# Corresponding Auto Names for IPv6 Addresses

<draft-kitamura-ipv6-auto-name-02.txt>

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# Introduction

IPv6 address is

too long and complicated **to remember for human**.

It is very **nuisance** or **almost impossible**
to '**type**' a ***literal IPv6 address*** **manually**.

Also, ***literal IPv6 address information*** can be called **meaningless**.

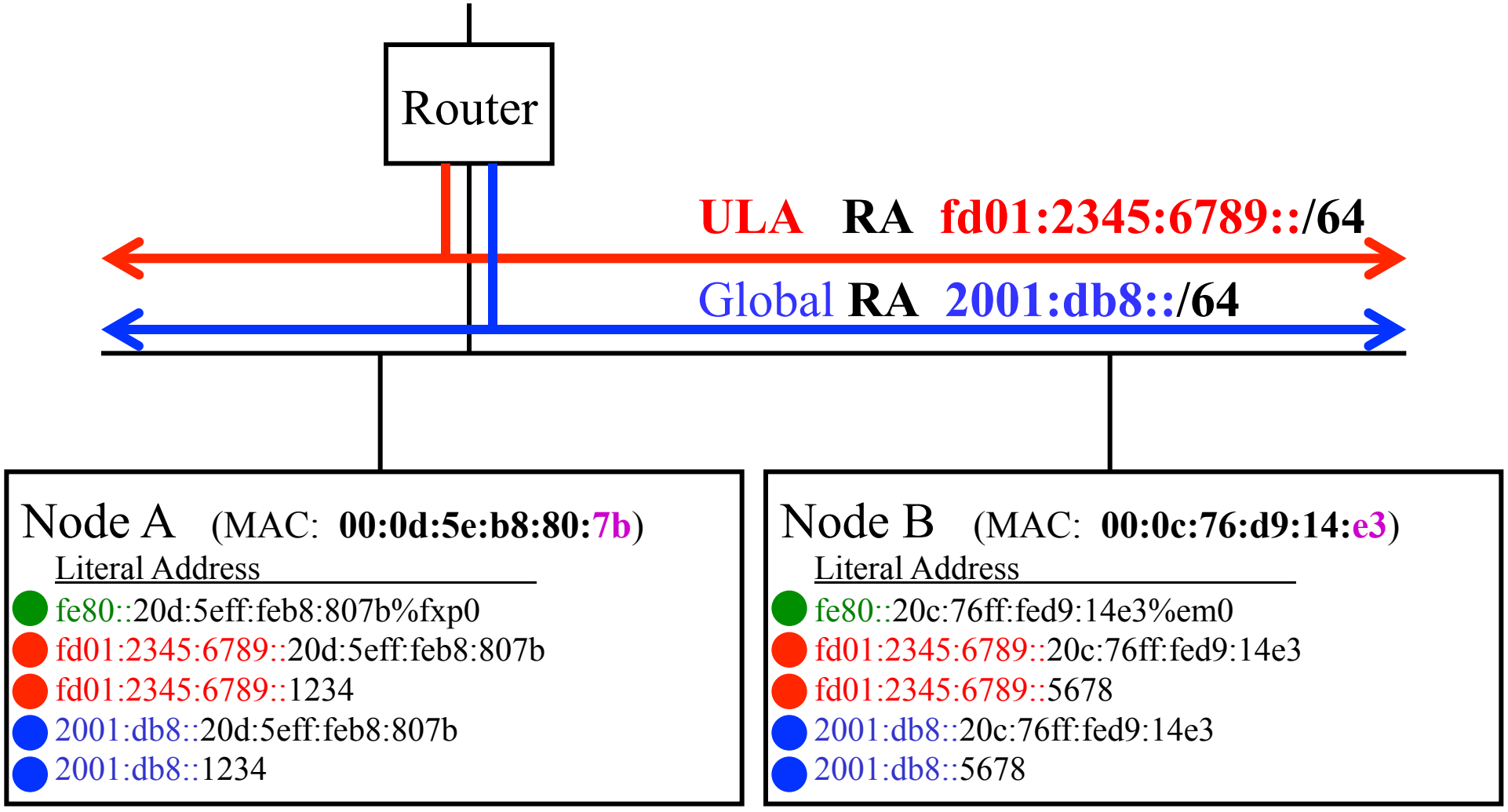
Because it is **very difficult** for human **to tell**
which IPv6 address is set to which actual IPv6 node **at a glance**.

