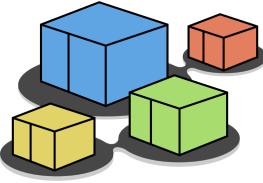




kathara lab

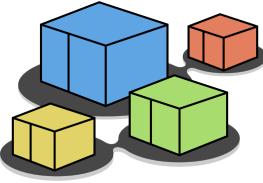
dns

Version	2.0
Author(s)	L. Ariemma, G. Di Battista, M. Patrignani, M. Pizzonia, F. Ricci, M. Rimondini
E-mail	contact@kathara.org
Web	http://www.kathara.org/
Description	using the domain name system – kathara version of an existing netkit lab



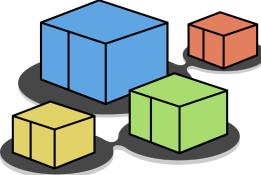
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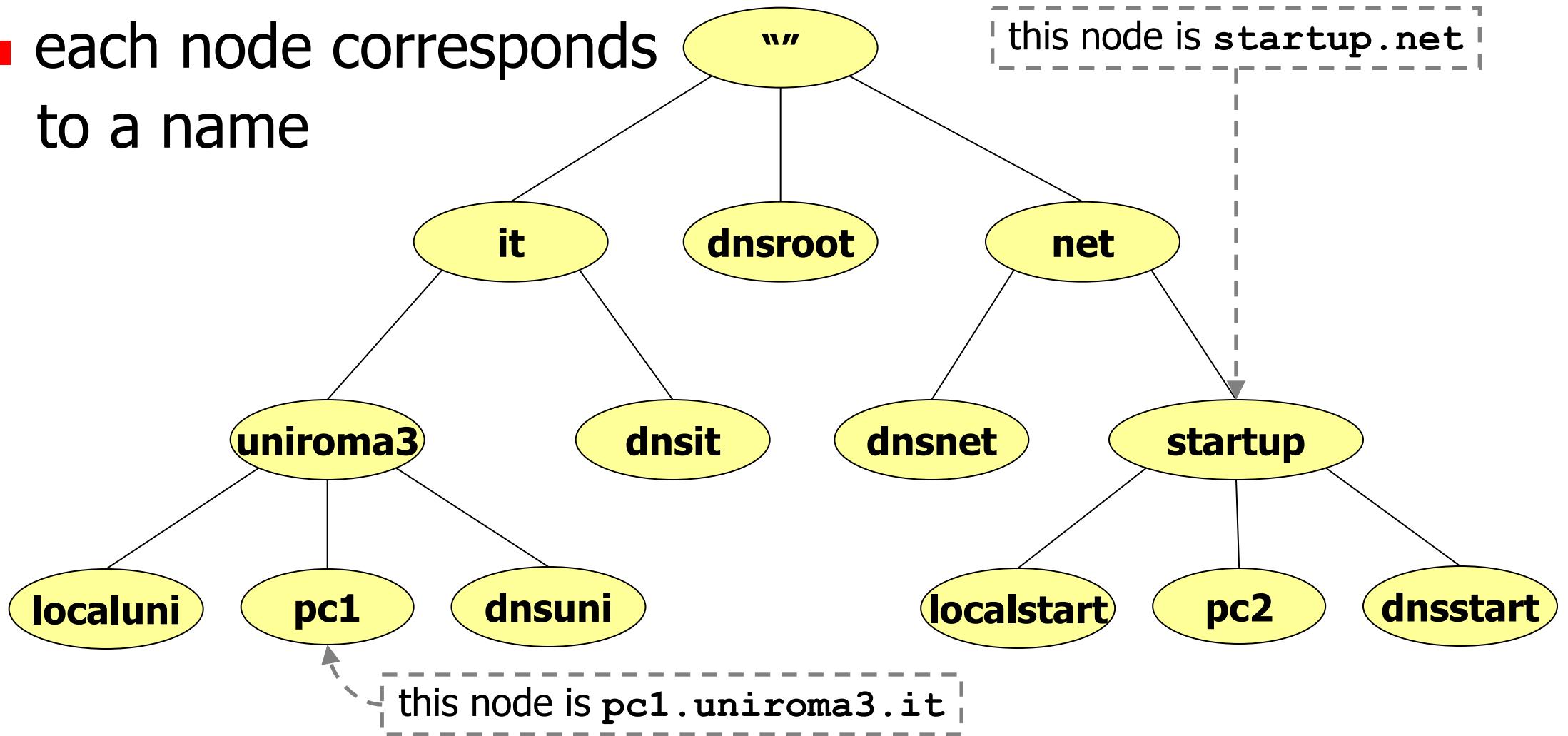
about the dns

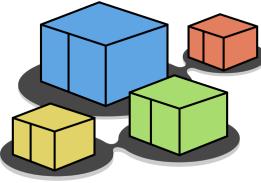
- takes care of associating names with ip addresses
- the **name system** is distributed over several nodes (hosts) that are hierarchically organized to form a tree
- each node in the hierarchy corresponds to a **name**
- a **domain** in the name system is a subtree
- a node in the hierarchy may be delegated to handle names for a particular zone
 - such a node is an **authoritative server** for that zone
- a **zone** is a domain which is devoid of those nodes having a different authoritative server (i.e., a tree without subtrees)



