS      ns. nobreak. com
                IN      NS      ns2. nobreak. com
; IP- Domain mapping here
1               IN      PTR     router. nobreak. com
2               IN      PTR     ns. nobreak. com
3               IN      PTR     ns2. nobreak. com
103             IN      PTR     power. nobreak. com
```

loopback   Reverse Zone   . IP 127.0.0.1 localhost.
     ,   .

```
* loopback          Reverse Zone        /var/named/zone- 0. 0. 127. in- addr. arpa

@               IN      SOA     ns. nobreak. com  hostmaster. nobreak. com (
                                1998122801  ; Serial
                                21600       ; Refresh ( 6 hours)
                                1800        ; Retry   (30 minutes)
                                1209600     ; Expire  (14 days)
                                86400)      ; Minimum( 1 day)
                IN      NS      ns. nobreak. com
                IN      NS      ns2. nobreak. com
; IP- Domain mapping here
1               IN      PTR     localhost.
```

Zone   FQDN   . BIND
      , ns.nobreak.com ns.nobreak.com.nobreak.com.   .
ns.nobreak.com.   FQDN   , ns   .
         ,   .

2.5.4.1.   Zone

Zone   .   ,
                    Zone   ,   IP   Zone
                                    ,   .
                                                                                                    ,   /   /
                                                            .

* named.boot (BIND 4)
```
primary         netbsd.org                        zone-default
primary         openbsd.org                       zone-default
...
primary         freebsd.org                       zone-freebsd.org ;
...
```

* named.conf (BIND 8)
```
zone "netbsd.org"       IN{ type master; file "zone-default"; };
zone "openbsd.org"      IN{ type master; file "zone-default"; };
...
zone "freebsd.org"      IN{ type master; file "zone-freebsd.org"; };
...
```

* zone-default
```
@               IN      SOA     ns.nobreak.com hostmaster.nobreak.com (
                                1999030601  ;serial
                                21600       ;Refresh ( 6 hours)
                                1800        ;Retry   (30 minutes)
                                1209600     ;Expire  (14 days)
                                86400)      ;Minimum( 1 day)
                IN      NS      ns.nobreak.com
                IN      NS      ns2.nobreak.com
                IN      A       210.105.79.39
                IN      MX 10   @
                IN      MX 20   mqueue.nobreak.com

www             IN      CNAME   @
telnet          IN      CNAME   @
ftp             IN      CNAME   @
mail            IN      CNAME   @
pop             IN      CNAME   @
news            IN      CNAME   news.nobreak.com
```

* zone-freebsd.org
```
$INCLUDE zone-default

ftp.kr          IN      A    147.46.102.39
www.kr          IN      CNAME   @
```

2.6. Name Server

                                                                    .   ,
            .   .

* NS.NOBREAK.COM(BIND 8)
```
# ls /etc/named.conf      # BIND 8
/etc/named.conf
# ls /var/named/          # Zone
named.root
zone-0.0.127.in-addr.arpa
zone-79.105.210.in-addr.arpa
zone-nobreak.com
# /usr/sbin/named         #                     (Solaris: /usr/sbin/in.named)
# ps ax | grep named      #                        (Solaris: ps -e | grep in.named)
  254 ?  S   0.00 named
```

```
* NS2. NOBREAK. COM (BIND 4)
# ls /etc/named. boot        # BIND-4
/etc/named. boot
# ls /var/named/           # Zone
named. root
zone-0.0.127. in-addr. arpa
# ndc start                # ndc(Name Daemon Control)
Name Server Started
# ndc status
  254  ?  S    0:00 named
# ls /var/named/           # Primary   Zone
named. root
sec-79.105.210. in-addr. arpa
sec-nobreak. com
zone-0.0.127. in-addr. arpa
```

2.7. Name Server

[3]   ,
                                                                     .
                    , Namespace   .

```
$ nslookup power. nobreak. com ns. nobreak. com   # Primary
Server:   ns. nobreak. com
Address:   0.0.0.0

Name:     power. nobreak. com
Address:   210.105.79.103

$ nslookup power. nobreak. com ns2. nobreak. com  # Secondary
Server:   ns2. nobreak. com
Address:   210.105.79.3

Name:     power. nobreak. com
Address:   210.105.79.103

$ nslookup power. nobreak. com ns. kornet. ne. kr  # Namespace
Server:   ns. kornet. nm. kr
Address:   168.126.63.1

Name:     power. nobreak. com
Address:   210.105.79.103
```

    3   ,   .
              ,   Zone   BIND
        .

Chapter 3   (Resolver)

3.1. Unix

Unix   DNS   /etc/resolv. conf   , /etc/nsswitch. conf
        . /etc/resolv. conf   Resolving   3   .
            Primary, Secondary, ISP   3   .

```
search nobreak. com        #                    (Suffix)
nameserver 210.105.79.2  # ns. nobreak. com
nameserver 210.105.79.3  # ns2. nobreak. com
```

```
    nameserver 168.126.63.1  # ns.kornet.ne.kr (          ISP    NS)
```

'search nobreak.com'   .

              ,   ,   .

    search nobreak.com kr.freebsd.org

                      www   www.nobreak.com   ,
www.kr.freebsd.org   .   ,
      ,   search   .

                                                                                   .

         ,   .

    search nobreak.com

    domain nobreak.com
    nameserver 210.105.79.2
    ...

    domain kornet.ne.kr
    nameserver 168.126.63.1
    ...

              DNS   /etc/nsswitch.conf   'hosts:'   'dns'
              .   OS   ,   .

    hosts: files dns

files   /etc/hosts   .   (files, dns)
      .

3.2. Microsoft Windows

Windows   Unix   /etc/resolv.conf   '   '   .'
      ' '   '   TCP/IP   , Figure 3-1   DNS
   .

Figure 3-1. Windows NT   Resolver

DNS PC '   '   . Unix   resolv.conf   , '
  ' 'domain' , 'DNS   ' 'nameserver' , '   ' 'search'
  .

Chapter 4. (Domain Parenting & Delegation)

, www.core.nobreak.com
. ,
.

Figure 4-1. Domain Delegation Namespace

Figure 4-1 .FreeBSD.ORG ,
KR.FreeBSD.ORG CORE , doc-
kr.core.kr.FreeBSD.org .
.

4.1. Zone

. Zone
. nms.nobreak.com , DNS
.

```
* zone-nobreak.com(NS.NOBREAK.COM)
nms                     IN      MX 10   mail.nms
                        IN      MX 20   mail2.nms
dns.nms                 IN      A       150.183.110.53
                        IN      MX 10   mail.nms
                        IN      MX 20   mail2.nms
mail.nms                IN      A       150.183.110.10
mail2.nms               IN      A       150.183.110.11
```

nobreak.com SOA , nms.nobreak.com
SOA .

4.2

nms.nobreak.com
NS .   nobreak.com
nms   ns.nms.nobreak.com   .

    * zone-nobreak.com(NS.NOBREAK.COM)
    nms   IN   NS   ns.nms   ; Delegation
                                 IN   NS   ns2.nms
    ns.nms   IN   A   150.183.110.2 ; Glue Record
    ns2.nms   IN   A   150.183.110.3

IP   A   ,   NS   .
(:   )

        ns.nms.nobreak.com   primary
      .

    * named.boot (NS.NMS.NOBREAK.COM)
    primary   nms.nobreak.com   zone-nms.nobreak.com

       , Zone   zone-nms.nobreak.com   .

    * zone-nms.nobreak.com(NS.NMS.NOBREAK.COM)
    @   IN   SOA   ns.nms.nobreak.com hostmaster.nms.nobreak.com (
                              1999012901 ; Serial
                              21600   ; Refresh (6 hours)
                              1800   ; Retry   (30 minutes)
                              1209600   ; Expire (14 days)
                              86400)   ; Minimum (1 day)
                      IN   NS   ns.nms.nobreak.com
                      IN   NS   ns2.nms.nobreak.com
                      IN   MX 10   mail
                      IN   MX 20   mail2

    ns   IN   A   150.183.110.2
    ns2   IN   A   150.183.110.3
    mail   IN   A   150.183.110.10
    mail2   IN   A   150.183.110.11

    dns   IN   A   150.183.110.53
                      IN   MX 10   mail
                      IN   MX 20   mail2

        ns2.nms.nobreak.com   Secondary   .

    * named.boot (NS2.NMS.NOBREAK.COM)
    secondary   nms.nobreak.com 150.183.110.2 sec-nms.nobreak.com

     ns, ns.nms, ns2.nms   BIND   ,   .

    $ nslookup -type=NS nms.nobreak.com ns.kornet.ne.kr
    nms.nobreak.com nameserver = ns.nms.nobreak.com
    nms.nobreak.com nameserver = ns2.nms.nobreak.com

    $ nslookup dns.nms.nobreak.com ns.kornet.ne.kr
    Name: dns.nms.nobreak.com
    Address: 150.183.110.53

4.3   in-addr.arpa

nobreak.com   B   150.183   , nms.nobreak.com
150.183.110   .

