

# DHCP v4/v6

## Relay Initiated Release

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[draft-gandhewar-dhc-v6-relay-initiated-release-01](#)

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# Agenda

- Recap
- Background
- Problem Scenarios
- Problem Statement
- Existing Solutions
- Why Relay Initiated Release?
- Concern
- Applicability
- Next Steps

# Recap

- Version 00 presented at IETF'93 at Prague
- Several comments received at IETF'93, dhcwg mailing list and unicast emails
- Lot of support from Service Providers and Vendors
- Critical problem for Service Providers and network operators
- Objection: How to handle clients which remember the lease?
- Thanks All for your support, comments ...

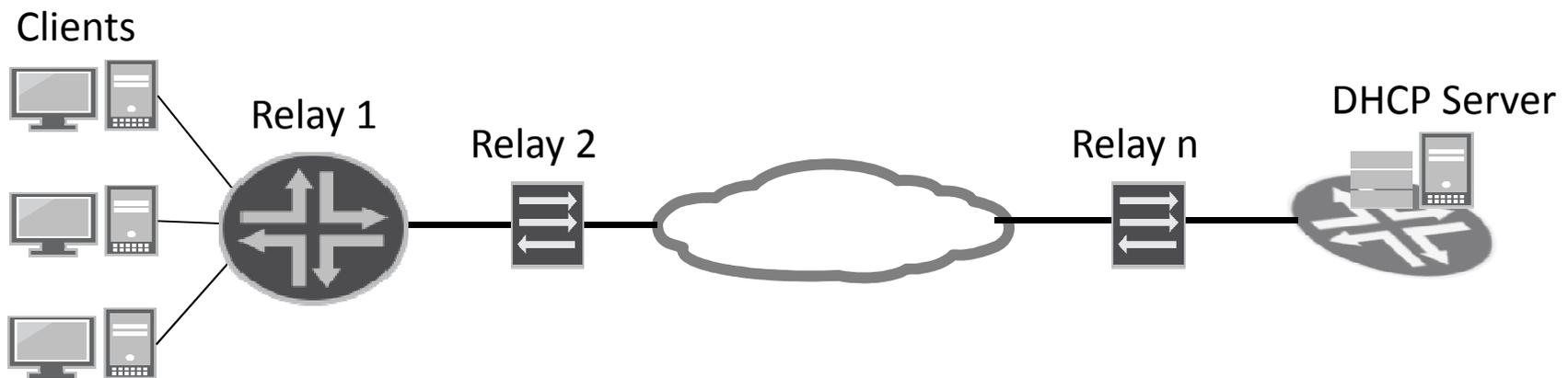
# Background

- When DHCP client receives the lease
  - IP address
  - Configuration Information
  - First Sign of Life (FSOL) Triggers Service Provider to **(per client)**
    - Create logical interface
    - **Program various routes e.g. access, framed routes**
    - Attach services e.g. data, voice, video
    - Maintain Policy
    - Apply QoS
    - Reserve Memory, Bandwidth etc
    - With Virtual Customer Premises Equipment (vCPE) - Per client (subscriber) service chaining in the cloud
- Resources reserved at Relay/Server & network devices
- Subscription ratio per BNG is determined by
  - Availability of addresses (plenty in case of IPv6) **and**
  - **Limited resources on the BNG**

# Service Providers Stats

- Collected data from Service Providers (7)
- Customer base ranging from 5M to 35M
- Typical lease period between 24 hrs to 48 hrs
- Administrative binding clean up – Many times a day per BNG to clean bad behaving clients
- Administrative clean up of clients on entire subnet – Once a week in one or more area to converse resources from subnet with high utilization
- Binding on Out of Sync node cleanup – Few times a week
- Client Device Replacement – 1% - 4% a month (Avg. 200K to 800K for a avg. of 20M clients base, i.e. approx 7K to 27K per day)
- 95% of the clients never send Release
- Subscription Ratio: Gets capped to less than  $\sim 3/4$ th of the capacity to consider stuck resources (E.g. 375K on BNG with capacity of 500K)

# Broadband Edge Network



Either Relay or Server is co-located on  
Broadband Network Gateway (BNG)

# Problem Scenarios

# #1 Administrative Cleanup

- Multiple Relay/Relay-Proxies in between Client and Server
- Administrator needs to disconnect a particular subscriber (client)
  - Operator decision (**Stats:** Few times a week)
  - Network protection against bad behaving client (**Stats:** Many times a day)
- Administrator needs to reset all the subscribers on a subnet
  - To conserve resources from subnet with high utilization (**Stats:** once a week in one or more area)
- Admin needs to access each of the device and clear the binding manually - **Cumbersome process**

