IPv6 Neighbor Cache Update
<draft-kitamura-ipv6-neighbor-cache-update-00.txt>

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Introduction / Background

IP address's "**Using Status**" is **frequently** changed
"Used" <=> "**Not Used**"

- **Disconnecting** / Connecting nodes
  from/to networks at mobile environments
- **Suspending** / **Hibernating** / Resuming nodes
  - Turn **Off** / On PCs
  - **Release** / Discover IP address by DHCP
- Utilize Changeable-type Addresses:
  Temporary Address / Ephemeral Address*

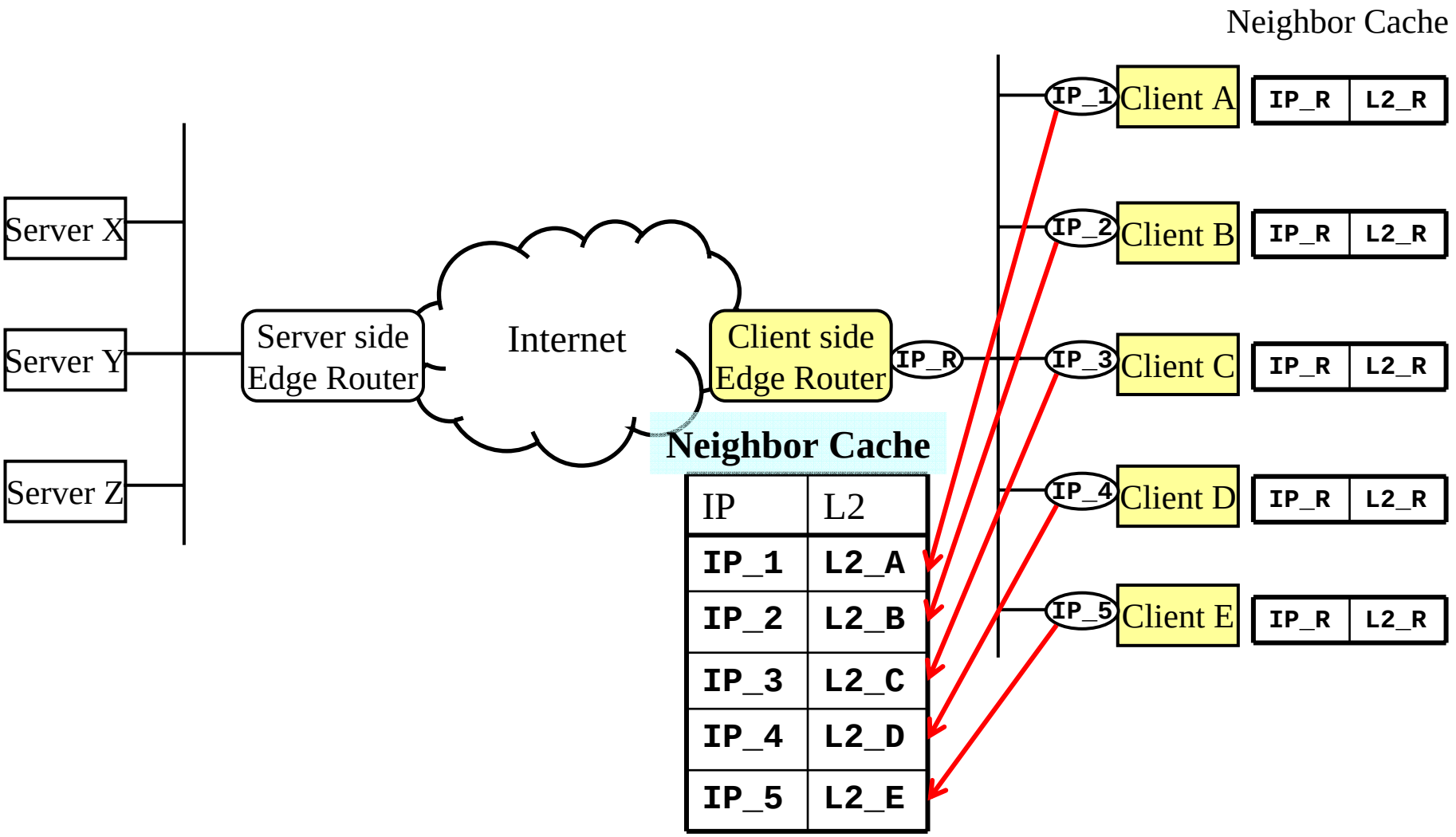
* <draft-kitamura-ipv6-ephemeral-address-01>