**Strong desires:**

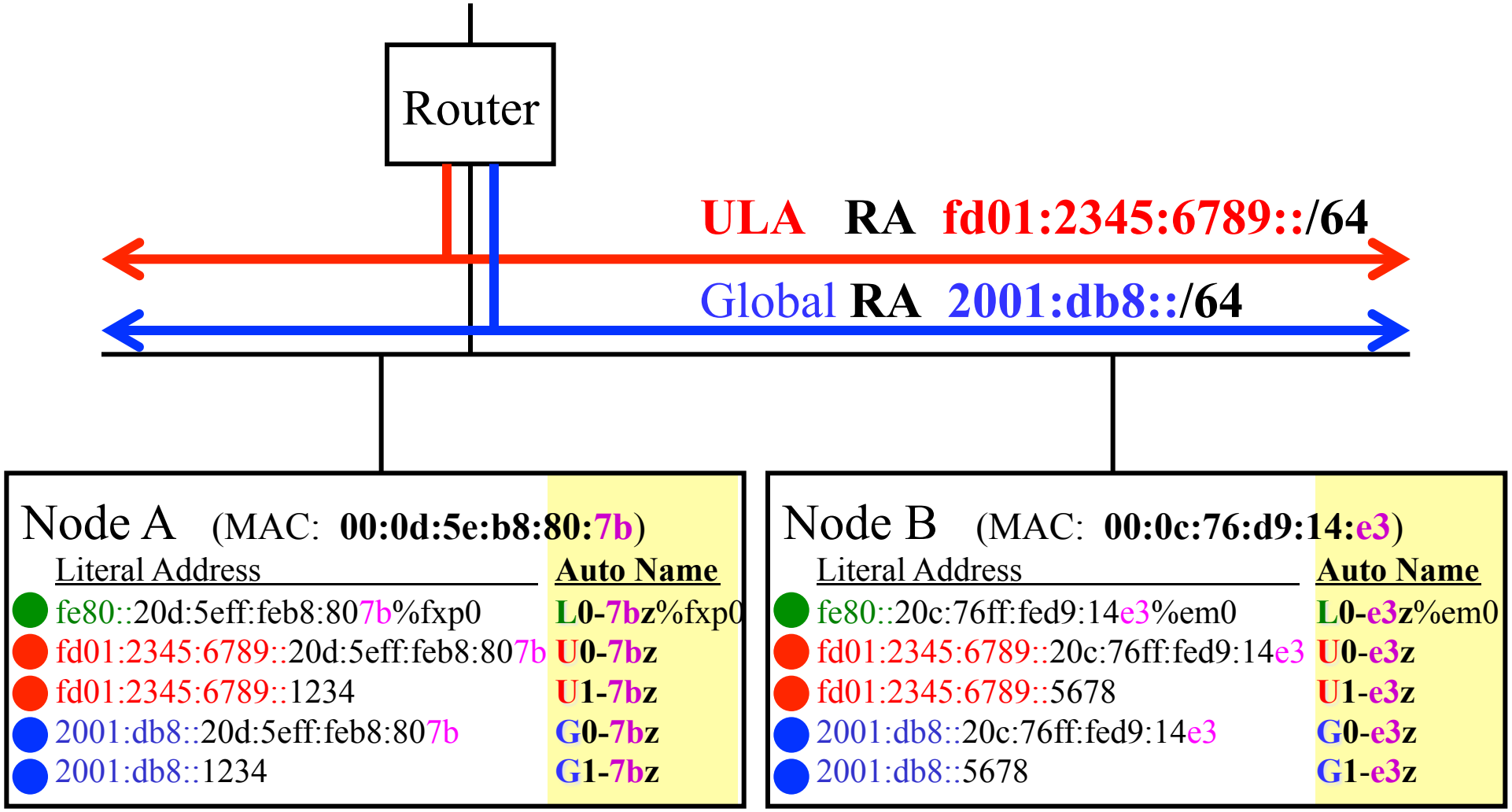
- Use **human-friendly "Name"** instead of ***literal IPv6 Address***.
- Annotate literal IPv6 address and
  Change information from **almost meaningless to meaningful**.

An idea **"Corresponding Auto Names"** is introduced
to solve above problems and to satisfy the above desires.

# Assumed Typical IPv6 Communication Environment



# **Auto Names** Examples



# Auto **Name Suffix** for Grouped Addresses

In order to make Auto Names meaningful,

- IPv6 addresses are grouped .
- Auto **Name Suffix** is used to show grouped addresses.

For ***IPv6 addresses*** that are set to the same interface (node),
the same Auto **Name Suffix** is used for their Auto Names.

As shown above example:

- '-7bz' is used for Auto **Name Suffix** for Node A (00:0d:5e:b8:80:**7b**)
- '-e3z' is used for Auto **Name Suffix** for Node B (00:0c:76:d9:14:**e3**)

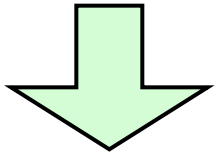
Naming rule of Auto **Name Suffixes** is based on
inheriting **the last octet** of the node's MAC address.

# Contribution in **Regular** Resolving (Name -> Address) (1/3) at command lines

When '**ping6**' or '**telnet**' to the specific IPv6 address of Node B from Node A, the following commands are typed.

```
>ping6   fe80::20c:76ff:fed9:14e3%fxp0
>telnet  fd01:2345:6789::20c:76ff:fed9:14e3
```

**Almost Impossible to 'type' commands for human**



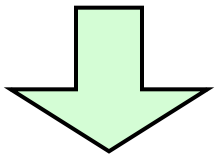
```
>ping6   L0-3ez%fxp0
>telnet  U0-3ez
```

**Become Possible to 'type' commands for human**

# Contributions in **Regular** Resolving (Name -> Address) (2/3) in URLs

When we access URLs that include a literal IPv6 address by '**web browser**', the following strings are must be typed.

```
http://[fe80::20c:76ff:fed9:14e3%fxp0]/....
http://[fd01:2345:6789::20c:76ff:fed9:14e3]/....
```