the dns name hierarchy

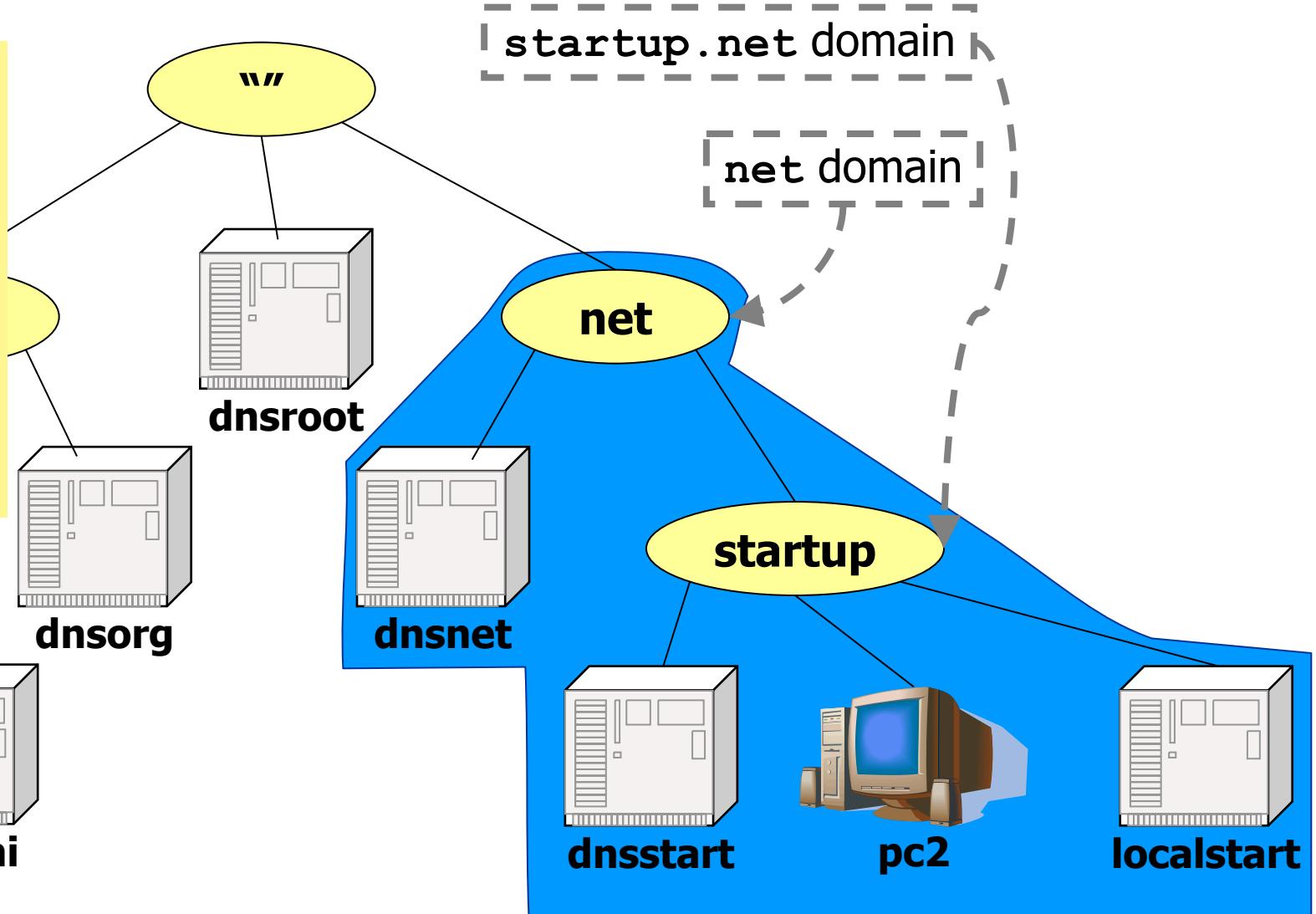
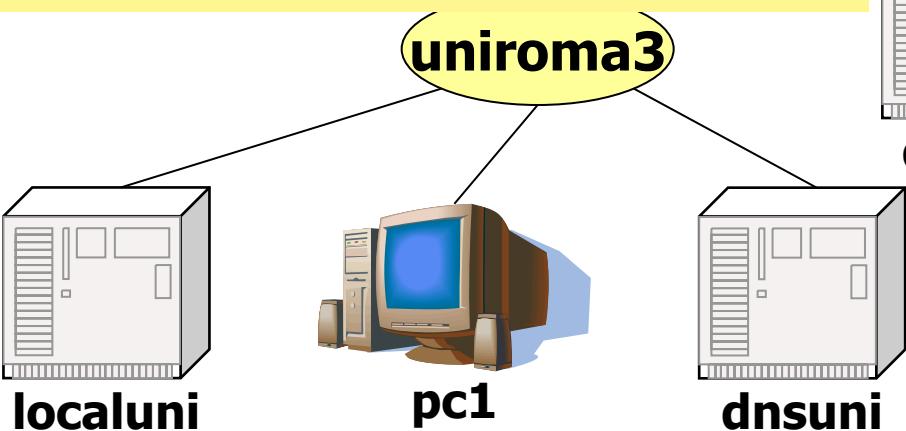
- each node corresponds to a name