Problems on (Not-Used) Remained Neighbor Cache Entries

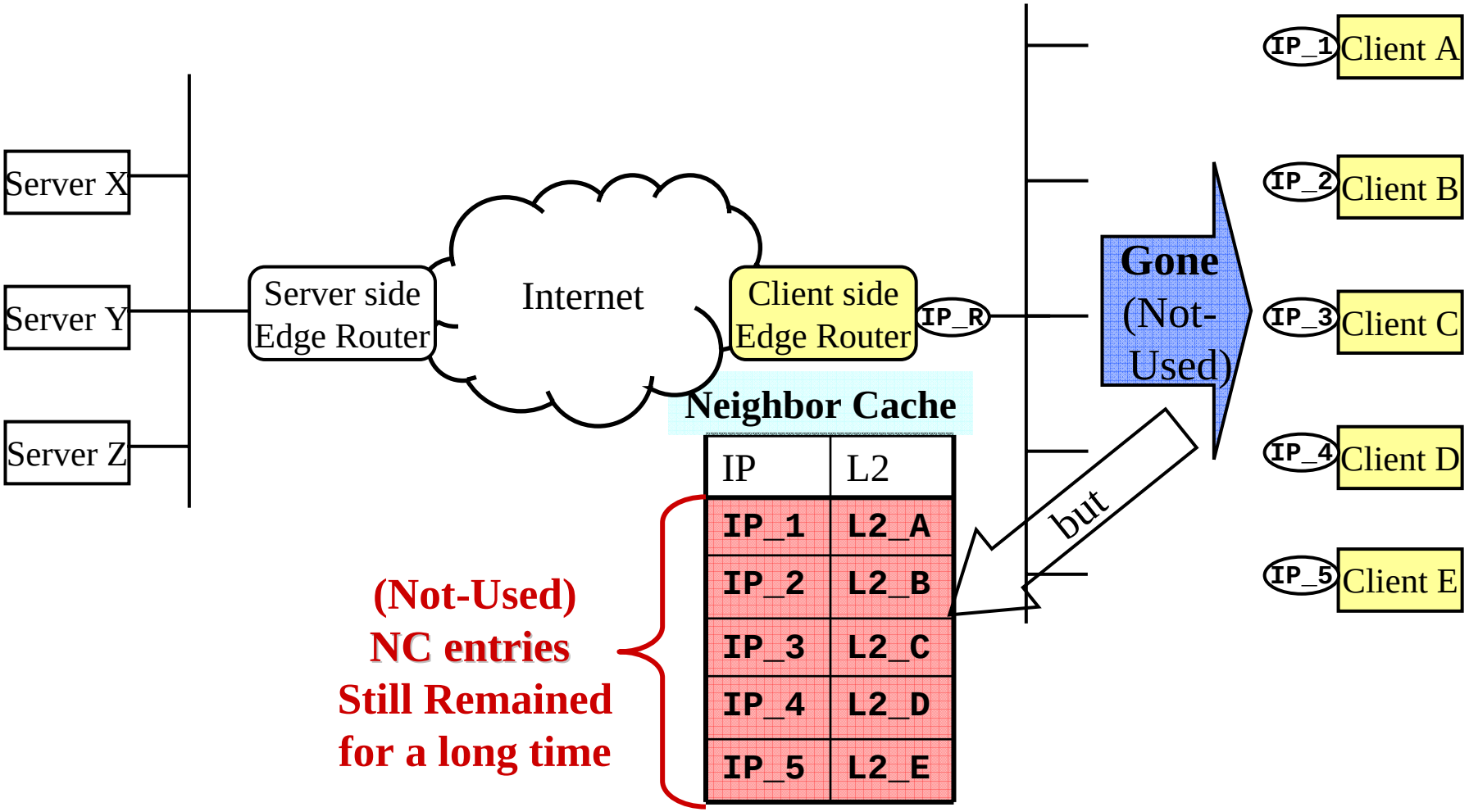
- What's happens when (IP address is gone)
  IP address's **Using Status** is changed
  form "Used" to "**Not Used**" ?