**Almost Impossible to 'type' such URLs for human**
**It is nuisance to use** '[' and ']' in URLs.

```
http://L0-3ez%fxp0/....
http://U0-3ez/....
```

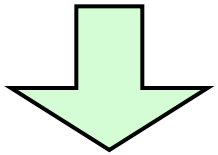
**Become Possible to 'type' such URLs for human**

**We are released from using** '[' and ']' in URLs !!

# Contribution in **Regular** Resolving (Name -> Address) (3/3) at filter configurations

Configure access filter (e.g., /etc/hosts.allow) as follows:

```
sshd : [fe80::20c:76ff:fed9:14e3%fxp0]       : allow
sshd : [fd01:2345:6789::20c:76ff:fed9:14e3] : allow
```



**Almost impossible to 'type' entries for human.**
**'copy and paste' is required to make entries.**
**Impossible to understand meanings at a glance**

```
sshd : L0-3ez%fxp0 : allow
sshd : U0-3ez      : allow
```

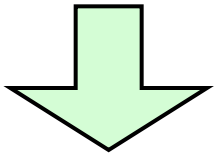
**Become Possible to 'type' entries for human**
**Easy to understand the meanings at a glance**

# Contribution in **Reverse** Resolving (Address -> Name) (1/2) session status

'netstat -a' (on Node A) shows connection status as followed:

```
Local Address                    Foreign Address                  (state)
fe80::20d:5eff:feb8:807b.8722    fe80::20c:76ff:fed9:14e3.23      ESTABLISH
fd01:2345:6789::1234.16258       fd01:2345:6789::5678.23          TIME_WAIT
```

**Almost Meaningless information for human**



```
Local Address                    Foreign Address                  (state)
L0-7bz.8722                      L0-e3z.23                        ESTABLISH
U1-7bz.16258                     U1-e3z.23                        TIME_WAIT
```

**Become Meaningful information for human**

Also, **Beautified display** by **fixed length character** of **Auto Name**

# Contribution in **Reverse** Resolving (Address -> Name) (2/2) packet dump etc.

**Other examples** where the Auto Names can contributes:

- In **access log files** of a server application:
  Accessed clients are can be recoded as meaningful Auto Names instead of (almost meaningless) literal IPv6 address.
- In **packet dumping** applications:
  Address information can be shown as meaningful Auto Names

The Auto Name technique can significantly help for human to analyze and understand above information.

Auto Name format is simple and easy enough for human to understand.
By using the Auto Names technique,
literal IPv6 addresses are annotated and
these information are converted from almost meaningful to meaningful.

# Deployed Notions and Functions used in **Auto Names**

- **Stateless** Name

| | Stateful | Stateless |
|---|---|---|
| Address | DHCPv6 | SLAAC |
| Name | Existing Domain Names | **Auto Names** |

- **Scoped** Name

| | Global | Site-Local (ULA) | Link-Local | Node-Local |
|---|---|---|---|---|
| Address | e.g., 2001:db8::/64 | e.g., fd01:2345:6789::/64 | fe80::/64 | |
| Name | Existing Domain Names | Existing Domain Names / **Auto Names** | **Auto Names** | **Auto Names** |

Scope is dependent on how **Auto Names** data is dealt and which "name services" are used.

# Design of Auto Names
## (Conceptual Design on Naming Rules)

**Auto Name** is ***fixed 6 characters strings***
and composed of "<**P**><**I**>-<**NGI**>" format.

<**P**>: stands for **P**refix part of IPv6 Address
1 character: (e.g., 'L', 'U', 'G')

<**I**>: stands for **I**nterface ID part of IPv6 Address
1 character: (e.g., '0', '1', '2', , , '9', 'a', , , 'z')

<**NGI**>: stands for **N**ode (Interface) **G**roup **I**D
3 characters: (e.g., '7bz', '3ez') **inherited** from the **last octet** (2 characters) of the node's MAC address

Above Auto Name examples satisfy <P><I>-<NGI> format.

- Node A: L0-7bz, U0-7bz, U1-7bz-u2, G0-7bz, G1-7bz
- Node B: L0-3ez, U0-3ez, U1-3ez-u2, G0-3ez, G1-3ez

# Site-dependent Mapping tables (for ***collision avoidance***)

Mapping tables are used **only when Auto Names** are **generated**

(These tables are **not used** for usual name resolving operations)

- MAC address – <NGI> value mapping table

| MAC Address | <NGI> value |
|---|---|
| **00:0d:5e:b8:80:7b** | **-7bz** |
| **00:0c:76:d9:14:e3** | **-e3z** |

- Prefix – <P> value mapping table

| Prefix | | <P> value |
|---|---|---|
| **fe80::/64** | Link-Local | **L** |
| **fd01:2345:6789::/64** | Site-Local (ULA) | **U** |
| **2001:db8::/64** | Global | **G** |

# **Auto Names** techniques in short

- Under certain **scoped name** environment,
  All IPv6 addresses (formed as Prefix + I/F ID) are
  shown in only ***fixed 6 characters***
  **("<P><I>-<NGI>“)** strings format.
  [kind of address **compression techniques** are used.]
- IPv6 Address information is annotated and changed
  almost meaningless ⇨ **meaningful**

- Human can remember, understand and ‘type’
  **Auto Names** (instead of literal IPv6 addresses).