```
$ nslookup -type=NS   183.150.in-addr.arpa
183.150.in-addr.arpa    nameserver = ns.nobreak.com
183.150.in-addr.arpa    nameserver = ns2.nobreak.com
```

          Inverse   .
183.150.in-addr.arpa   110.183.150.in-addr.arpa   Zone   .

```
* zone-183.150.in-addr.arpa (NS.NOBREAK.COM)
110              IN     NS      ns.nms.nobreak.com
                 IN     NS      ns2.nms.nobreak.com
```

     , ns.nms.nobreak.com   ns2.nms.nobreak.com   primary, secondary   Inverse
Zone   ,   .

```
* named.boot (NS.NMS.NOBREAK.COM)
primary         110.183.150.in-addr.arpa         zone-110.183.150.in-addr.arpa
```

```
* named.boot (NS2.NMS.NOBREAK.COM)
secondary       110.183.150.in-addr.arpa        150.183.110.2    sec-110.183.150.in-addr.arpa
```

```
* zone-110.183.150.in-addr.arpa (NS.NMS.NOBREAK.COM)
@                IN     SOA     ns.nms.nobreak.com hostmaster.nms.nobreak.com (
                        1999012901  ;Serial
                        21600       ;Refresh ( 6 hours)
                        1800        ;Retry   (30 minutes)
                        1209600     ;Expire  (14 days)
                        86400)      ;Minimum ( 1 day)
                 IN     NS      ns.nms.nobreak.com
                 IN     NS      ns2.nms.nobreak.com

2                IN     PTR     ns.nms.nobreak.com
3                IN     PTR     ns2.nms.nobreak.com
10               IN     PTR     mail.nms.nobreak.com
11               IN     PTR     mail2.nms.nobreak.com
53               IN     PTR     dns.nms.nobreak.com
```

4.4. Classless in-addr.arpa

     : RFC2317

                                        (octet)   ,
                                  .   210.105.79.1-128
nobreak.com   129-256   nms.nobreak.com
     .

     , IP   ISP   (half)   ,
                                  .

                79.105.210.in-addr.arpa   129-256(B   )   IP   NS
                        ns.nms.nobreak.com   . 79.105.210.in-addr.arpa
     Zone   .

* zone-79.105.210.in-addr.arpa (NS.NOBREAK.COM)

```
2              IN      PTR     ns.nobreak.com
3              IN      PTR     ns2.nobreak.com
...
129            IN      NS      ns.nms.nobreak.com    # 129-254
               IN      NS      ns2.nms.nobreak.com
...
254            IN      NS      ns.nms.nobreak.com
               IN      NS      ns2.nms.nobreak.com
```

NS   , ns.nms.nobreak.com   IP 129-254
              primary   .   .

* named.boot (NS.NMS.NOBREAK.COM)

```
primary  129.79.105.210.in-addr.arpa  zone-129.79.105.210.in-addr.arpa
...
primary  254.79.105.210.in-addr.arpa  zone-254.79.105.210.in-addr.arpa
```

   ,   Zone   129.79.105.210.in-addr.arpa - 254.79.105.210.in-addr.arpa
              .

* zone-129.79.105.210.in-addr.arpa (NS.NMS.NOBREAK.COM)

```
@              IN      SOA     ns.nms.nobreak.com hostmaster.nms.nobreak.com (
                       1999012901  ;Serial
                       21600       ;Refresh ( 6 hours)
                       1800        ;Retry   (30 minutes)
                       1209600     ;Expire  (14 days)
                       86400)      ;Minimum ( 1 day)
               IN      NS      ns.nms.nobreak.com
               IN      NS      ns2.nms.nobreak.com
               IN      PTR     dns.nms.nobreak.com
```

* zone-130.79.105.210.in-addr.arpa (NS.NMS.NOBREAK.COM)

```
@              IN      SOA     ns.nms.nobreak.com hostmaster.nms.nobreak.com (
                       1999012901  ;Serial
                       21600       ;Refresh ( 6 hours)
                       1800        ;Retry   (30 minutes)
                       1209600     ;Expire  (14 days)
                       86400)      ;Minimum ( 1 day)
               IN      NS      ns.nms.nobreak.com
               IN      NS      ns2.nms.nobreak.com
               IN      PTR     dhcp.nms.nobreak.com
```

IPv4   4   ,   4   Zone   ,
      .

                          IP   Zone   ,
      ,   .

                                       .

* zone-79.105.210.in-addr.arpa (NS.NOBREAK.COM)

```
2              IN      PTR     ns.nobreak.com
3              IN      PTR     ns2.nobreak.com
...
129            IN      CNAME   129.nms.79.105.210.in-addr.arpa.
...
254            IN      CNAME   254.nms.79.105.210.in-addr.arpa.
nms            IN      NS      ns.nms.nobreak.com
               IN      NS      ns2.nms.nobreak.com
```

Namespace   Inverse   in-addr.arpa   ,
                         .   arpa   IP   ,
nms.79.105.210.in-addr.arpa   ,

Classless in-addr.arpa   .

129.79.105.210.in-addr.arpa   129.nms.79.105.210.in-addr.arpa   CNAME   ,
nms.79.104.210.in-addr.arpa   primary   ns.nms.nobreak.com   ,
.

* named.boot (NS.NMS.NOBREAK.COM)
```
primary   nms.79.105.210.in-addr.arpa   zone-nms.79.105.210.in-addr.arpa
```

* zone-nms.79.105.210.in-addr.arpa (NS.NMS.NOBREAK.COM)
```
@               IN    SOA     ns.nms.nobreak.com hostmaster.nms.nobreak.com (
                              1999012901  ; Serial
                              21600       ; Refresh ( 6 hours)
                              1800        ; Retry   (30 minutes)
                              1209600     ; Expire  (14 days)
                              86400)      ; Minimum ( 1 day)
                IN    NS      ns.nms.nobreak.com
                IN    NS      ns2.nms.nobreak.com

129             IN    PTR     dns.nms.nobreak.com
130             IN    PTR     mail.nms.nobreak.com
...
254             IN    PTR     layla.nms.nobreak.com
```

129-254   PTR   . 79.105.210.in-addr.arpa Zone   IP   CNAME
                                DNS   .

                              Class   Reverse   ISP
        ,   ISP   Class   ,   Class
                        .   IP
                                                          .   Public
IP   (PC   ) Reverse
              ,   Reverse Resolving
    .

Classless in-addr.arpa   ,   C   210.105.79 - 210.105.81
      ,   81   .   ,   ISP   81.105.210.in-
addr.arpa   ,   ,
          Namespace   ,
              .

Chapter 5. DNS   Sendmail

5.1. MX

MX   .
              , nobreak.com   Sendmail   .