- Related **Neighbor Cache Entries**
  (that are created for the "Gone IP addresses")
  are **not deleted** and **still remained**
  for a long time (typically 24 hours).

Example:
(Not-Used) Long Remained NC entries 1/2



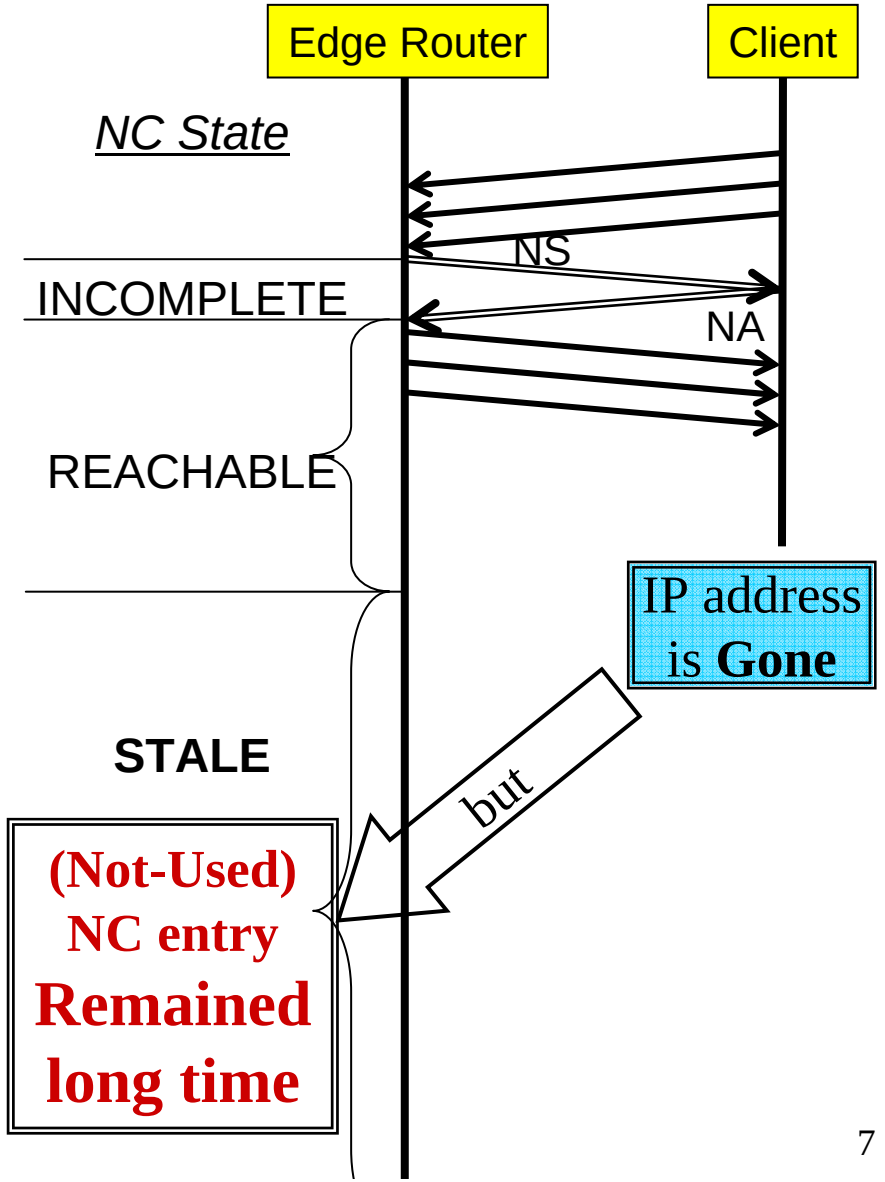
Example:
(Not-Used) Long Remained NC entries 2/2



Why Not-Used NC entries are remained?

- NC state procedures are showed in right figure that is defined in ND specification [RFC4861].