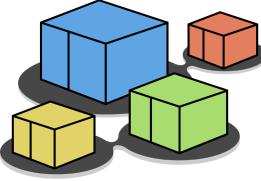




the dns name hierarchy

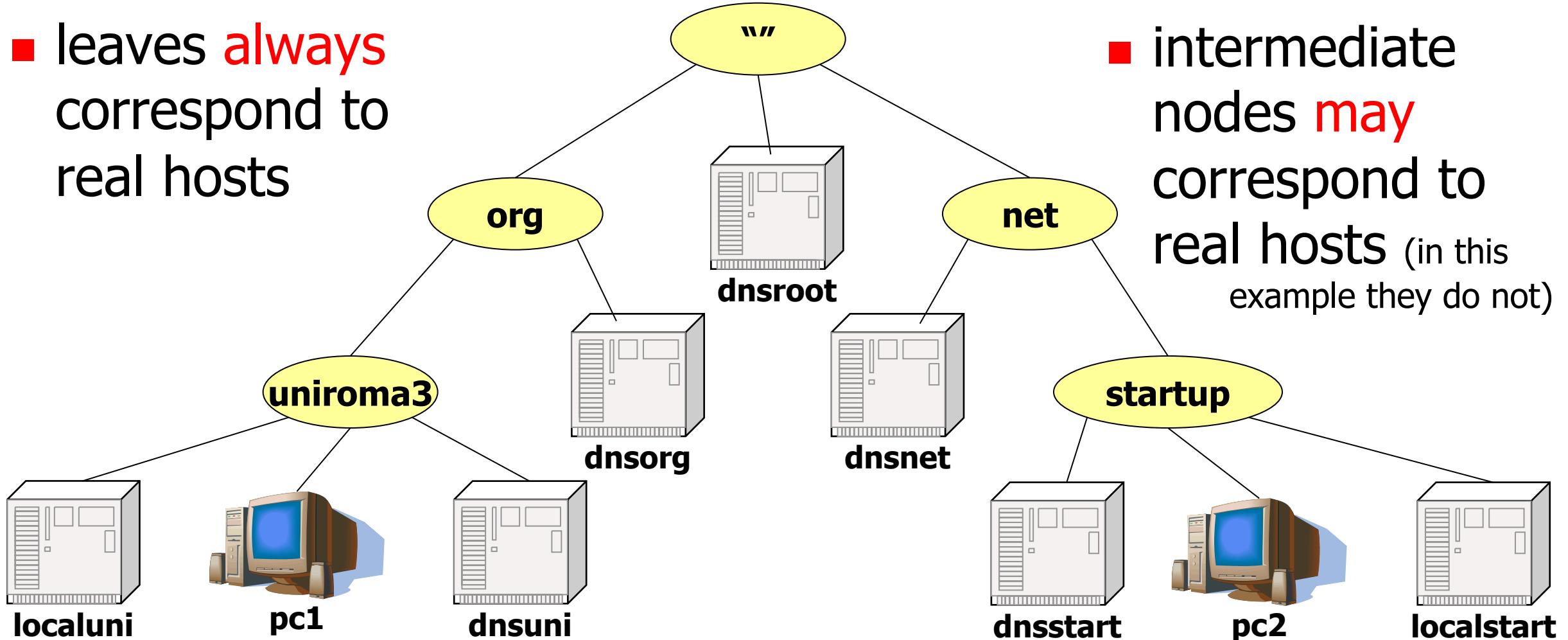
- **domains** are subtrees
 - their name is the name of the root node
 - every node (including leaves) defines a domain
 - domains do **overlap**

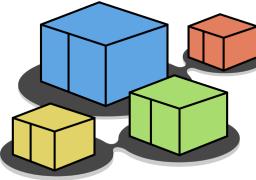




the dns name hierarchy

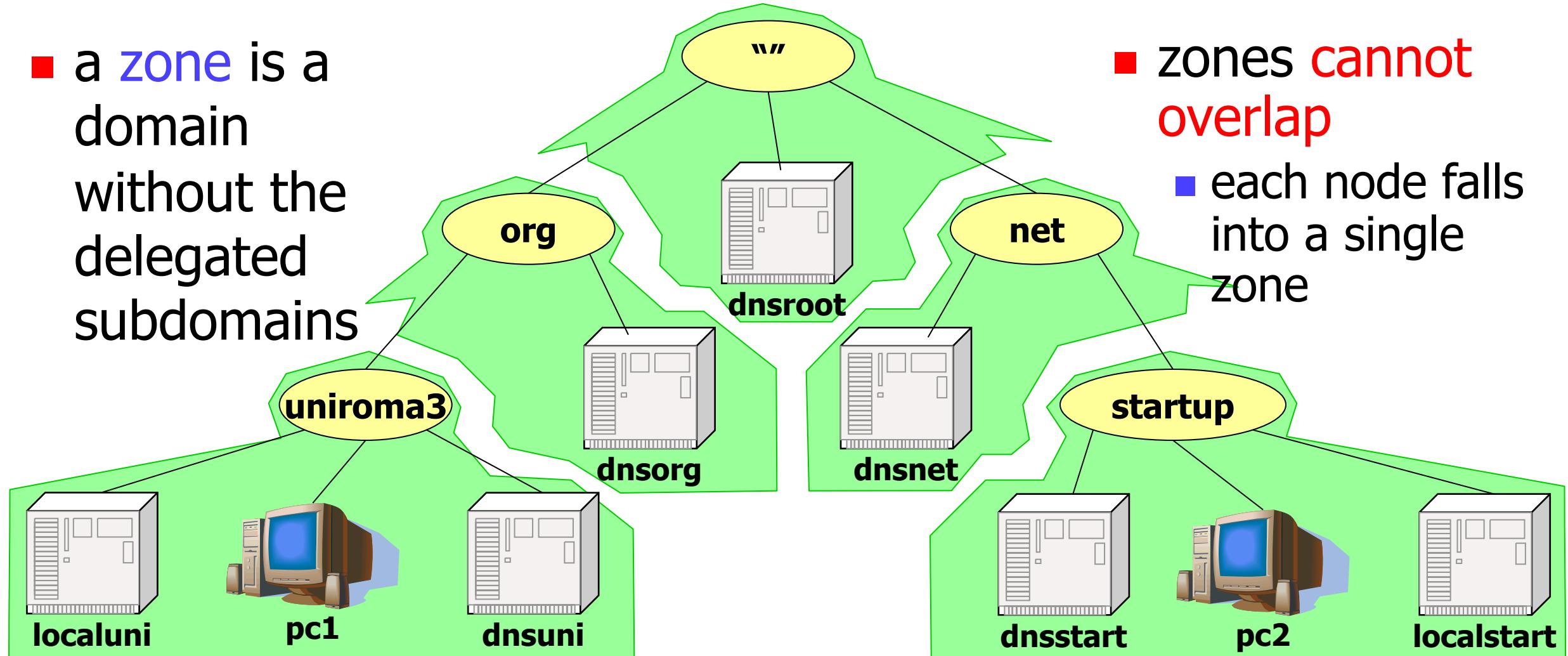
- leaves **always** correspond to real hosts