```
nobreak.com             IN     MX 10    layla.nobreak.com
                        IN     MX 20    marie.nobreak.com
                        IN     MX 20    suzi.nobreak.com
```

1.   .

2. layla   .

3. marie   suzi   .

4. (3)   .

5.   ,   2-4   .

         MX   , layla   marie   ,   marie
                    ,   MX   .   ,
                                     ,
          ,   priority
              (layla)   .   marie   suzi   Sendmail
                                     .

    1.   (nobreak.com)   .

    2.   (Relay)   .

                                     Sendmail   w   (sendmail.cw   sendmail.cf   Cw)
nobreak.com   ,   .
         ,   .

              OS   Sendmail   ,
                                                  .   SMTP
          IP(   )   ,
Feature   (
                    ,   IP   )   . (: Allowing
controlled SMTP relaying in Sendmail 8.9)

layla   marie   ,   (sendmail.cf
                    Timeout.queuereturn=5d   )   (Sendmail   ,   30   -
q30m)   .   layla   nobreak.com   .

    * layla   /etc/sendmail.cw(Solaris: /etc/mail/sendmail.cw)
    nobreak.com

marie   suzi   . layla
                    marie(suzi)   ,   marie   MX
                                                  .   suzi   suzi
              .

              ?   .   Sendmail   MX
         ,   (sendmail.cw   )   .   ,
                                   (   )
         (MX   )   MX   .

    nobreak.com   IN   MX 10   layla.nobreak.com
                                        IN   MX 20   marie.nobreak.com (   )
                                        IN   MX 20   suzi.nobreak.com (   )

       marie   Sendmail   MX   layla   ,   layla
                    .

    nobreak.com   IN   MX 10   layla.nobreak.com

              Sendmail   MX   (sendmail.cw   marie.nobreak.com
              ), suzi   ,   suzi   ,
                    . Sendmail   ,   (sendmail.cf
MaxHopCount=17,   25)   ,   marie   suzi   MaxHopCount
                    (postmaster)   .

    From: Mail Delivery Subsystem<MAILER-DAEMON@marie.nobreak.com>
    To: postmaster@marie.nobreak.com
    Subject: Returned mail: Too many hops 26 (25 max):...

```
     ----- The following addresses had permanent fatal errors -----
    <nobreak@nobreak.com>

     ----- Transcript of session follows -----
    554 Too many hops 26 (25 max):...
    ======================================================
    Received: from suzi.nobreak.com by marie.nobreak.com...
    Received: from marie.nobreak.com by suzi.nobreak.com...
    ...
    Received: from suzi.nobreak.com by marie.nobreak.com...
    Received: from marie.nobreak.com by suzi.nobreak.com...
    ...
```

.

```
    nobreak.com              IN     MX 10   layla.nobreak.com
                             IN     MX 20   marie.nobreak.com
```

```
    From: Mail Delivery Subsystem<MAILER-DAEMON@marie.nobreak.com>
    To: postmaster@marie.nobreak.com
    Subject: Returned mail: Local configuration error

     ----- The following addresses had permanent fatal errors -----
    <nobreak@nobreak.com>

     ----- Transcript of session follows -----
    553 marie.nobreak.com config error: mail loops back to me (MX problem?)
    554 <nobreak@nobreak.com>... Local configuration error
    ======================================================
    ...
```

DNS   sendmail.cw
      , alias   sendmail.cw   .

5.2 MX

                        MX   .

```
    mailhub         IN    A      210.105.79.107
```

      mailhub   ,   MX
            .   MTA   mailhub
                               .

Sendmail   .   Sendmail   mailhub   lookup(type=any)   .
Authoritative   Non-authoritative Answer   A   , Authoritative Answer
      MX   IP   .   MX
             Non-authoritative Answer   Sendmail   MX   .
mailhub   MX   .
                                            ,   mailhub
              .

```
    mailhub         IN    A      210.105.79.107
                    IN    MX 10  mailhub.nobreak.com
```

mailhub   ,   MX   .   ,
                                MX   .

5.3. MX 와 CNAME

: RFC974

MX 와   CNAME   .   RFC   MX
         CNAME

                                              ,
                              ,
.

```
layla           IN     MX 10    marie.nobreak.com
marie           IN     CNAME    suzi.nobreak.com
suzi            IN     CNAME    mailhub.nobreak.com
mailhub         IN     A        210.105.79.75
                IN     MX 10    mailhub.nobreak.com
```

layla   lookup   .

1. lookup layla.nobreak.com -> return marie.nobreak.com

2. lookup marie.nobreak.com -> return suzi.nobreak.com

3. lookup suzi.nobreak.com -> return mailhub.nobreak.com

4. lookup mailhub.nobreak.com -> return 210.105.79.75

                                                        ,   BIND
    ("layla.nobreak.com" IN MX points to a CNAME marie.nobreak.com)   Syslog   ,
        MTA   Sendmail   (   )   .   ,   MTA
                                                             , MX   CNAME   ,
                .

```
layla           IN     MX 10    mailhub.nobreak.com
marie           IN     CNAME    mailhub.nobreak.com
suzi            IN     CNAME    mailhub.nobreak.com
mailhub         IN     A        210.105.79.75
                IN     MX 10    mailhub.nobreak.com
```

    ,   Sendmail   CNAME
          .   user@marie.nobreak.com   , user@mailhub.nobreak.com
               ,   To: user@marie.nobreak.com
user@mailhub.nobreak.com   .
    ,   Sendmail   Virtual Domain
                      .   CNAME   , CNAME
        A   MX   .

5.4. Nonrecursive MX lookup

                      , mailhub   .   mx2
             , Sendmail   MX   Nonrecursive   ,   mx1(A
)   .

```
mailhub         IN     MX 10    mx1.nobreak.com
mx1             IN     MX 10    mx2.nobreak.com
                IN     A        210.105.79.231
```

         Sendmail   MX   CNAME   Recursive   ,

, Sendmail   MX   .

```
mailhub       IN     MX 10   mx1.nobreak.com
mx1           IN     MX 10   mx2.nobreak.com
mx2           IN     MX 10   mailhub.nobreak.com   ; Loop
```

5.5. Sendmail   Virtual Domain

nobreak.com   kr.freebsd.org   ,
nobreak@nobreak.com   nobreak@kr.freebsd.org   .
aliases   ,   .
      Sendmail   , Sendmail
            . Sendmail   RuleSet, m4, aliases, dbm/btree/hash
                  .

            Sendmail 8.8   ,   .

```
$ telnet localhost smtp
Trying 127.0.0.1...
220 kfug2.kr.freebsd.org ESMTP Sendmail 8.9.3/8.9.3
```

      8.8   , ftp://ftp.sendmail.org/pub/sendmail/   .
Sendmail 8.2   domaintable Feature   ,   Sendmail
8.8   virtusertable Feature   .

5.5.1. m4   sendmail.cf

    sendmail-VERSION/cf/cf/   mc   , Virtual Domain
virtusertable, genericstable Feature   .   mc   .

   * generic-bsd4.4.mc   freebsd.mc
   divert(0)dnl
   VERSIONID(`@(#)generic-bsd4.4.mc   8.7 (Berkeley) 5/19/1998')
   OSTYPE(bsd4.4)dnl
   DOMAIN(generic)dnl
   MAILER(local)dnl
   MAILER(smtp)dnl
   FEATURE(virtusertable, btree /etc/domainaliases.db)dnl
   FEATURE(genericstable, btree /etc/useraliases.db)dnl

virtusertable Feature   (in-bound)   RuleSet   ,
genericstable Feature   (out-bound)   (
      From:)   RuleSet   . DNS   Forward Zone   Reverse Zone
      .

btree   (domainaliases.db)   B-Tree(Berkeley DB)
      .   hash(Berkeley DB)   dbm(NDBM)   ,
btree(Berkeley DB) > hash(Berkeley DB) > dbm(NDBM)   .   btree   hash
         Berkeley DB(FreeBSD   Unix   )   ,
sendmail makemap   -DNEWDB   (Berkeley DB   -DNEWDB
)   .

Berkeley DB   -DNDBM   (NDBM   Unix
)   DBM   .   Berkeley DB   GNU
      GDBM   DB   .

      freebsd.mc   m4(Macro Language Processor)   sendmail.cf   .