- Not-Used NC entries are **remained at STALE state for a long time** and finally they are **deleted by the "garbage collections".**



Characteristics on

(Not-Used) Long Remained NC entries

It is clear:

- from efficient
  resource management viewpoint:
  NOT Good.
- from security enhancement viewpoint:
  NOT Good.

What should we do?

- We have to follow the manner:
  “Leave everything neat and tidy when you go behind you”

- When using status of an IP address is changed from “**Used**” to “**Not-Used**”, its related cache entry **should be deleted cooperatively.**

- We have to provide **quick and clear neighbor cache update (delete)** functions.

Proposed Solutions: Neighbor Cache Update (Delete) Methods

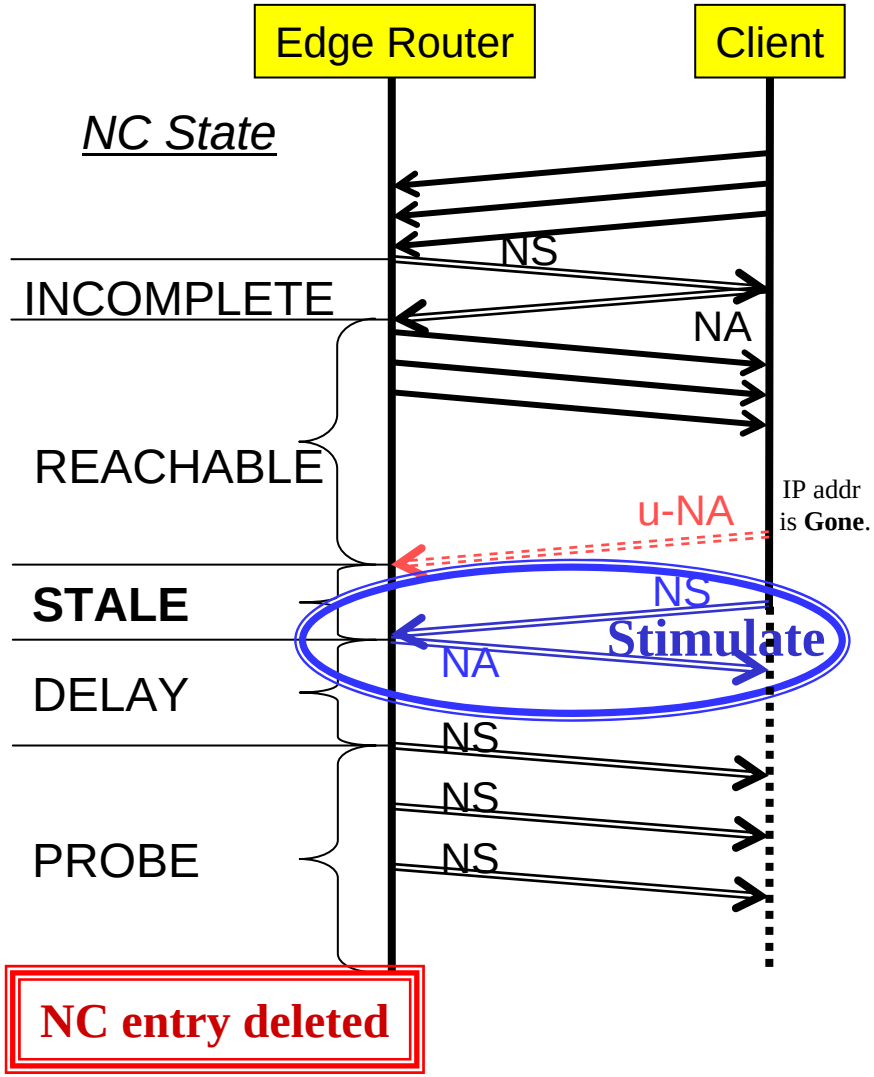
Three types of Neighbor Cache Update (delete) methods are proposed.

1. **Heuristic** Type:
   Does **NOT** require any ND message extensions
2. **Explicit** Type:
   Requires small extensions (NA message Flags)
3. **Explicit** + **Heuristic** Combined Type:
   Any types of nodes are supported effectively

Heuristic Type
Neighbor Cache Update

- **Stimulate** the remaining **STALE** (**inactivated**) NC entry by sending the special NS message (source = Gone IP address) from client node.
- (The target NC entry is **activated** by issuing NA.) Its state is proceeded to next state **DELAY** and finally the target **NC entry is deleted**.
- Takes short time periods for **DELAY** and **PROBE** states.