# Discussions

Please let us know you comments.

Goal of this I-D is
to be published as “Informational RFC”.

Reserved slides are started from here.

# <P> Value

<P> value stands for Prefix (Scope) part of IPv6 Address
as 1 character format.

Auto Names of IPv6 addresses whose prefixes are same
use the same <P> value.

Typically, following characters are used:

"L": used for Link-local scoped addresses.

"U": used for ULA

"G": used for Global scoped address

If multiple prefixes for the same scope are used, other character (such as “H", “I",,,) can be used depending on circumstances.

# <I> Value

<I> value stands for Interface ID part of IPv6 Address
as 1 character format.

<I> value assignment is based on
three address type categorization

| type | description |
|---|---|
| **"0"** | used for **EUI64-based** address |
| "1" - "9" | used for **manually** set addresses<br>(stateful addresses will be categorized here) |
| "a" - "z" | used for **automatically** generated and set addresses<br>except EUI64-based<br>(Temporary addresses are categorized here) |

# Address Type Distinction

- EUI64-based Address Identification
  - When **IPv6 and MAC** addresses are found **simultaneously**, it is easy to identify.

- Manual or Automatic Distinction
  - **Human bias** is checked by using "**Zero Contain Rate**" in IPv6 Address.

# <NGI> Value

<NGI> value is also called Auto **Name-Suffix**.

<NGI> value is shown as 'XYZ' format:

'XY': (1st, 2nd chars) are **inherited** from
the **last octet** (2 characters) of the node's MAC address

'Z' : (3rd char) suffix char to **avoid a collision** of 'XY'
starting from "z"
if 'XY' is collided, 'Z' is changed into "y", "x" „,

**Collision Probability** of 256 states (1 octet):

By using the ***birthday paradox theorem***, probability is calculated.
If there are **19 nodes** (interfaces) on the same scope,
collision is happened **with 50%** probability.

Collision check procedure for 'XY' is necessary.

**Q**uestion:

Who will became happy

with this Auto Name technique?

**A**nswer:

People who face literal IPv6 address problems.

If you feel **frustration** to handle **literal IPv6 addresses**,

you can become **happy** with this **Auto Name** technique**.**

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# Contribution in **Reverse** Resolving (Address -> Name) (2/3) neighbor cache

'ndp -a' (on Node A) shows neighbor cache status as followed:

```
Neighbor                                Linklayer Addr.  Netif Expire   S
fe80::20d:5eff:feb8:807b%fxp0           0:0d:5e:b8:80:7b fxp0 permanent R
fd01:2345:6789::20d:5eff:feb8:807b      0:0d:5e:b8:80:7b fxp0 permanent R
fd01:2345:6789::1234                    0:0d:5e:b8:80:7b fxp0 permanent R
2001:db8::20d:5eff:feb8:807b            0:0d:5e:b8:80:7b fxp0 permanent R
2001:db8::1234                          0:0d:5e:b8:80:7b fxp0 permanent R
fe80::221:85ff:fea7:82ff%fxp0           0:21:85:a7:82:ff fxp0 23h50m51s S
fe80::20c:76ff:fed9:14e3%fxp0           0:0c:76:d9:14:e3 fxp0 23h51m56s S
fd01:2345:6789::20c:76ff:fed9:14e3      0:0c:76:d9:14:e3 fxp0 23h52m50s S
fd01:2345:6789::5678                    0:0c:76:d9:14:e3 fxp0 23h53m51s S
2001:db8::20c:76ff:fed9:14e3            0:0c:76:d9:14:e3 fxp0 23h54m53s S
2001:db8::5678                          0:0c:76:d9:14:e3 fxp0 23h55m54s S
```

```
Neighbor                                Linklayer Addr.  Netif Expire   S
L0-7bz%fxp0                             0:0d:5e:b8:80:7b fxp0 permanent R
U0-7bz                                  0:0d:5e:b8:80:7b fxp0 permanent R
U1-7bz                                  0:0d:5e:b8:80:7b fxp0 permanent R
G0-7bz                                  0:0d:5e:b8:80:7b fxp0 permanent R
G1-7bz                                  0:0d:5e:b8:80:7b fxp0 permanent R
L0-ffz%fxp0                             0:21:85:a7:82:ff fxp0 23h50m51s S
L0-3ez%fxp0                             0:0c:76:d9:14:e3 fxp0 23h51m56s S
U0-3ez                                  0:0c:76:d9:14:e3 fxp0 23h52m50s S
U1-3ez                                  0:0c:76:d9:14:e3 fxp0 23h53m51s S
G0-3ez                                  0:0c:76:d9:14:e3 fxp0 23h54m53s S
G1-3ez                                  0:0c:76:d9:14:e3 fxp0 23h55m54s S
```

# Name Services

- It is not clarified:
  which actual ‘**name services**’ is used for Auto Names.
  - DNS is **first strong candidate** for it.
    - All OS have DNS resolver implementations.
    - By using the DNS user authenticate implementation, it is easy to achieve the ‘Scoped Name’ features.