```
# cd sendmail-VERSION/cf/cf
# m4 ../m4/cf.m4 freebsd.mc > freebsd.cf
# cp freebsd.cf /etc/sendmail.cf
```

sendmail.cf   ,   Feature   RuleSet
           sendmail.cf   . (RuleSet   m4
sendmail.cf   )

* FEATURE(virtusertable, btree /etc/domainaliases.db)dnl
```
# Virtual user table (maps incoming users)
Kvirtuser btree /etc/domainaliases.db

# handle virtual users (RuleSet 0   Parse1            )
R$+ < @ $=w. >          $: < $(virtuser $1 @ $2 $@ $1 $: @ $) > $1 < @ $2 . >
R<@> $+ + $* < @ $* . >
                        $: < $(virtuser $1 + * @ $3 $@ $1 $: @ $) > $1 + $2 < @ $3 . >
R<@> $+ + $* < @ $* . >
                        $: < $(virtuser $1 @ $3 $@ $1 $: @ $) > $1 + $2 < @ $3 . >
R<@> $+ < @ $+ . >      $: < $(virtuser @ $2 $@ $1 $: @ $) > $1 < @ $2 . >
R<@> $+                 $: $1
R< error : $- $+ > $*   $#error $@ $(dequote $1 $) $: $2
R< $+ > $+ < @ $+ >     $: $>97 $1
```

* FEATURE(genericstable, btree /etc/useraliases.db)dnl
```
# Generics table (mapping outgoing addresses)
Kgenerics btree /etc/useraliases.db

# handle generics database (RuleSet 93            )
R$+ < @ $=G . > $: < $1@$2 > $1 < @ $2 . > @     mark
R$+ < @ *LOCAL* >       $: < $1@$j > $1 < @ *LOCAL* > @ mark
R< $+ > $+ < $* > @     $: < $(generics $1 $: $) > $2 < $3 >
R< > $+ < @ $+ >        $: < $(generics $1 $: $) > $1 < @ $2 >
R< $* @ $* > $* < $* >  $@ $>3 $1 @ $2                       found qualified
R< $+ > $* < $* >       $: $>3 $1 @ *LOCAL*                  found unqualified
R< > $*                 $: $1                                not found
```

5.5.2. Forward-map

,   w(sendmail.cw)   .

* /etc/sendmail.cw
```
nobreak.com
kr.freebsd.org
```

domainaliases   Virtual User Table   .

* /etc/domainaliases
```
webmaster@nobreak.com        dipper
moonhunt@nobreak.com         moonhunt@ieee.org
cjh@nobreak.com              error:nouser Unknown User
@nobreak.com                 nobreak
@kr.freebsd.org              %1@xfree86.org
```

           webmaster@nobreak.com   dipper   , moonhunt@nobreak.com
              moonhunt@ieee.org   . cjh@nobreak.com
           'Unknown User'   ,   nobreak.com
nobreak   .   , kr.freebsd.org   xfree86.org
           .   aliases   .

* /etc/domainaliases
```
announce@kr.freebsd.org        announce.ml
admin@kr.freebsd.org           admin.ml
```

* /etc/aliases
```
announce.ml:              :include:/var/ml/announce.ml
admin.ml:                 nobreak, moonhunt@ieee.org
```

5.5.3. Reverse-map

kfug2.kr.freebsd.org   ,   out-bound
user@kfug2.kr.freebsd.org   From   .   Reverse-map
           .

* /etc/useraliases
```
nobreak            nobreak@nobreak.com
cjh                cjh@kr.freebsd.org
```

5.5.4.

makemap   dbm/btree/hash   .   btree
           .

```
# makemap btree /etc/domainaliases.db < /etc/domainaliases
# makemap btree /etc/useraliases.db < /etc/useraliases
# ls /etc/domainaliases* /etc/useraliases*
/etc/domainaliases        /etc/useraliases
/etc/domainaliases.db     /etc/useraliases.db
```

 Sendmail   .

```
# kill -HUP `cat /var/run/sendmail.pid`

# sendmail -bv webmaster@nobreak.com
webmaster@nobreak.com.. deliverable: mailer local, user dipper

# sendmail -bv cjh@nobreak.com
cjh@nobreak.com.. Unknown User

# sendmail -bv anybody@kr.freebsd.org
anybody@kr.freebsd.org... deliverable: mailer esmtp,
host xfree86.org., user anybody@xfree86.org
```

Chapter 6. BIND   /

6.1. BIND

BIND   .
     ,   /var/named/   /var/tmp/   .

HUP

    BIND   .   ,   .
              BIND   ,   ,   Zone
       (Serial   )   ,   .

INT

BIND $ORIGIN
          ,   named_dump.db   .

ILL(BIND-8)/IOT(BIND-4)

     BIND   named.stats   .   ,
          .

USR1

          named.run   . BIND
          ,   ,
                    .

USR2

                              .

WINCH

     BIND   Syslog   .   ,
                    Syslog   .

6.2. BIND Syslog

BIND   Syslog   .
                         Syslog   . Syslog   /etc/syslog.conf
          ,   /var/log/messages   /var/adm/messages   .

     , BIND   , HUP   ,   .

    Jan 1 5:33:39 ns named[288]: starting. named 8.2
    Jan 2 16:57:11 ns named[291]: reloading nameserver
    Feb 5 3:34:31 ns named[289]: named shutting down

Syslog   '   named[PID]:   '   , BIND-4
    BIND-8   .

    Feb 1 11:33:40 ns named[288]: master zone "nobreak.com"
    (IN) loaded (serial 1999012901)

Zone   . BIND-4   'primary zone'
    , BIND-8   'master zone'   .

     BIND   . (BIND-4   OS   BIND
      Feature   )

    Feb 2 18:57:12 ns named[291]: USAGE 917949432 917837292
    CPU=1558.86u/491.54s CHILDCPU=921.29u/1228.57s

    Feb 2 18:57:12 ns named[291]: NSTATS 917949432 917837292
    Unknown=3 A=95677 NS=3 SOA=275 PTR=563972 MX=11355 TXT=16 AXFR=10 ANY=17840

    Feb 2 18:57:12 ns named[291]: XSTATS 917949432 917837292
    RR=270905 RNXD=92478 RFwdR=133260 RDupR=505 RFail=8882
    RFErr=0 RErr=75 RAXFR=10 RLame=111437 ROpts=0
    SSysQ=24028 SAns=467186 SFwdQ=221971 SDupQ=255265 SErr=5319

RQ=689151 RIQ=17 RFwdQ=0 RDupQ=224 RTCP=53 SFwdR=133260
SFail=290 SFErr=0 SNaAns=189120 SNXD=186481

2 BIND . '917949432 -
917837292' , ( ) . USAGE CPU ,
CPU 1558 (u) , 491 (s) .
CHILDCPU , , CHILDCPU 0u/0s .
NSTATS XSTATS BIND Statistics .

Feb 5 09:39:05 ns named[26674]: Sent NOTIFY for "nobreak.com IN SOA"
(nobreak.com); 1 NS, 1 A

BIND-8 Dynamic Update Primary Secondary Zone
. nobreak.com Zone
.

Feb 5 09:36:00 ns named[26674]: ns_forw query(57.132.119.210.in-addr.arpa)
No possible A RRs

Resolver ( ) .

Feb 5 09:35:46 ns named[26674]: Lame server on 'ryu.siyon.com'
(in 'siyon.com'?): [210.105.79.103].53 'ns.mylover.com'

siyon.com ns.mylover.com , Authority
. Lame Delegation .

6.3. BIND Syslog /

, .
, ,
.

Feb 3 12:53:27 ns named[291]: ns_forw query(shpark.co.kr)
contains our address (ns.nobreak.com 210.105.79.2)

shpark.co.kr ns.nobreak.com( ) , Authority
. Lame Delegation ,
.

Feb 5 10:09:01 ns named[26674]: "nobreak.com IN NS"
points to a CNAME (ns.nobreak.com)

Feb 5 10:09:11 ns named[26674]: "mns.nobreak.com IN MX"
points to a CNAME (mail.nobreak.com)

Feb 5 09:57:15 ns named[26674]: power.nobreak.com has CNAME and other data

CNAME . MX MTA
(:sendmail) ,
. , .

nobreak.com   IN   NS   ns.nobreak.com   ; (X) ns   CNAME   .
ns   IN   CNAME   mild.nobreak.com

mns   IN   MX   mail.nobreak.com ; (X) mail   CNAME   .
mail   IN   CNAME   mhub.nobreak.com

power   IN   CNAME   layla.nobreak.com
               IN   MX   mhub.nobreak.com ; (X)   .

CNAME   , NS/MX/SOA   CNAME
          .

      Feb 5 09:24:56 ns2 named-xfer[2502]: record too short from
      [210.105.79.2], zone nobreak.com

Primary NS   xfrnets(BIND-4)   allow-transfer(BIND-8)   , Zone Transfer   ,
Zone   .   , Zone Transfer
       .

6.4. BIND Statistics

                                                                    ,   [6]
timeout(DNS   UDP   )   .

Figure 6-1.

BIND   ILL(BIND-8)/IOT(BIND-4)   .
BIND   /var/named/named.stats   /var/tmp/named.stats   .

      # **kill -ILL `cat /var/run/named.pid`**
      # **ls -al /var/named/named.stats**
      -rw-r--r-- 1 root   root   19832 Mar 8 04:51 /var/named/named.stats