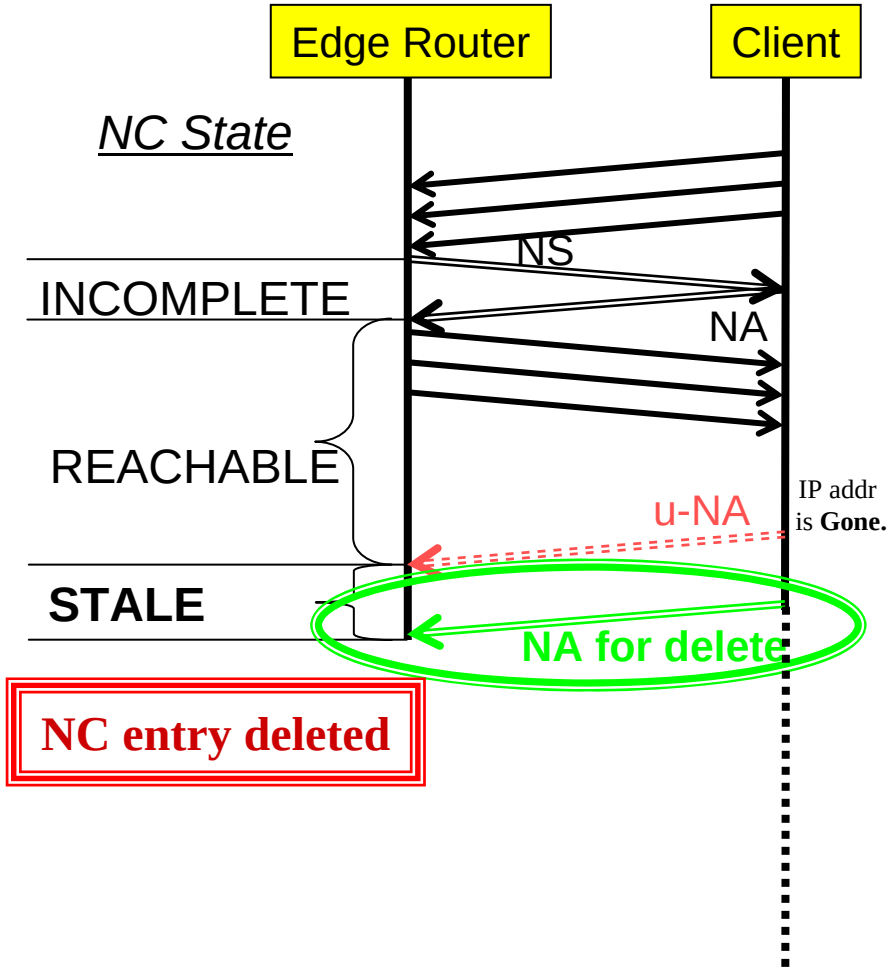
- **No** ND message **extensions are required**.