# Target **IPv6 Addresses** of Auto Names

- Target of Auto Names:
  **All** unicast IPv6 addresses
  (**include link-local scoped addresses**) are target
- Exception (non-target):
  "***Well-managed***" IPv6 addresses are basically **non-target**

Definition of "***Well-managed***" addresses:

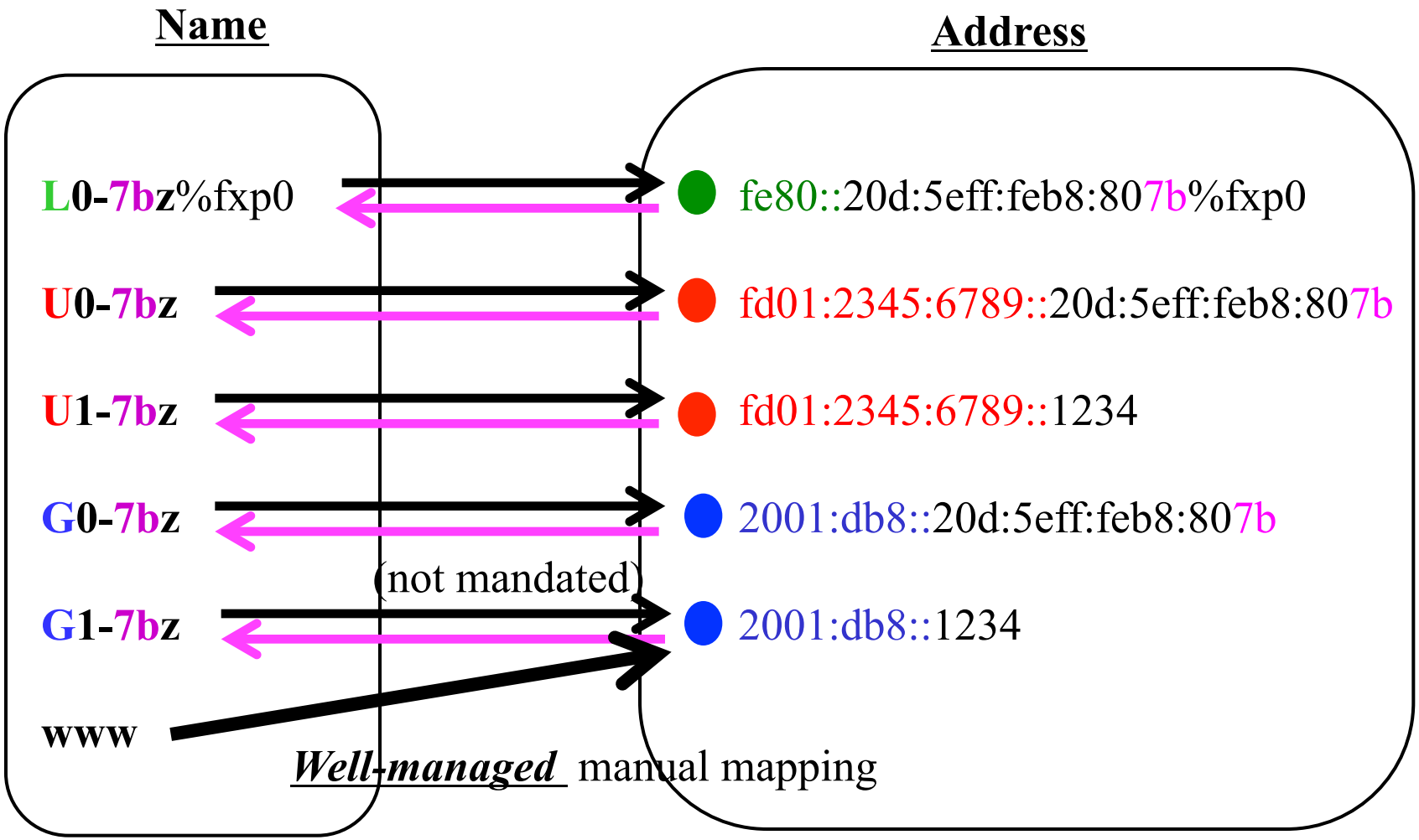
Their "Domain Names" are manually (or statefully) registered into name services (such as the DNS) already.

**Reverse** mapping Auto Name entries are needed for **All** addresses.

**Regular** mapping Auto Name entries
will **not be mandated** for "**Well-managed**" addresses.

(It is OK to register **Regular** mapping entries,
because one-multiple entries are possible and they will not cause problems.)