```
# cat /var/named/named.stats
+++ Statistics Dump +++ (920978301) Tue Mar  9 20:18:21 1999
208719  time since boot (secs)
3396    time since reset (secs)
3       Unknown query types
205739  A queries
39      NS queries
916     SOA queries
802719  PTR queries
19192   MX queries
2       TXT queries
15      AAAA queries
129     AXFR queries
29359   ANY queries
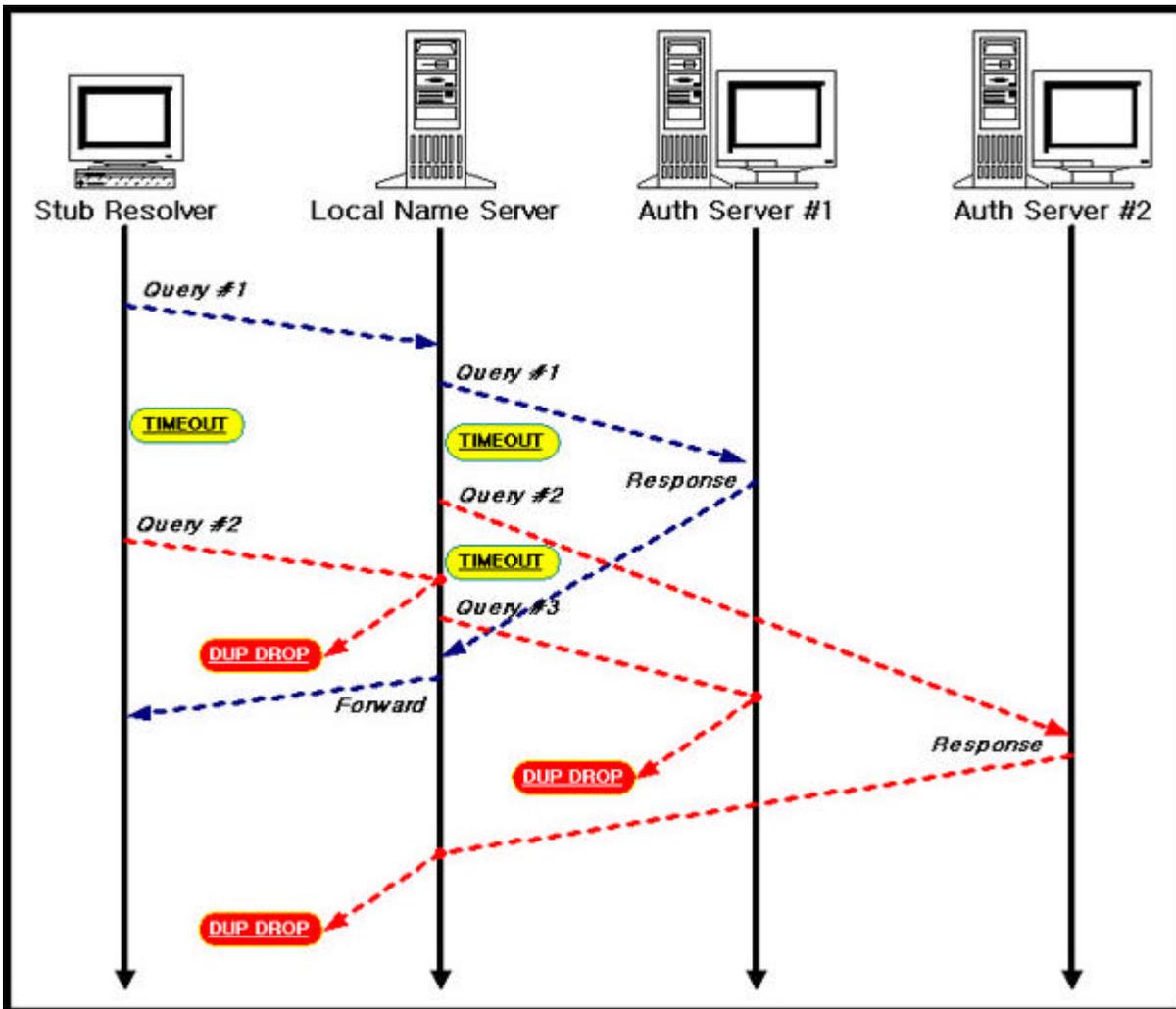
++ Name Server Statistics ++
(Legend)
        RR      RNXD    RFwdR   RDupR   RFail
        RFErr   RErr    RAXFR   RLame   ROpts
        SSysQ   SAns    SFwdQ   SDupQ   SErr
        RQ      RIQ     RFwdQ   RDupQ   RTCP
        SFwdR   SFail   SFErr   SNaAns  SNXD
(Global)
        447781  164719  227112  869     25991
        0       245     125     170586  0
        33963   720395  337570  294284  8122
        1058113 0       337570  190     0
        227112  20791   0       228616  298214

[210.104.247.129]
        157     0       0       0       10
        0       0       0       147     0
        0       36      146     22      0
        36      0       0       0       0
        11      0       0       0       13
```

.
.
.

   BIND 8.2   .

   208719 time since boot (secs)
   3396   time since reset (secs)

BIND   (HUP   )
    .

   3   Unknown query types

                                    .   ,
       .

   205739 A queries

A   ,   .

   39   NS queries

       BIND   , NS   .
Dig   Nslookup   .

   916   SOA queries

SOA   Secondary NS   Zone   .

802719 PTR queries

Reverse   A   .

19192 MX queries

MX   Sendmail   MTA   .

2   TXT queries
15   AAAA queries

TXT   AAAA   Dig   Nslookup   DNS   .

129   AXFR queries

AXFR   Secondary   Zone Transfer   ,   Zone Transfer   .

29359   ANY queries

Any   Sendmail   A, MX, CNAME   .

                          (Remote   Stub Resolver)   .
             [Global]   ,
                                   , BIND-8   [Global]
       .   ,   /   ,
                          (   )   .
                                                              .

* named.conf (BIND-8)
```
options {
        host-statistics yes;
};
```

Legend   , S(Sent)
                          , R(Received)   .   BIND
       .

RR(Sent us an answer) 447781
RQ(Sent us a query) 1058113

                              (Answer)   RR   ,   (Question)   RQ   . RR
       RQ   , RR   RQ   .

RNXD(Sent us a negative response) 164719
SNXD(Sent thema negative response) 298214

RNXD   '   '   . SNXD   '   '
              .

RFwdR(Sent us a response we had to fwd) 227112
SFwdR(Forwarded a response to them) 227112
RFwdQ(Sent us a query we had to forward) 337570
SFwdQ(Forwarded a query to them) 337570

Resolver
              Resolver   , RFwdR   (RR)
              , SFwdR   .   RFwdQ   Resolver   (RQ)
              , SFwdQ   .

RDupR(Sent us an extra answer) 869

RDupQ(Sent us a retry) 190
SDupQ(Sent thema retry) 294284

Timeout   ,   /
     ,   (Retry)   . RDupR
                    ([6]   )   , RDupQ
     (   )   , SDupQ
                              .

RFail(Sent us a SERVFAIL) 5176
SFail(Sent thema SERVFAIL) 90

RFail   (Remote)   Zone   ,   , Secondary   Expire
                    SERVFAIL   . SFail
SERVFAIL   .

RFErr(Sent us a FORMERR) 0
SFErr(Sent thema FORMERR) 0

RFErr   FORMERR   . FORMERR
               . SFErr   FORMERR
     .   0   .

RErr(Sent us some other error) 245
SErr(Sent failed) 8122

     SERVFAIL   FORMERR   /   RErr/SErr   .

RAXFR(Sent us an AXFR) 125

AXFR   Secondary   Zone Transfer   .   0
                                        Secondary
     .

RLame(Sent us a lame delegation) 170586

                    Authority   0   .
                    Primary   Secondary   .

ROpts(Sent us some IP options) 0

IP   , ROpts   .

SSysQ(Sent thema sysquery) 33963

                         .   (   )
                    .

RIQ(Sent us an inverse query) 0

RIQ   Reserve Domain   ,   BIND   PTR queries
               .   RIQ   0   .

RTCP(Sent us a query using TCP) 0

RTCP   TCP   .   UDP   /
     0   ,   .

SAns(Sent theman answer) 720395
SNaAns(Sent thema non-autoritative answer) 228616

6.5. BIND Debugging Output

BIND , .
BIND , .
.