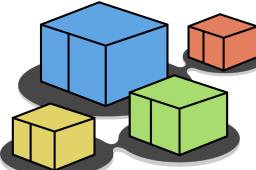


zones

- a **zone** is a domain without the delegated subdomains

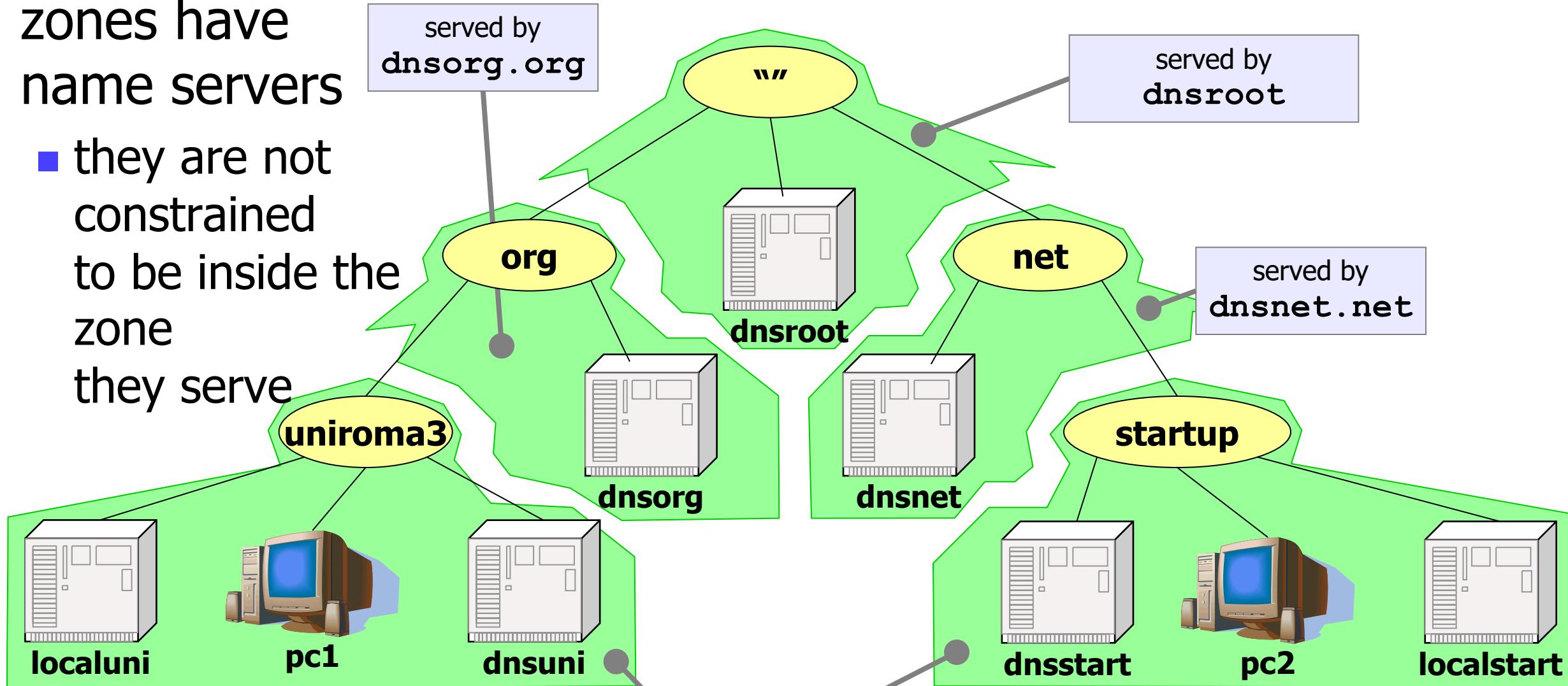


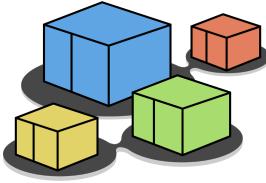
- **zones cannot overlap**
 - each node falls into a single zone



zones

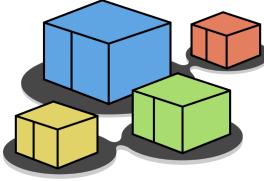
- zones have name servers
 - they are not constrained to be inside the zone they serve