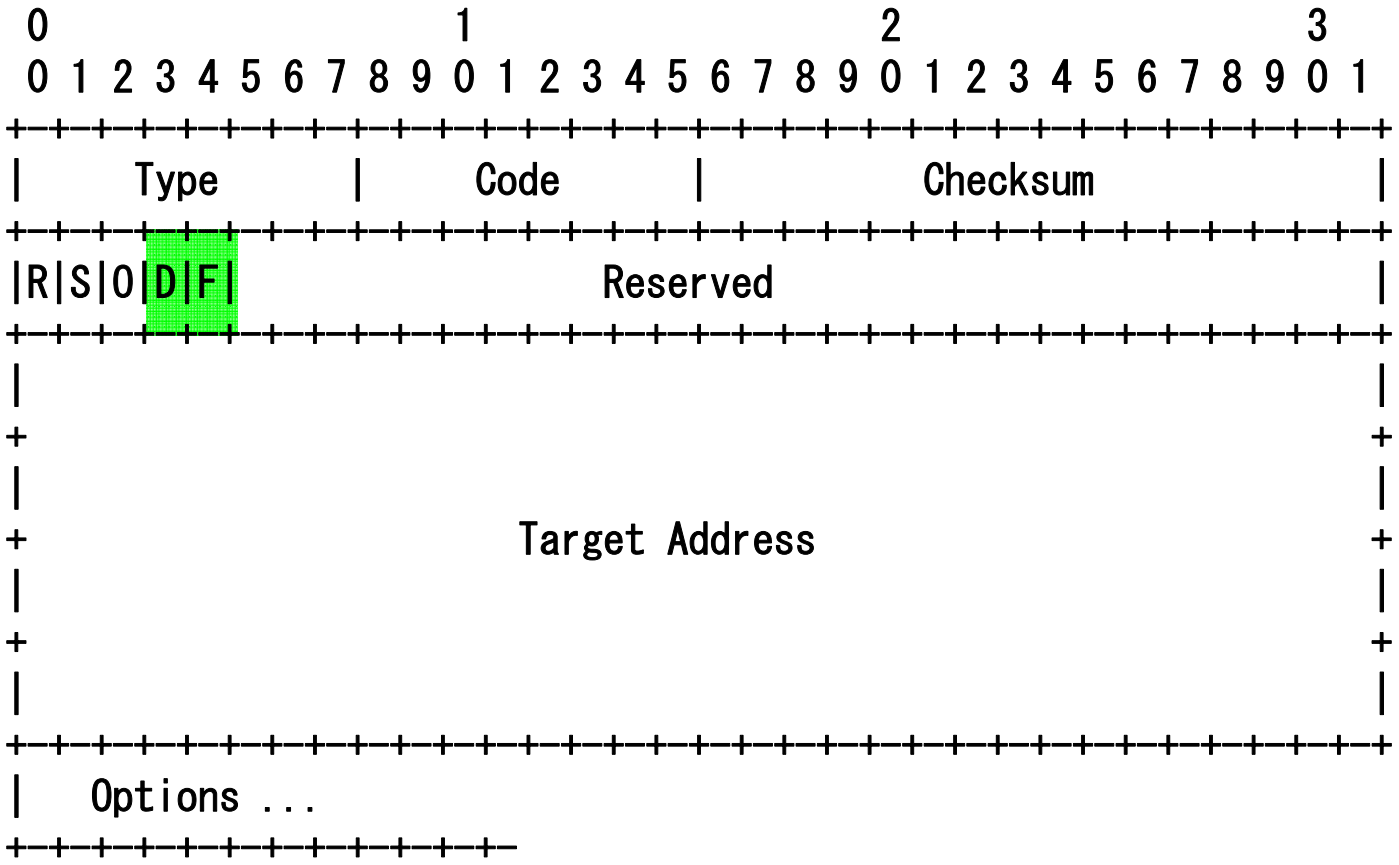
Explicit Type: Neighbor Cache Update

- Issue an **Extended NA message (+extended flags) to delete** target NC entry from client node.

- If a receiver node understands **the extended flags**, the target **NC entry is quickly deleted.**
- If the node does **not** understand, the message is simply **ignored**. (the NC entry is not deleted and errors are not reported.)