## #2 Synchronize Binding

- Multiple Relay/Relay-Proxies in between Client and Server
- If one of these DHCP devices is out of sync in this chain, client cannot be serviced until administrative cleanup
- **Stats:** Few times a week
- **Several hours to restore service** to the subscriber (client)

# #3 Client Device Replaced

- When the client (set-top box) is replaced
  - Client device failure
  - Client device upgrade
  - Change in service
- **More than one lease for the same client**
- **Stats:** ~1% - 4% of the clients every month (200K – 800K clients for 20M subscribers)

## #4 Client Move

- When clients move frequently across networks
- **More than one lease for the same client**

## #5 Frequent Login/Logout

- Typical in busy Wi-Fi centers where large number of clients join and leave frequently
- Cannot have optimal lease period
- **Inefficient use of resources**

## #6 Ungraciously Disconnected Client

- Service Provider Statistics: **95%** of the clients never send Release
- Inefficient use of resources
- Protecting resources against bad behaving clients

# Problem Statement

- How to conveniently clear binding administratively?
- How to handle the out-of sync network node?
- How to release unused binding and use resources optimally?
- How to enable higher subscription per BNG i.e. cleanup old lease where client holds multiple leases?
  - Service Providers (SP) are forced to reduce the subscription per box due to clients with multiple leases and inefficient use of **limited resources**
  - E.g. Resources on BNG to support max 500K subscribers, SPs cannot utilize max capacity. **SP: subscribe upto max 3/4<sup>th</sup> of the capacity** so here max 375K
  - The bandwidth may still be available as it's oversubscribed e.g. 10:1 for residential subscribers and 4:1 for business subscribers

# Existing Solutions

Existing Solutions	Evaluation
<b>Short Lease</b>	<ul style="list-style-type: none"><li>• Except administrative cleaning, solves all cases</li><li>• No need for protocol extn.</li><li>• Not a scalable solution<ul style="list-style-type: none"><li>➤ BNG supports Call Setup rate (CSR) (i.e. Subscriber login rate) in the range of 500 Calls Per Second (cps) which includes subscriber management</li><li>➤ BNG also needs to support client logouts at the same rate i.e. removing the services (opposite of login)</li><li>➤ Causes additional burden to process frequent renews – affects the performance</li></ul></li></ul>
<b>Use of Line-id (RFC 6788) as Subscriber Identifier</b>	<ul style="list-style-type: none"><li>• May solve few scenarios for IPv6 need more investigation since there is fundamental change to identify subscriber on the BNG network</li><li>• For the device replacement scenario, access routes may not work, need further investigation</li><li>• Need solution for DHCPv4</li></ul>

# Proposed Solution

## Relay Initiated Release (RIR)

# Why Relay Initiated Release?

- Standardized approach provides infrastructure to clear binding in the network, at all the DHCP devices
- Detection and Initiation of RIR at the first Relay
  - Release resources at all the network devices
  - Synchronizes all network devices
  - Distributed functionality at Relay makes it highly scalable
- Based on the network, use case based granular control with appropriate configuration
- Allows higher subscription rate and optimal use of resources
- **SP:** *It's just clean. It makes sure that all the elements of the DHCP chain are in sync, allows use of longer leases and not worry as much about running out of resources. It also provides a way to get stats for bad behaving clients.*

# Concern

- In situations where Relay cannot differentiate between client unavailable and network unavailable
- If mistakenly RIR is sent due to network unavailable
  - Binding is cleared in the network - Relay, Server, etc
  - Client being operational, continue to use the address/lease
- Problematic state at client continues till
  - Renew, Rebind, Lease expiry
  - Restart of DHCP process
- **SP:** *Normally resolved by a reboot of a Set-top box, which is pretty much the first thing any of our customers would do. Not desirable of course, but it's likely they will take that step before initiating a phone call. With RIR, BNG will be cleaned and ready to login the subscribers, thus saving a phone call from our customer.*

# Applicability

- Relay Initiated Release (RIR) is applicable in any network for following
  - Scenario#1: Administrative delete binding
  - Scenario#2: To synchronize client binding state in the network
  - Scenario#3: Device replaced
  - Scenario#4: Client move
- Since the old client is already gone, these use cases are applicable to all the networks
- By making each of the use case configurable, the control remains with the Administrator

# Applicability

- Scenario #6: Detecting Disconnected clients -  
Applicable scenarios
  - Where Client reestablishes DHCP binding
    - DSL based network where circuit gets reestablished on network reconnect
    - Client running liveness detection which reestablishes DHCP on reconnect
  - Controlled environment
    - Asymmetric lease from first relay
    - Network access routes by relay
  - Risk is known and accounted by the Service Provider –  
by configuring the RIR on specific network interfaces

# Applicability

- Scenario #6 Contd.