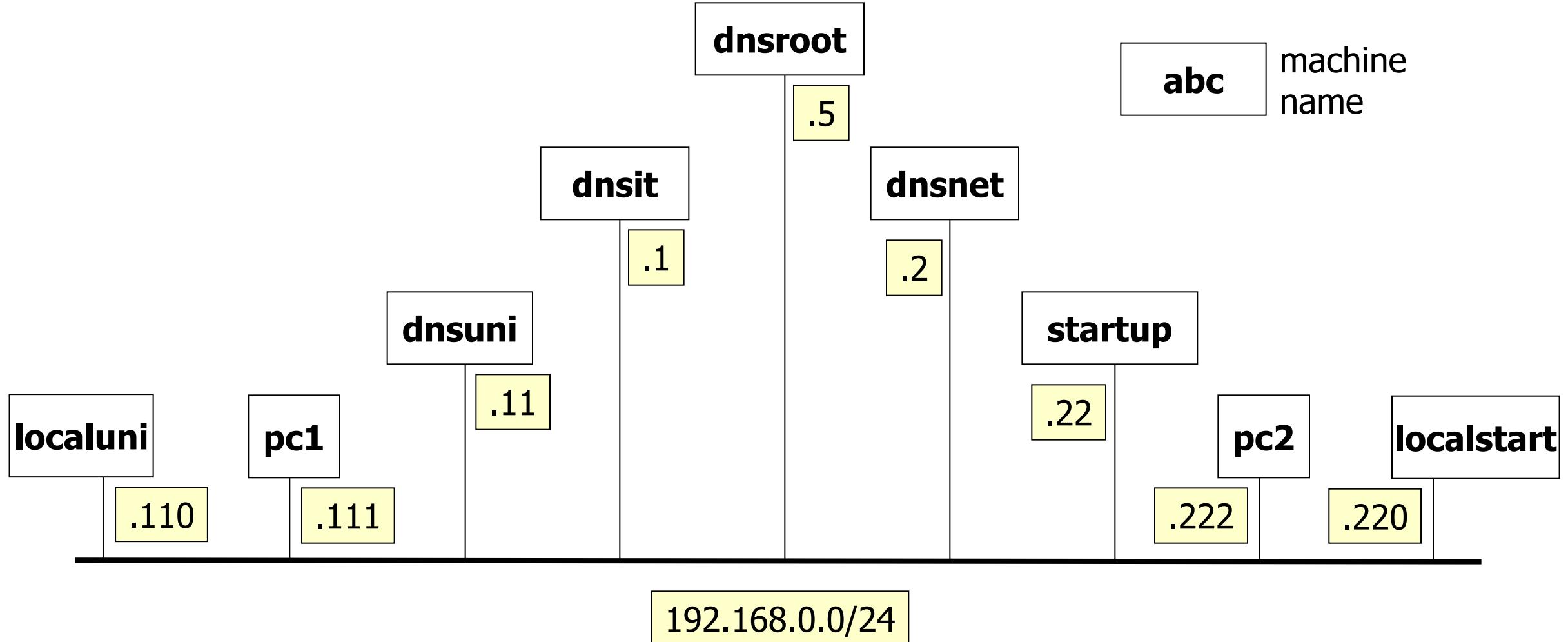


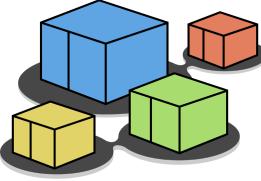
more about the dns

- the dns hierarchy is orthogonal with respect to the actual network topology
- in order to focus on the behavior of the dns we choose a flat topology, consisting of a single collision domain