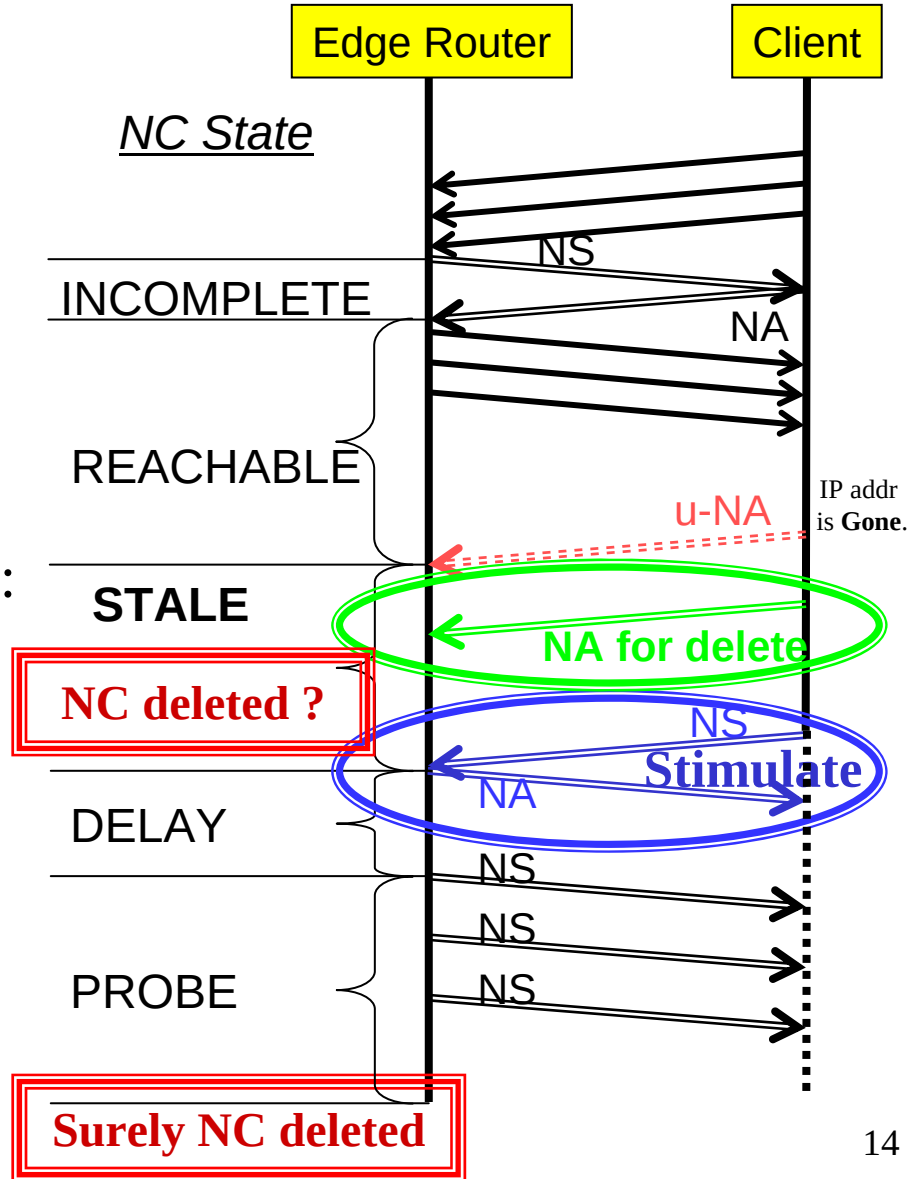
Explicit Type:
NA Message **Flags** Extensions



D: Delete flag (Delete entry except its state is REACHABLE)
F: Force Delete flag (Force to delete entry at any states)

Explicit + Heuristic Combined Type Neighbor Cache Update

- **Support both types of nodes** that ***do*** and ***do not*** understand the NA extensions **effectively**.
  - Nodes ***do*** understand extensions: the entry is deleted quickly by the **1st Explicit operation**.
  - Nodes ***do not*** understand extensions: the entry is deleted shortly by the **2nd Heuristic operation**.
- In any node cases, the target **NC entry is surely deleted.**



Implementations

- Proposed all "***Neighbor Cache Update*** " specification has been implemented and verified.
- Delete Responder (Edge Router) type:
  - Explicit Type:
    - FreeBSD
  - Heuristic Type:
    - IOS, Linux, FreeBSD, MacOS X, Windows, etc.
- Delete Initiator (Client) type:
  - Explicit / Heuristic Type: (Verified)
    - FreeBSD
  - Explicit / Heuristic Type: (Under Developing)
    - Linux, MacOS X, Windows, etc.

Consensus Verification to Proposed Methods

Which methods do you prefer?

1. **Heuristic** Type:
   Does **NOT** require any ND message **extensions**
2. **Explicit** Type:
   Requires small extensions (NA message Flags)
3. **Explicit** + **Heuristic** Combined Type:
   Any types of nodes are supported effectively
   [**Authors recommend this type method]**

Related Issues

- Same types of problems can be found in IPv4 ARP table entries.

- How do we have to deal with it?