## Non-Applicable Scenarios

- Any network where client cannot detect the circuit break w.r.t. relay.
- CMTS based cable network where clients are behind the cable modem (CM)
  - If Relay or Server deployed on the CM then this can utilize the RIR
- Client does not have the capability to reestablish DHCP on reconnect
- Relay running liveness detection without client being aware
- Client cannot detect the disconnect w.r.t. the first Relay (e.g. due to number of devices in between client and relay)

- Possible solutions

- Disable configuration to generate RIR on such networks
- Asymmetric lease from the first Relay – RIR can be generated as Client's short lease is expired
- Client with liveness detection and restart DHCP on reconnect

# Configuration

- Configuration at first Relay to generate RIR
  - By default generation of RIR should be disabled
  - Administrative delete binding
  - CLI based initiation for synchronizing binding state
  - Device Replaced
  - Client Move
  - Accept/drop incoming RIR
  - Client Unavailable
    - Client can reestablish DHCP binding e.g. DSL based network
    - Controlled environment (asymmetric relay lease, access route)
    - Risk is accounted by the Service Provider
- Configuration at Server to accept RIR
- Configuration at intermediate Relay to forward RIR

# Next Steps

- Questions, Feedback, Improvements
- Contributions?
- Support the Call for Adoption as a WG draft

**Thank You!**

# Backup Slides

# Network Resources

- Relay/Server Embedded in BNG
  - Creates logical interface per client (subscriber)
  - Programs various routes e.g. access, framed routes
  - Attaches services e.g. data, voice, video
  - Maintains Policy
  - Applies QoS
  - Memory, Bandwidth etc
- vCPE - Virtual Customer Premises Equipment
  - Relay is part of IP Front End
  - Per client (subscriber) service chaining in the cloud
  - Resources are reserved in the cloud

# #3 Client Device Replaced

- When the client (set-top box) is replaced
  - Client device failure
  - Client device upgrade
  - Change in service
- **More than one lease for the same client**
- **Stats:** ~1% - 4% of the clients every month (200K – 800K clients for 20M subscribers)
- Detection (out-of-scope of the draft)
  - Administrative e.g. all the clients on an interface or network
  - First Relay detecting – Out-of-order DISCOVER/SOLICIT from different DUID on the interface where there can be only one client
  - Same Circuit-Id, Remote-Id on the same interface
  - **Proprietary methods**

## #4 Client Move

- When clients move frequently across networks
- **More than one lease for the same client**
- Detection (out-of-scope)
  - First Relay detecting - DISCOVER/SOLICIT from the same DUID on a group of interfaces where client can move
  - **Proprietary methods**