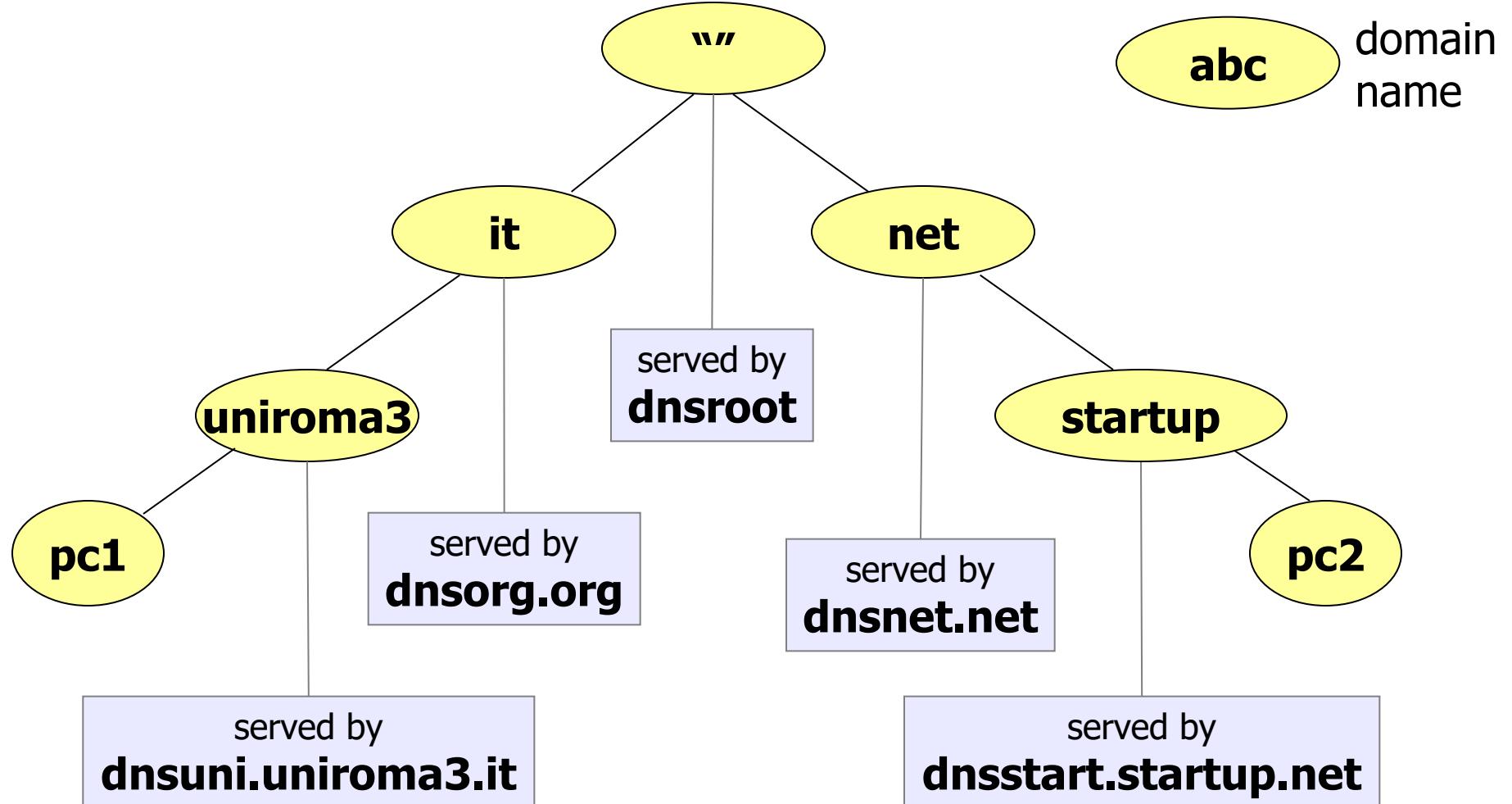


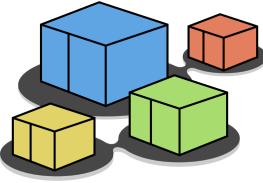
step 1 – network topology





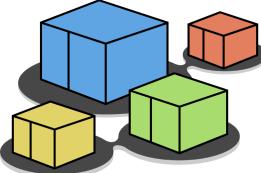
step 1 – dns (zone) hierarchy





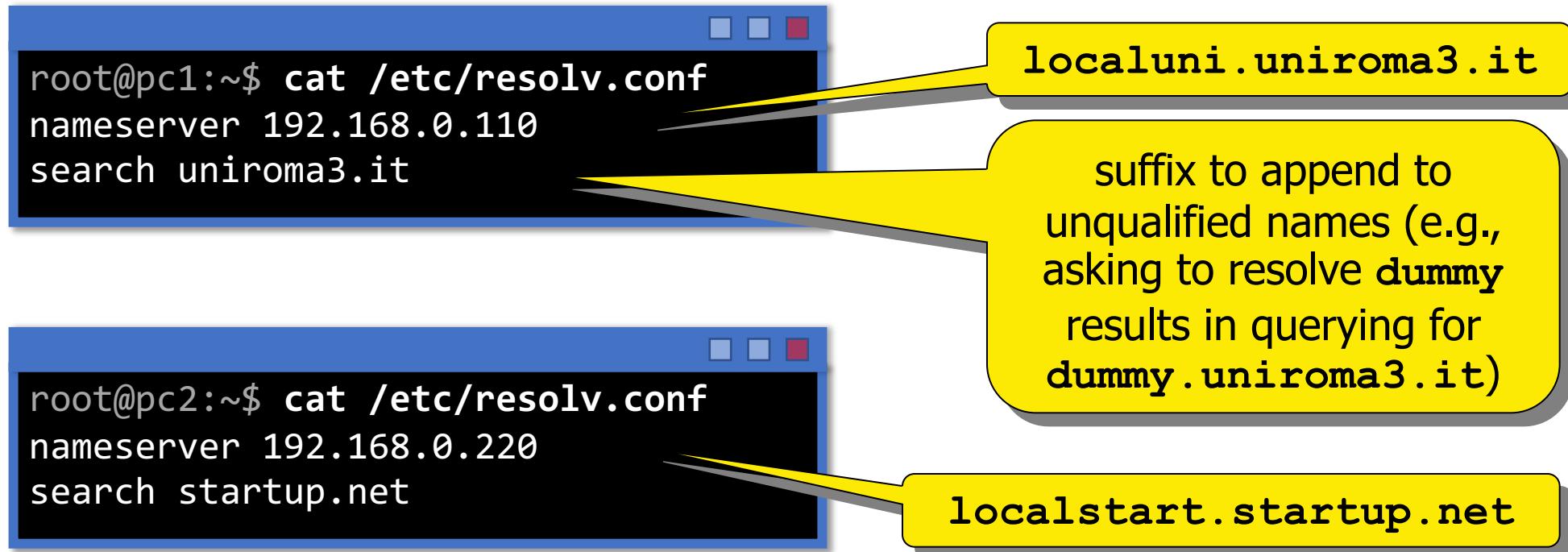
step 2 – starting the lab

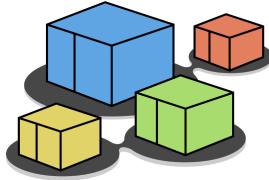
- the lab is configured to
 - start all the 9 vms
 - automatically configure the network interfaces
 - automatically configure the authority name servers
 - automatically configure the local name servers
 - automatically start the name server software (bind) on each name server



step 2 – exploring the configuration

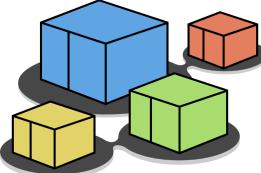
- configuration on the PCs consists of the specification of the default name server





step 2 – exploring the configuration

- configuration on the name servers specifies
 - associations between zones and name servers
 - information about the root name servers
 - authoritative information
 - associations between names and IP addresses
 - authorization to resolve recursive queries



step 2 – exploring the configuration

- configuration on the name servers specifies
 - associations between zones and name servers

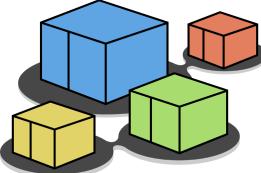
```
root@dnsuni:~$ cat /etc/bind/named.conf
include "/etc/bind/named.conf.options";  
  
zone "." {
    type hint;
    file "/etc/bind/db.root";
};  
  
zone "uniroma3.it" {
    type master;
    file "/etc/bind/db.it.uniroma3";
};
```

include some additional configuration

where to find information about the root name server

we are the primary master for zone **lugroma3.org**

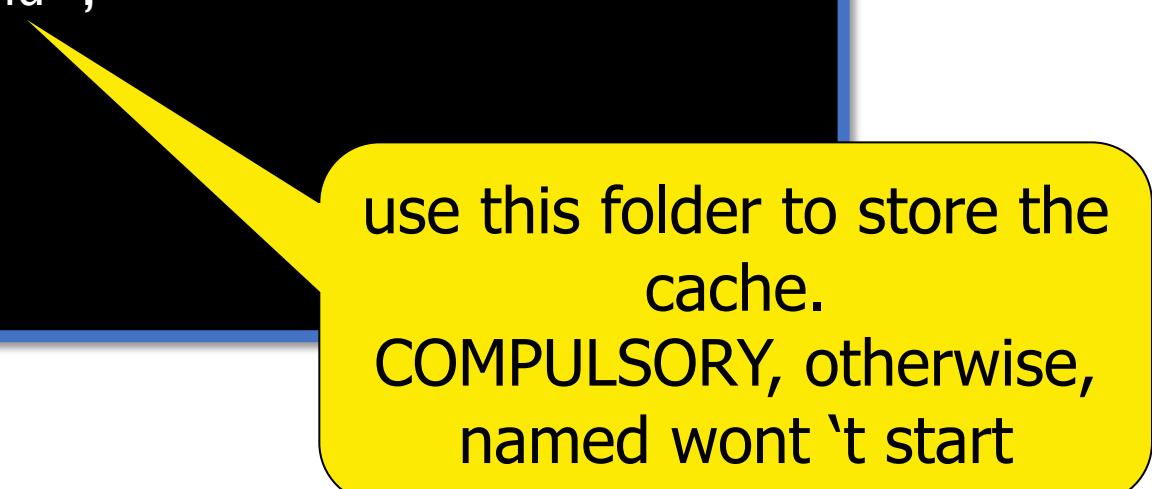
where to find data about the names in this zone