```
# kill -USR1 `cat /var/run/named.pid` (or 'ndc trace')
# ping www.openbsd.org
# kill -USR2 `cat /var/run/named.pid` (or 'ndc notrace')
# ls -al /var/named/named.run
-rw-r--r-- 1 root  bin  1153 Mar 10 00:30 named.run
```

BIND USR1 ,
. /var/named/named.run /var/tmp/named.run ,
USR2 .
. BIND , named -
d 1 & .

```
datagram from [210.105.79.6].3442, fd 21, len 33;
```

210.105.79.6 3442 33 byte UDP 6
. IP (listen) bound
.

```
req: nlookup(www.openbsd.org) id 28375 type=1 class=1
```

datagram www.openbsd.org (req) . IN
(class=1) A(type=1) 28375 .

```
req: missed 'www.openbsd.org' as '' (cname=0)
```

(Authority ,
) . cname=0 www.openbsd.org CNAME
, BIND CNAME ,
0 CNAME .

```
forw: forw-> [198.41.0.10].53 ds=23 nsid=19461 id=28375 5ms retry 4sec
```

lookup 'J.ROOT-SERVERS.NET(198.41.0.10:53)'
.

```
datagram from [198.41.0.10].53, fd 21, len 449;
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 19461
;; flags: qr; Ques: 1, Ans: 0, Auth: 12, Addit: 12
;; QUESTIONS:
;;        www.openbsd.org, type = A, class = IN

;; AUTHORITY RECORDS:
ORG.      518400 IN      NS      A.ROOT-SERVERS.NET.
ORG.      518400 IN      NS      I.ROOT-SERVERS.NET.
ORG.      518400 IN      NS      K.GTLD-SERVERS.NET.

;; ADDITIONAL RECORDS:
A.ROOT-SERVERS.NET.      3600000 IN      A       198.41.0.4
```

```
    I. ROOT-SERVERS. NET.        3600000 IN      A       192. 36. 148. 17
    K. GTLD-SERVERS. NET.        518400  IN      A       195. 8. 99. 11
```

J.ROOT- SERVERS.NET   .   delegation
                            .   .

    resp: nl ookup(www. openbsd. org) qtype=1

        www.openbsd.org.   .

    resp: found 'www. openbsd. org' as ' org' (cname=0)
    resp: forw - > [195. 8. 99. 11]. 53 ds=23 nsid=19462 id=28375 1ms

                        , ORG   , 'K. GTLD- SERVERS. NET
(195. 8. 99. 11)'   .

    datagram from[195. 8. 99. 11]. 53, fd 21, len 219;
    ;; - >>HEADER<<- opcode: QUERY, status: NOERROR, id: 19462
    ;; flags: qr rd; Ques: 1, Ans: 0, Auth: 5, Addit: 3
    ;; QUESTIONS:
    ;;   www. openbsd. org, type = A, class = IN

    ;; AUTHORITY RECORDS:
    OPENBSD org,   172800 IN   NS   ZEUS. THEOS. COM.
    OPENBSD org,   172800 IN   NS   CVS. OPENBSD. org,
    OPENBSD org,   172800 IN   NS   NS. SIGMASOFT. COM.

    ;; ADDITIONAL RECORDS:
    ZEUS. THEOS. COM.   172800 IN   A   199. 185. 137. 1
    CVS. OPENBSD org,   172800 IN   A   199. 185. 137. 3
    NS. SIGMASOFT. COM.   172800 IN   A   209. 249. 129. 35

K. GTLD- SERVERS. NET   .

    resp: nl ookup(www. openbsd. org) qtype=1
    resp: found 'www. openbsd. org' as ' openbsd. org' (cname=0)

        www.openbsd.org.   , openbsd.org.   .

    resp: forw - > [199. 185. 137. 3]. 53 ds=23 nsid=19467 id=28375 22ms
    datagram from[199. 185. 137. 3]. 53, fd 21, len 272;

CVS.OPENBSD.ORG(199. 185. 137. 3)   ,   (A)   . (
    1   ,
)

    send_msg - > [210. 105. 79. 6]. 3442 (UDP 21) id=28375

                                        , 28375
        .

Chapter 7. DNS

7.1. NSLOOKUP

                                                                    Resolver
                        .   nslookup   dig
                    ,   .

```
$ nslookup
Default Server:  ns.nobreak.com
Address:  210.105.79.2
> exit
```

nslookup   '>'   /etc/resolv.conf
                         . nslookup   BIND   'Default NS - >
Timeout - > Error'   .

7.1.1.

nslookup   A   , IP   (in-addr.arpa)
PTR   . set type=RR   A   , RR
(Resource Record)   A, ANY, CNAME, HINFO, MX, NS, PTR, SOA, TXT   .   ANY
                                                              .

```
> www.kr.freebsd.org               # IP
Name:   www.kr.freebsd.org
Address:  150.183.110.39

> ftp.kr.freebsd.org
Name:   www.kr.freebsd.org              # ftp    www   CNAME
Address:  150.183.110.39
Aliases:  ftp.kr.freebsd.org

> 150.183.110.39                   #
Name:   www.kr.freebsd.org
Address:  150.183.110.39

> set type=MX                      # MX
> kr.freebsd.org
kr.freebsd.org  preference = 10, mail exchanger = mail.kr.freebsd.org

> set type=NS                      # NS
> kr.freebsd.org                   #
kr.freebsd.org    nameserver = ns.kr.freebsd.org
kr.freebsd.org    nameserver = ns2.kr.freebsd.org
ns.kr.freebsd.org internet address = 150.183.110.2
ns2.kr.freebsd.org internet address = 150.183.110.3

> 46.102.39.in-addr.arpa.          #
kr.freebsd.org    nameserver = ns.kr.freebsd.org
kr.freebsd.org    nameserver = ns2.kr.freebsd.org
ns.kr.freebsd.org internet address = 150.183.110.2
ns2.kr.freebsd.org internet address = 150.183.110.3
```

7.1.2.

nslookup   recurse   ,   Authority
                           Authoritative   (   )   . server,
lserver   .   (   )
                                      , server   , lserver
(nslookup   )   . lserver   ,
                                    ,
                   .   .

```
$ nslookup
Default Server:  ns.nobreak.com
Address:  210.105.79.2
```

nslookup 　　　　　　　　　　 ns.nobreak.com 　 lserver 　　　　　　　　　　 NS
　　　　　.

```
> server ns.jp.freebsd.org         #
Default Server:  ns.jp.freebsd.org
Address:    199.100.7.25

> server ns.nobreak.com
*** Can't find address for server ns.nobreak.com: Non-existent host/domain
```

ns.jp.freebsd.org 　　　　 ns.nobreak.com 　　　　　　　　.　　　　　 lserver
　　　 ns.nobreak.com 　　　　　　　.

```
> lserver ns.nobreak.com
Default Server:  ns.nobreak.com
Address:    210.105.79.2
```

　　　　　　　　　　　　　　　　　　　　, 　　　 root 　　　　　　　　.

```
> root
Default Server:  a.root-servers.net
Address:    198.41.0.4
```

7.1.3

　　　　　 Resolver 　　　　　　　　, 　　　　　　　　, 　　　　　　　,
nslookup 　　　　　　　　　　　　.　　　　　　　　　　, 　　　　　
　　　　, 　　　　　　　　, 　　　　　　　.

Figure 7- 1.