# **Regular** (Name -> Address) and **Reverse** (Name <- Address) mapping



# IPv6 Address Appearance Detection mechanism

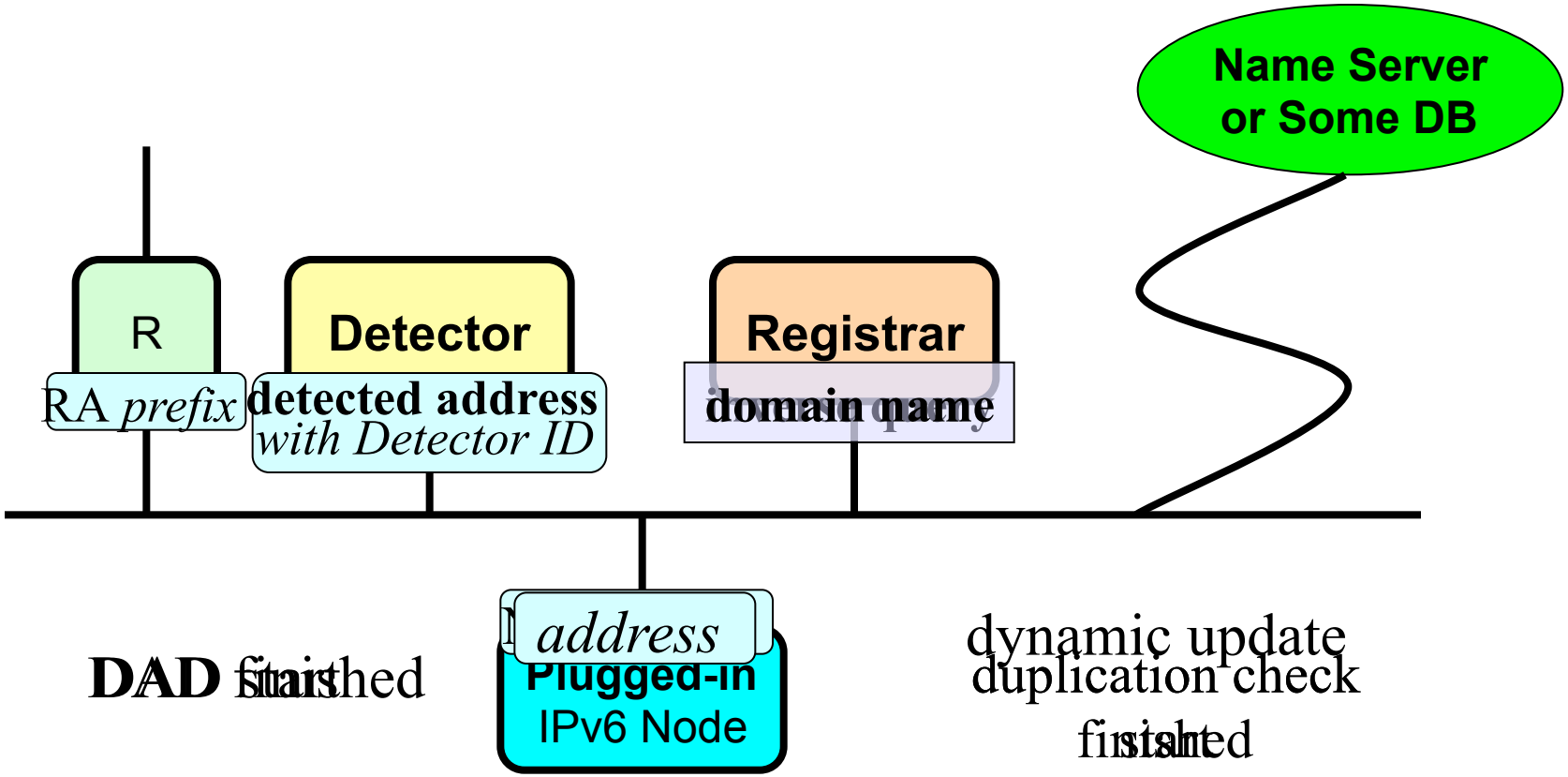
In order to detect newly appeared IPv6 address, DAD message (NS for DAD) is effectively used.

DAD message has the following good capabilities:

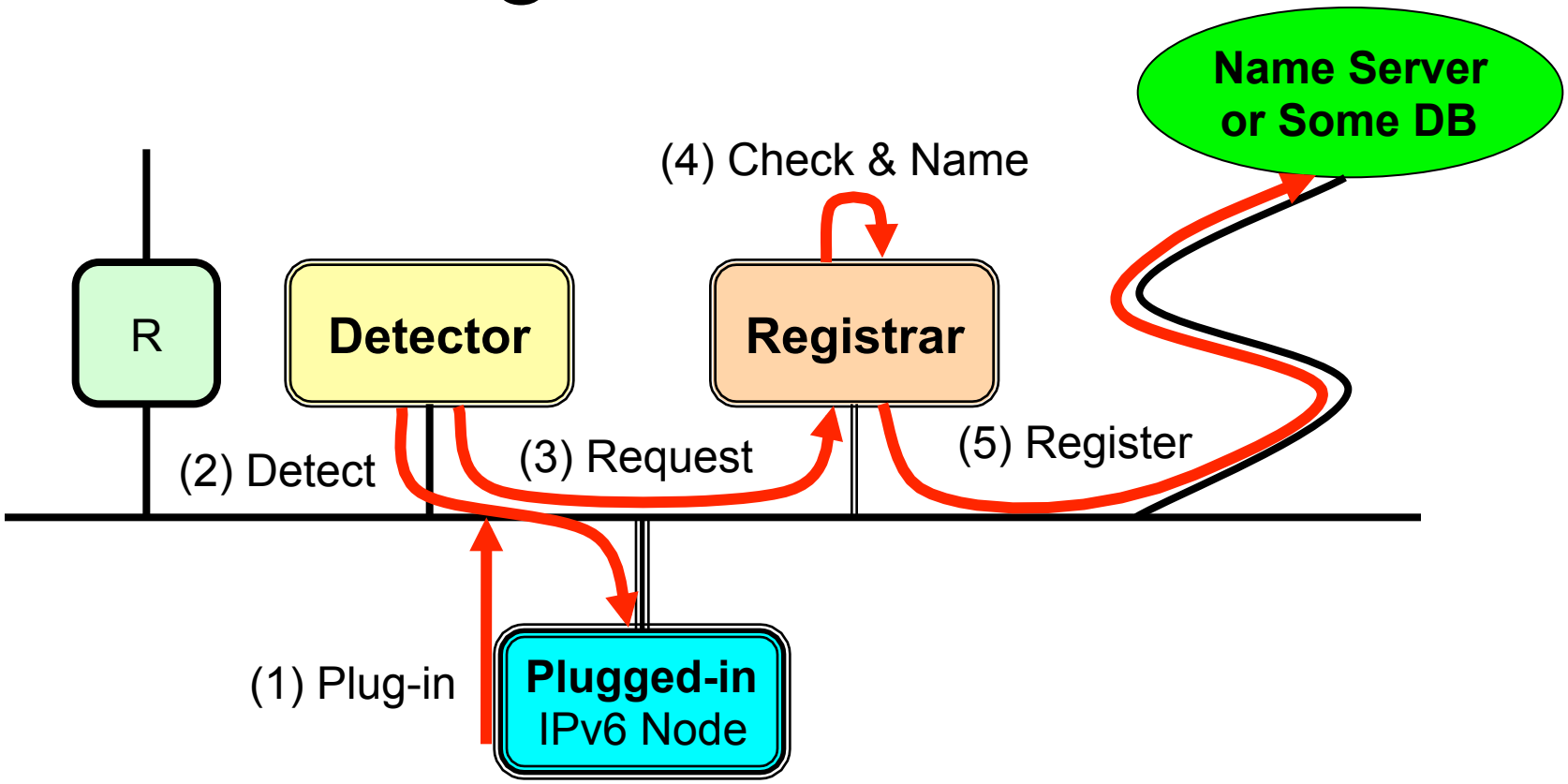
- issued only when node would like to set new IPv6 address
- issued for All types (link-local, global, temporary,,,)
- L2 broadcast and easy to capture (without using mirror port)
- distinguishable from other NS messages, because source address of the message is unspecified ("::") and different from others
- Captured DAD message includes all necessary information (such as, IPv6 address and MAC address)

Detector captures DAD messages and detects newly appeared IPv6 addresses. Detected information is sent to Registrar.