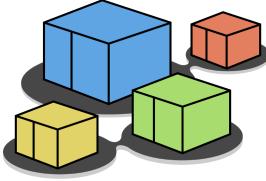
step 2 – exploring the configuration

- configuration on the name servers specifies
 - additional configuration

```
root@dnsuni:~$ cat /etc/bind/named.conf.options
options {
    directory "/var/cache/bind";
};
```



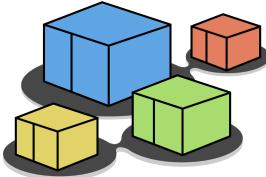
use this folder to store the
cache.
COMPULSORY, otherwise,
named wont 't start



format of a resource record

<domain> <class> <type> <rdata>

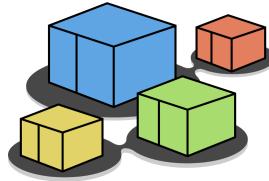
- domain: the record owner (=domain to which the record refers)
- class: usually IN (=Internet system); may be HS (=hesiod) or CH (=chaos)
- type: see next slide...
- rdata: record data (depends on the record type)



step 2 – exploring the configuration

available record types

A	a host address.
A6	an IPv6 address.
AAAA	Obsolete format of IPv6 address
AFSDB	(x) location of AFS database servers. Experimental.
CERT	holds a digital certificate.
CNAME	identifies the canonical name of an alias.
DNAME	for delegation of reverse addresses. Replaces the domain name specified with another name to be looked up. Described in RFC 2672.
GPOS	Specifies the global position. Superseded by LOC.
HINFO	identifies the CPU and OS used by a host.
ISDN	(x) representation of ISDN addresses. Experimental.
KEY	stores a public key associated with a DNS name.
KX	identifies a key exchanger for this DNS name.
LOC	(x) for storing GPS info. See RFC 1876. Experimental.
MX	identifies a mail exchange for the domain. See RFC 974 for details.
NAPTR	name authority pointer.
NSAP	a network service access point.
NS	the authoritative nameserver for the domain.
NXT	used in DNSSEC to securely indicate that RRs with an owner name in a certain name interval do not exist in a zone and indicate what R
PTR	a pointer to another part of the domain name space.
PX	provides mappings between RFC 822 and X.400 addresses.
RP	(x) information on persons responsible for the domain. Experimental.
RT	(x) route-through binding for hosts that do not have their own direct wide area network addresses. Experimental.
SIG	("signature") contains data authenticated in the secure DNS. See RFC 2535 for details.
SOA	identifies the start of a zone of authority.
SRV	information about well known network services (replaces WKS).
TXT	text records.
WKS	(h) information about which well known network services, such as SMTP, that a domain supports. Historical, replaced by newer RR SRV.
X25	(x) representation of X.25 network addresses. Experimental

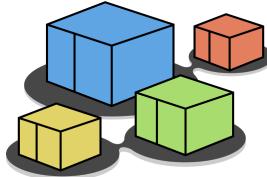


step 2 – exploring the configuration

- configuration on the name servers specifies
 - information about the root name servers

```
root@dnsuni:~$ cat /etc/bind/db.root
.
          IN  NS      ROOT-SERVER.
ROOT-SERVER.   IN  A       192.168.0.5
```

a resource record

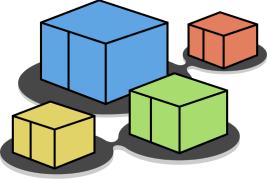


step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
```

time to live, in seconds
(determines how long a resource record should be cached)



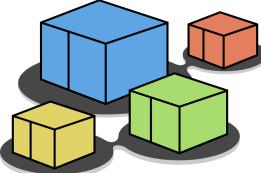
step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsslug:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
              root.dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                28    ; refresh
                                14    ; retry
                                3600000 ; expire
                                0     ; negative cache ttl
                                )
```

- must be all on a single line; line breaks can only be introduced when using parentheses
- a zone data file can contain only one SOA record

Start of Authority record



step 2 – exploring the configuration

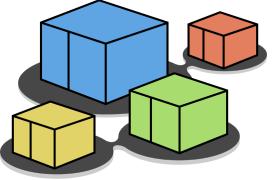
- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@       IN      SOA    root.dnsuni.uniroma3.
```

this record is referred to the current origin (`uniroma3.it`)

- all domain names in this data file that are not fully qualified (do not end with a '.') are relative to the *origin*
- the *origin* is the domain name in the *zone* statement of the server configuration file:

```
zone "uniroma3.it" {
    type master;
    file "/etc/bind/db.it.uniroma3";
};
```

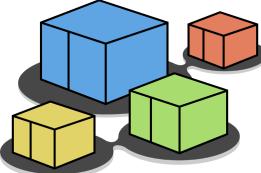


step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@       IN      SOA     dnsuni.uniroma3.org.
root.dnsuni.uniroma3.org. (
                          20060312        serial
                          28 ;
```

primary master (=authority) server for this zone (`dnsuni.uniroma3.org`);
don't forget the trailing dot, or the origin name (`uniroma3.org`) would be appended!