```
    (1)
> set norecurse       # Iterative
> www.kr.freebsd.org
Server:  ns.nobreak.com
Address:  210.105.79.2
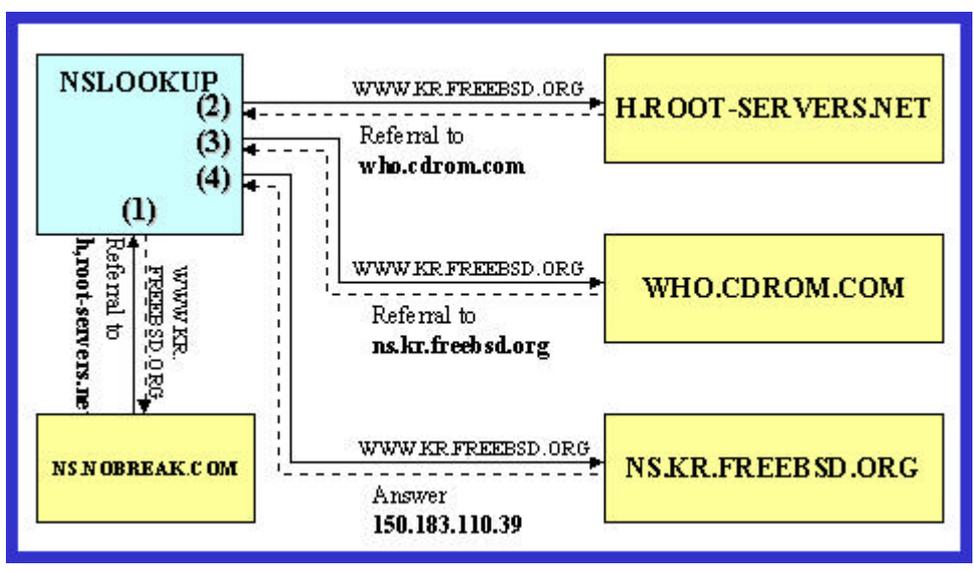
Name:    www.kr.freebsd.org
Served by:
- H.ROOT-SERVERS.NET
        128.63.2.53
```

```
                ORG.
    - B.ROOT-SERVERS.NET
            128.9.0.107
                ORG.
    . . .
```

ORG.   .

(2)
```
> server h.root-servers.net.
> www.kr.freebsd.org.
Server:   h.root-servers.net
Address:  128.63.2.53

Name:     www.kr.freebsd.org
Served by:
- WHO.CDROM.COM
        204.216.27.3
            FREEBSD.ORG.
- NS1.CRL.COM
        165.113.1.36
            FREEBSD.ORG.
- NS2.CRL.COM
        165.113.61.37
            FREEBSD.ORG.
```

(3)
```
> server who.cdrom.com
> www.kr.freebsd.org.
Server:   who.cdrom.com
Address:  204.216.27.3

Name:     www.kr.freebsd.org
Served by:
- ns.kr.freebsd.org
        150.183.110.2
            kr.freebsd.org.
- ns2.kr.freebsd.org
        150.183.110.3
            kr.freebsd.org.
```

(4)
```
> server ns.kr.freebsd.org.
> www.kr.freebsd.org.
Server:   ns.kr.freebsd.org
Address:  150.183.110.2

Name:     www.kr.freebsd.org
Address:  150.183.110.39
```

7.1.4. Zone Transfer

                Zone   , Primary   Zone
Zone Transfer   .   Secondary NS   ,
                        Zone   .
Zone Transfer Authority   , nslookup   NS
            , ls   .

```
> server ns.kr.freebsd.org.
> ls -t A kr.freebsd.org.        # A
 kr.freebsd.org.                 server = ns.kr.freebsd.org
 kr.freebsd.org.                 server = ns2.kr.freebsd.org
 mail                            150.183.110.32
 mqueue                          150.183.110.33
 www                             150.183.110.39
 www2                            150.183.110.40
```

```
> ls -d kr.freebsd.org          #
kr.freebsd.org.               SOA    ns.nobreak.comhostmaster.kr.freebsd.org.
                              (1999031501 21600 1800 1209600 86400)
kr.freebsd.org.               NS     ns.nobreak.com
kr.freebsd.org.               NS     ns2.nobreak.com
kr.freebsd.org.               MX     10    mail.kr.freebsd.org
kr.freebsd.org.               MX     20    mqueue.kr.freebsd.org
cvsup                         CNAME  www.kr.freebsd.org
mail                          A      150.183.110.32
mqueue                        A      150.183.110.33
ftp                           CNAME  www.kr.freebsd.org
ftp2                          CNAME  www2.kr.freebsd.org
ftp3                          CNAME  ftp.free.nobreak.com
www                           A      150.183.110.39
www                           HINFO  Pentium200   FreeBSD 2.2.8
www                           TXT    "Korea FreeBSD Users Group"
www2                          A      150.183.110.40
www2                          HINFO  Pentium133MHz   FreeBSD 2.2.8
www2                          TXT    "Korea FreeBSD Users Group"

> ls -t MX kr.freebsd.org > MX.kr.freebsd.org    #
> view MX.kr.freebsd.org                         #
```

BIND   named-xfer   Zone Transfer   .
         Secondary   .

    secondary   kr.freebsd.org 210.105.79.2   sec-kr.freebsd.org

BIND   secondary   .

```
loop(Interval == TTL) {
        named-xfer -z kr.freebsd.org -f /var/named/sec-kr.freebsd.org -s Current_Serial 210.105.79.2
        switch ( $? ) {        // named-xfer                      '$?'
                case 0 : OK;  //                        , Zone Transfer
                case 1 : OK;  //                        , Zone Transfer
                case 2 : ERROR; //
                              //                                      Authority
                case 3 : ERROR; //                       ,
        }
        primary  kr.freebsd.org  sec-kr.freebsd.org
}
```

                   (: Secondary NS's IP)   Zone Transfer   , Primary
NS   . (Zone Transfer   ,
)

    xfrnets 210.105.79.3&255.255.255.255 210.105.80.128&255.255.255.128

        BIND-4   , IP 210.105.79.3   210.105.80.129-254   Zone Transfer
             . BIND-4   IP   "IP&Mask"
        ,   210.105.79.0   .

```
options {
        allow-transfer { localnets; 210.105.79.3; };
};
```

BIND-8   , 210.105.79.3   . localnets
               any, none, localhost   .

7.1.5.   .nslookuprc

nslookup   ~/.nslookuprc   ,   .

,   .

```
* .nslookuprc
set type=NS
set nosearch
set debug
```

7.2. DIG

Dig(Domain Information Groper)   . nslookup
        ,   ,   , Shell Script   .   ns.kornet.ne.kr
        www.nobreak.com   A   .

```
$ dig [@       ]          [       ] [+        ]
$ dig @ns.kornet.ne.kr  www.nobreak.com A
;; ANSWER SECTION
www.nobreak.com           16h12m36s IN CNAME  ns.nobreak.com
ns.nobreak.com            1d19h12m27s IN A  210.105.79.2
;; AUTHORITY SECTION
nobreak.com               22h17m35s IN NS  ns.nobreak.com
nobreak.com               22h17m35s IN NS  ns2.nobreak.com
;; ADDITIONAL SECTION
ns.nobreak.com            1d19h12m27s IN A  210.105.79.2
ns2.nobreak.com           1d1h46m58s IN A  210.105.79.3
```

DIG   ANSWER SECTION   ,
AUTHORITY SECTION   ,   ,   ADDITIONAL SECTION
                .

7.3. DNSWALK

Dnswalk   Perl   MX, PTR   A,
CNAME,   ,   ,   , Lame Delegation
Zone   .   .
Dnswalk   .

- http://www.cis.ohio-state.edu/~barr/dnswalk/

```
$ dnswalk -raFl freebsd.org
Checking freebsd.org.
Getting zone transfer of freebsd.org. from ns2.iafrica.com...done.
SOA=implode.root.com     contact=hostmaster.freebsd.org
FAIL: Cannot get SOA record for pt.freebsd.org from zeus.ci.ua.pt
(lame?):  Connection refused
BAD  lv.freebsd.org NS ns.fasts.com. lame NS delegation
BAD  eu.freebsd.org NS server.zsb.th-darmstadt.de:  unknown host
WARN  irc3.freebsd.org CNAME irc.nocturnal.net:  CNAME (to nocturnal.net)
WARN  ns.th.freebsd.org A 203.154.230.20:  no PTR record
WARN  irc2.freebsd.org CNAME va.i-Plus.net:  unknown host
1 failures, 3 warnings, 1 errors.
```

Dnswalk   Zone Transfer   Dig   Resolver
        . Delegation
            .

Chapter 8. Miscellaneous

8.1. FQDN(Fully Qualified Domain Name)

FQDN   .   , YAHOO.COM.
    , WWW.YAHOO.COM.   .   FQDN
              ,   Namespace   .

www(   ), yahoo.com.(   ), www.yahoo.com.(FQDN)

                                                                        ('.'   )
        ,   .

8.2. DNS   BIND

DNS   Domain Name System   ,   .   ,
    IP   . ,
              ,   Resolver
          ,   DNS   .

BIND   Berkeley Internet Name Domain   , DNS   ,'   '
              DNS   . BIND
          ,   .

8.3. BIND-4(Traditional)   BIND-8(Next Generation)

BIND   1999   1   BIND-4   BIND-8   . 1998   5   11   4.9.7
                      BIND-4   , BIND-8   8.2   . BIND-8
    RFC2136, RFC1996   .   BIND-8
              ,   OS   BIND-4
    ,   .   ,   BIND-8   .

BIND-4   BIND-8   ,   . BIND-4   named.boot
    , BIND-8   named.conf   .   .   Zone
              , BIND-4   BIND-8   ,
          .

8.4.   (Public Domain)

                                      .
                          . ,
                      resolving   .
                          .

8.5. CNAME

CNAME   DNS   . A   '   /   '
        . , CNAME   CNAME

, RFC . , BIND implementation
Aliasing , CNAME
IP
, CNAME
. CNAME (MX, SOA, NS) CNAME
.

8.6. Zone

Zone .

- TAB . .

- TTL 2D, 1W
  .

- , FQDN .