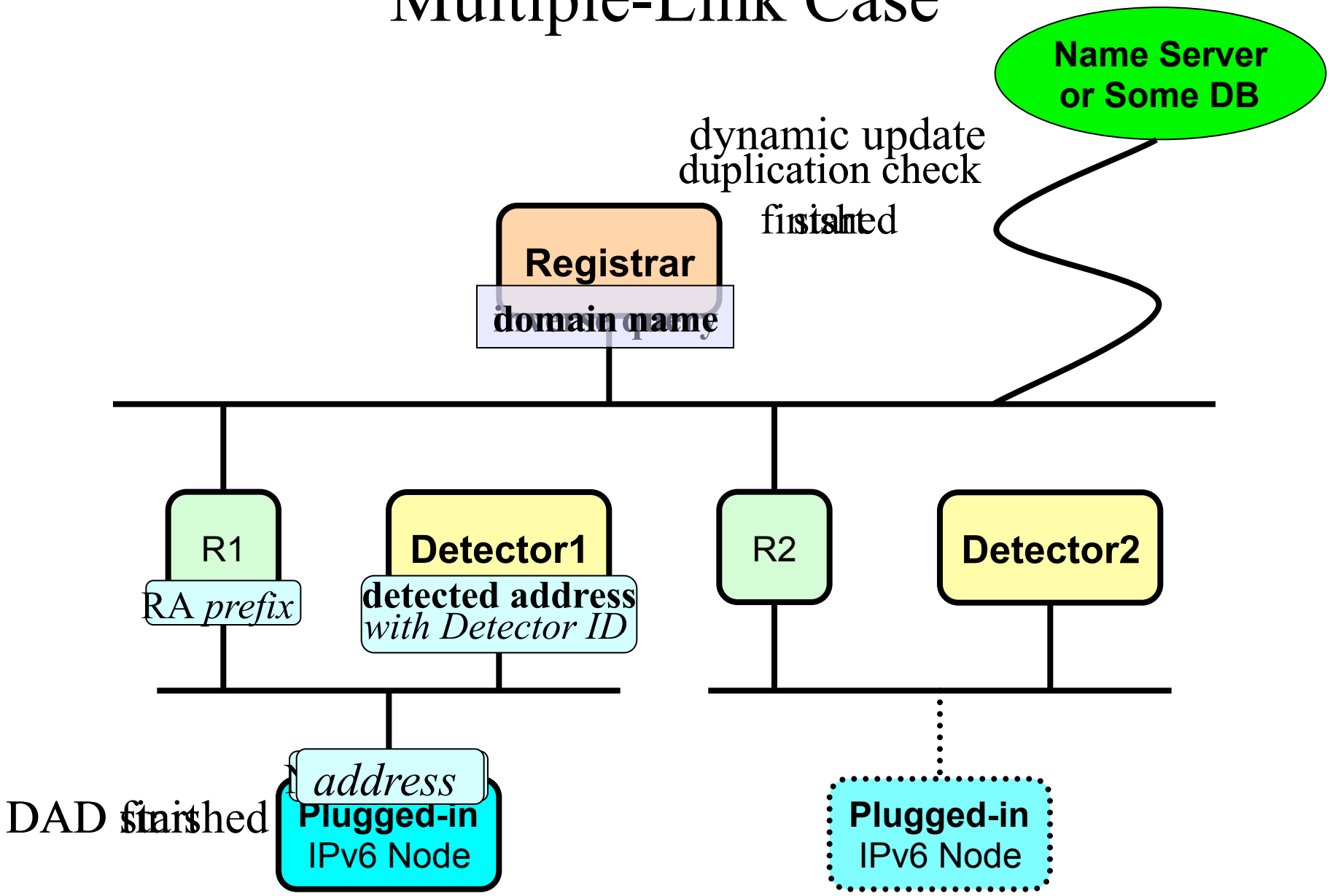
# Single-Link Case



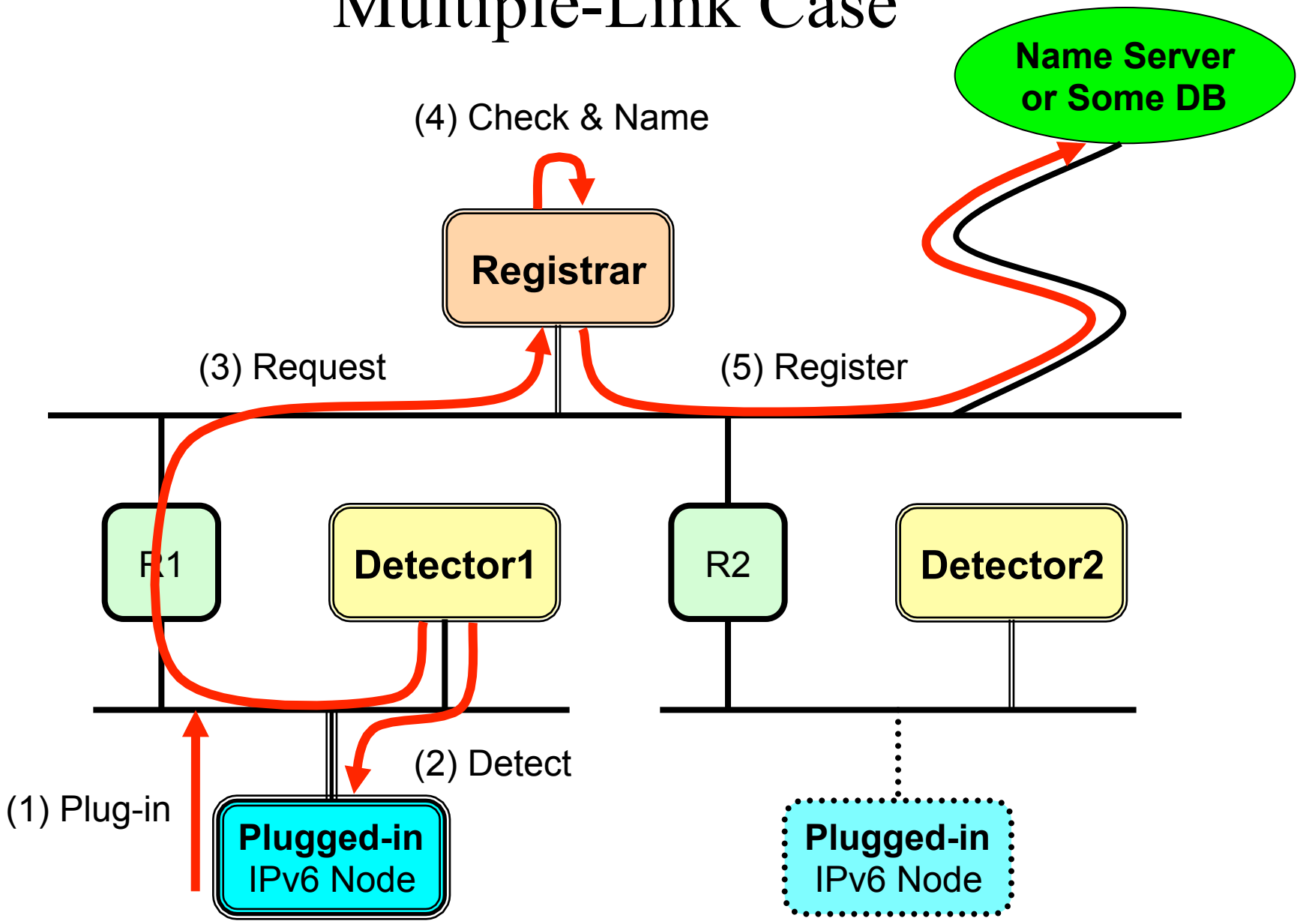
# Single-Link Case



# Multiple-Link Case



# Multiple-Link Case



# Roles/Characteristics Comparison

| | **Detector** | **Registrar** |
|---|---|---|
| Main Roles | Detect appearance<br>Send detected data | Check received data<br>Prepare “Auto Name”<br>Register to name service |
| Intelligence | **NOT required** | Required |
| Function | **Simple** | Complex |
| Maintenance | Almost **Free** | Required |
| Located place | Limited | NOT limited |
| Implementation | **Easy** | Not easy |

# Typical Procedures