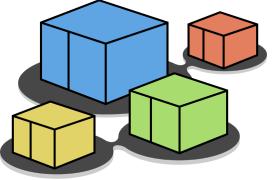
step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
root.dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                0000000000 ; refresh
                                0000000000 ; expire
                                cache ttl)
```

mail address of the person that is
responsible for the zone
(root@dnsuni.uniroma3.org)

- the first '.' must be replaced by a '@'
- only meant to be used by humans; has no use within the dns service

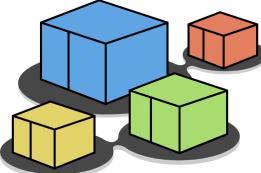


step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
root.dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                28 ; refresh
                                14 ; retry
                                3600000 ; expire
                                0 ; negative cache ttl
)
```

make sense for
master/slave server
configurations



step 2 – exploring the configuration

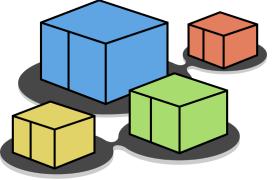
- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
              root dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                28   ; refresh
                                14400 ; expire
                                3600  ; ttl)
```

serial number

2006031201 ; serial
28 ; refresh

- determines how recent the information is
- influences all data within the zone
- conventional format:
YYYYMMDDNN (year, month, day, # of changes within that day)



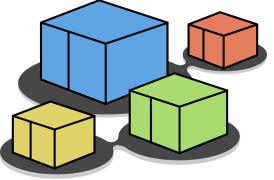
step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
              root.dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                28   ; refresh
                                14   ; retry
                                3600000 ; expire
```

refresh interval
(seconds)

- tells a slave how often to check that the data for this zone is up to date

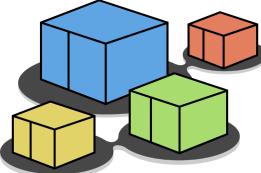


step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
              root.dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                28    ; refresh
                                14    ; retry
                                3600000 ; expire
                                0     ; negative cache ttl
              )
```

interval (seconds)
between
subsequent
attempts to
contact the master



step 2 – exploring the configuration

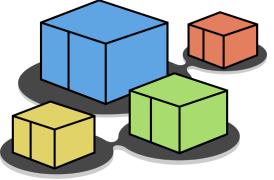
- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/named.conf.local
$TTL    60000
@           IN
root.dnsuni.uniroma3
```

slave expire time
(seconds)

- if the slave fails to contact the master for this amount of time, it considers the zone data too old and stops giving answers about it

```
2006031201 ; serial
28 ; refresh
14 ; retry
3600000 ; expire
0 ; negative cache ttl
)
```

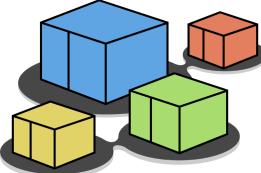


step 2 – exploring the configuration

- configuration on the name servers specifies
 - authoritative information

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
              root.dnsuni.uniroma3.org. (
                                2006031201 ; serial
                                28    ; refresh
                                14    ; retry
                                3600000 ; expire
                                0     ; negative cache ttl
              )
```

ttl for negative responses from authoritative name servers



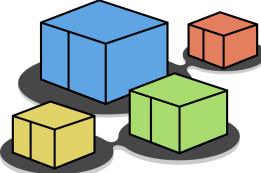
step 2 – exploring the configuration

- configuration on the name servers specifies
 - associations between names and ip addresses

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL      60000
@           IN      SOA      dnsuni.uniroma3.org.
                         .org. (
                           2006031201 ; serial
                           28 ; refresh
                           14 ; retry
                           3600000 ; expire
                           0 ; negative cache TTL
                         )
@           IN      NS       dnsuni.uniroma3.it.
dnsuni.uniroma3.it.   IN      A        192.168.0.11
pc1.uniroma3.it.     IN      A        192.168.0.111
```

record type NS
(name server)

the authoritative name server for
this zone (`lugroma3.org`) is
`dnslug.lugroma3.org`



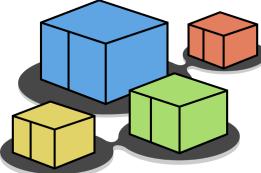
step 2 – exploring the configuration

- configuration on the name servers specifies
 - associations between names and ip addresses

```
root@dnsuni:~$ cat /etc/bind/db.it.uniroma3
$TTL    60000
@           IN      SOA     dnsuni.uniroma3.org.
              root.dnsuni.uniroma3.org. (
                                2006031201 ;
                                28 ; refresh
                                14 ; retry
                                3600000 ; exp
                                0 ; negative
)
@           IN      NS      dnsuni.uniroma3.it.
dnsuni.uniroma3.it.   IN      A       192.168.0.11
pc1.uniroma3.it.     IN      A       192.168.0.111
```

record type A
(address)

two machines in this zone:
`dnslug.lugroma3.org`
`pc1.lugroma3.org`
(the origin name is automatically appended)



step 2 – exploring the configuration

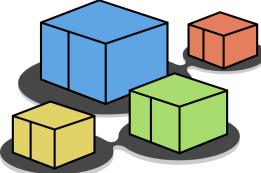
- configuration on the name servers specifies
 - associations between names and ip addresses

```
root@dnsit:~$ tail -n 5 /etc/bind/db.it
@                      IN      NS      dnsit.it.
dnsit.it.                IN      A       192.168.0.1

uniroma3.it.             IN      NS      dnsuni.uniroma3.it.
dnsuni.uniroma3.it.      IN      A       192.168.0.11
```

dnsit.it is the authority for this zone (.it)

dnsuni.uniroma3.org is the authority for zone uniroma3(.it)



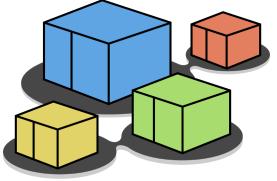
step 2 – exploring the configuration

- configuration on the name servers specifies
 - allowing recursive queries

```
root@localuni:~$ cat /etc/bind/named.conf.options
options {
    directory "/var/cache/bind";
    allow-recursion { 192.168.0.0/24; };
    dnssec-validation no;
};
```

do not validate DNSSEC
over the recursive queries

allow recursive queries
from 192.168.0.0/24



let's start the lab