```
ftp                    IN     MX     mail
www                    IN     CNAME  power

ftp.nobreak.com        IN     MX     mail.nobreak.com
www.nobreak.com        IN     CNAME  power.nobreak.com
```

FQDN . CNAME
.

```
ftp                    IN     MX     mail.nobreak.com
www                    IN     CNAME  power.nobreak.com
```

- , , .

8.7. (Glue Record)

NS A ,
. ns.nms.nobreak.com .

```
nms.nobreak.com        IN     NS     ns.nms.nobreak.com
ns.nms.nobreak.com     IN     A      150.183.110.2       ;
```

, ns.kr.freebsd.org ,
freebsd.org NS ns.kr.freebsd.org
ns.nms.nobreak.com ns.kr.freebsd.org IP .

```
nms.nobreak.com        IN     NS     ns.nms.nobreak.com ; (X)
ns.nms.nobreak.com     IN     A      210.105.79.2

nms.nobreak.com        IN     NS     ns.kr.freebsd.org   ; (O)
```

, IP
. .

8.8. Lame Delegation

Lame delegation   Namespace   .

```
nms.nobreak.com          IN     NS      ns.nms.nobreak.com
                         IN     NS      ns2.nms.nobreak.com
```

        nms.nobreak.com   ,
                Authority   ,   Primary, Secondary   Lame
delegation   .

8.9. Authoritative answer & Non-authoritative answer

Name Server
Namespace   .   Resolving   TTL(Time
To Live)   , TTL   .   Resolving
                                            Non-authoritative answer   ,   TTL
                    Primary   Authoritative
answer   .

8.10. Positive & Negative Caching

                Resolving   .

```
$ finger @kfug.kr.freebsd.org
$ talk nobreak@kfug.kr.freebsd.org
```

        ,   ,
                        .   ,   ?
                                            .   ,
                                    .   Negative   ,
Positive   .

        ,   named   .
        ,   Zone   (kill -HUP)   .

8.11. Iterative(Nonrecursive) & Recursive

                Recursive   ,   (Stub Resolver   )
Namespace   .   Iterative   (
)   ,   NS   .   Recursive
                    , Iterative   (
Iterative   )   .   ,   Iterative
                                    ,   (:resolv.conf,   DNS   )
                    . BIND-4   'options no-recursion'   , Iterative
        , BIND-8   options   'recursion no;'   .

8.12. RTT(Round Trip Time)   Nameserver

                     ,   Round Trip Time   . (Recursive
) BIND   RTT   ,
      Authority NS   RTT   . Authority NS   RTT
                    ,   (   )
   RTT   . RTT   RTT
            .   ,
      RTT   .

8.13.

      : RFC 1034 p25

Zone   (*)   .

      *   IN   A   210.105.79.20

            Zone   , Zone
                .   MX   .

      *   IN   MX   mail

                                                              ,   MX   ,
                                .   MX
            . (
)

      ,   (   )   .   .

      www *   IN   A   210.105.79.20

www.ANYTHING.nobreak.com   ,
            .

8.14. Serial Number

                                                                              Serial
      .   YYYYMMDDNN   4294   , 19990205010
                  '0'   .   Secondary   Zone
            .   .

      • Secondary   ,   Primary Zone   Serial   . Secondary
                          Zone   (Zone Transfer)   BIND   .

      • Secondary   , Zone   Serial   '0'
            . Secondary   '0'   Serial   Zone   ,   , Refresh
                  ,   Serial   .

      nslookup -type=SOA kr.freebsd.org ns2.nobreak.com

Secondry   Zone   Serial   .

8.15. IP   TTL

,   TTL   10
(6000sec)   .

    www   6000   IN   A   210.105.79.6

                                    TTL   0   ,   .
                        Resolving   ,   .
Maximum Propagation Delay Time(TTL +   SOA   Refresh)   ,   (IP
)   ,   ,
            , 1-2   TTL   .   Zone
      , SOA   Minimum   .

8.16.

                        ,   ,
            .   ,   .
                        ,   .
        ,   . Shuffle Addresses   BIND 4.9
            .

    www   180   IN   A   210.105.79.101
                       180   IN   A   210.105.79.102
                       180   IN   A   210.105.79.103

                        IP   ,
            .

    $ nslookup www.nobreak.com
    Name: www.nobreak.com
    Addresses: 210.105.79.101, 210.105.79.102, 210.105.79.103

    $ nslookup www.nobreak.com
    Name: www.nobreak.com
    Addresses: 210.105.79.102, 210.105.79.103, 210.105.79.101

    $ nslookup www.nobreak.com
    Name: www.nobreak.com
    Addresses: 210.105.79.103, 210.105.79.101, 210.105.79.102

                        (Load Balancing)   ,   3
      ,   .   ,   TTL
            (TTL   )   .

                            CNAME   .   CNAME
      ,   .

    options {
          multiple-cnames yes;
    };

        BIND-8   ,   YAHOO!(www.yahoo.com)   .

```
www              180     IN      CNAME   www1.nobreak.com
                 180     IN      CNAME   www2.nobreak.com
                 180     IN      CNAME   www3.nobreak.com
www1             180     IN      A       210.105.79.101
www2             180     IN      A       210.105.79.102
www3             180     IN      A       210.105.79.103
        180 IN  A    210.105.79.104
        180 IN  A    210.105.79.105
```

A   Resolver   NS   Authority NS   IP(   )
                                                 ,   CNAME   NS
                                                        , TTL   Resolver
                      .

* Authority NS
```
$ nslookup www.nobreak.com ns.nobreak.com
Name:     www1.nobreak.com
Address:  210.105.79.101
Aliases:  www.nobreak.com

$ nslookup www.nobreak.com ns.nobreak.com
Name:     www2.nobreak.com
Address:  210.105.79.102
Aliases:  www.nobreak.com

$ nslookup www.nobreak.com ns.nobreak.com
Name:     www3.nobreak.com
Address:  210.105.79.103, 210.105.79.104, 210.105.79.105
Aliases:  www.nobreak.com
```


*   (Third Party Name Server)
```
$ nslookup www.nobreak.com ns.kornet.ne.kr
Name:     www2.nobreak.com
Address:  210.105.79.102
Aliases:  www.nobreak.com

$ nslookup www.nobreak.com ns.kornet.ne.kr
Non-authoritative answer:
Name:     www2.nobreak.com
Address:  210.105.79.102
Aliases:  www.nobreak.com
```

$ sleep 180 (TTL   )

```
$ nslookup www.nobreak.com ns.kornet.ne.kr
Non-authoritative answer:
Name:     www3.nobreak.com
Address:  210.105.79.103, 210.105.79.104, 210.105.79.105
Aliases:  www.nobreak.com

$ nslookup www.nobreak.com ns.kornet.ne.kr
Non-authoritative answer:
Name:     www3.nobreak.com
Address:  210.105.79.104, 210.105.79.105, 210.105.79.103
Aliases:  www.nobreak.com

$ nslookup www.nobreak.com ns.kornet.ne.kr
Non-authoritative answer:
Name:     www3.nobreak.com
Address:  210.105.79.105, 210.105.79.103, 210.105.79.104
Aliases:  www.nobreak.com
```


     ,
(Clustering)   .

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