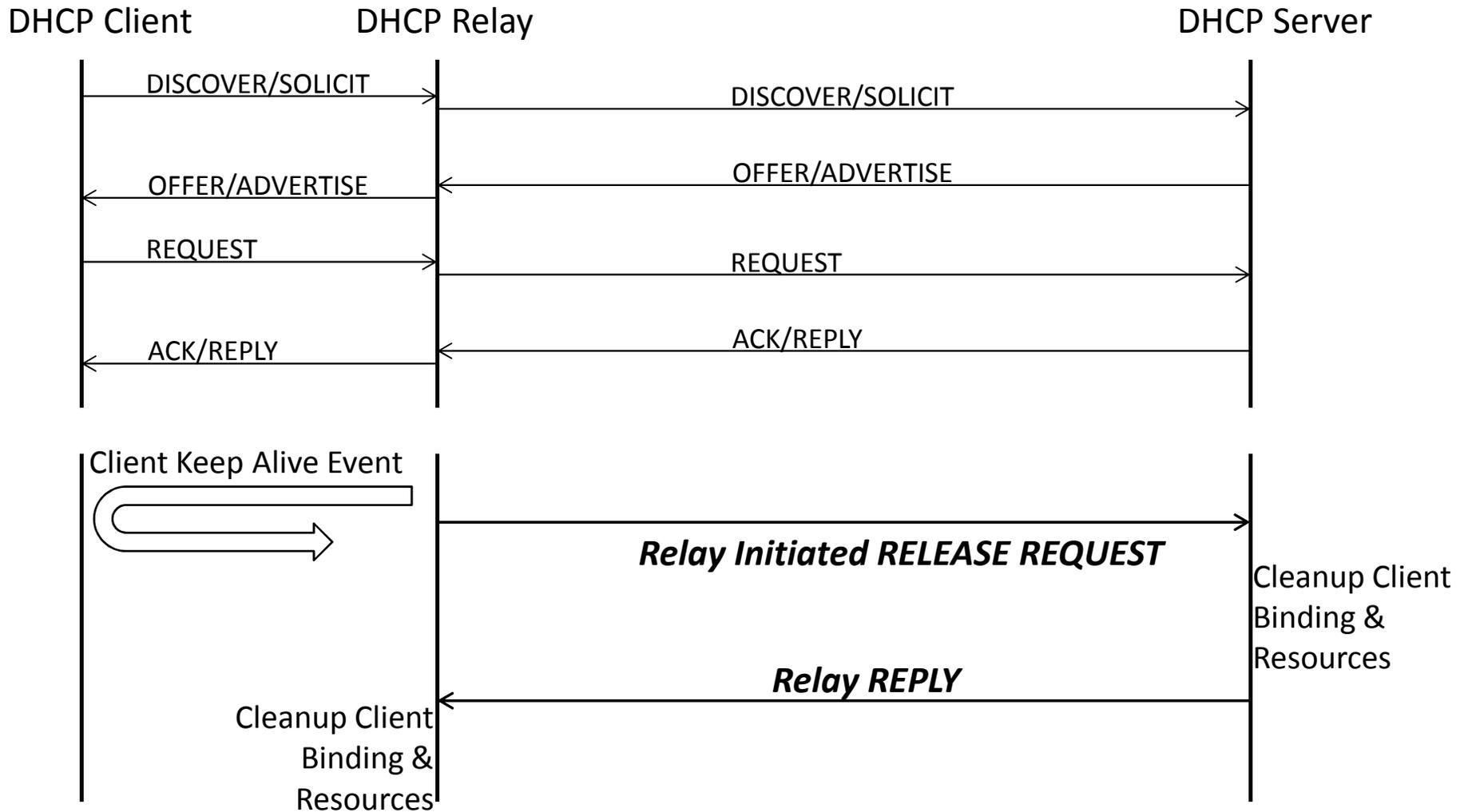
## #5 Frequent Login/Logout

- Typical in busy Wi-Fi centers where large number of clients join and leave frequently
- Cannot have optimal lease period
- **Inefficient use of resources**
- Detection (out-of-scope)
  - Asymmetric lease at the first Relay (takes longer lease from the Server and gives smaller lease to the client)
  - Keepalive
  - **Proprietary methods**

# #6 Ungraciously Disconnected Client

- Service Provider Statistics: **95%** of the clients never send Release
- Inefficient use of resources
- Protecting resources against bad behaving clients
- Detection (out-of-scope)
  - For DHCP over PPP, DHCP reestablishes on PPP reconnect
  - PPP to DHCP migrated clients run liveness detection and re-establishes DHCP on liveness failure
  - Asymmetric lease at the first Relay
  - **Proprietary methods**

# Proposed Solution



# Proposed Solution ...contd.

- On Client's unavailability or replacement
  - Relay initiates a Release on behalf of client
- Clearing of unused bindings
  - optimizes the use of resources
- Higher resource availability
  - enables higher subscription for Service Providers
- Configurable behavior
  - provides granular control at relay as well as server
- Retry, Timeout, ACK
  - ensures synchronized client state at all the DHCP network devices

# DHCPv4 Release By Relay

- Configurable behavior at first DHCP device e.g. relay
- DHCPRELEASEBYRELAY includes
  - ciaddr, chaddr, clientId, serverId
  - giaddr, option 82 (Relay Agent Information Option)
- Unicast to the server

# DHCPv4 Relay Reply

- Configurable behavior at Server
- DHCPRELAYREPLY includes – Status Code Option 151
  - NotConfigured
  - NotAllowed – to restrict requests from particular relay
  - NoBinding
  - Success
- Unicast to the relay

# DHCPv6 Release Request

- Configurable behavior at first DHCP device e.g. relay to send RELEASE-REQUEST
- Common Options
  - MUST Relay Identifier
  - MUST Server Identifier
  - MAY Interface Identifier
- One or more - Client Data Option
  - MUST Client Identifier
  - One or more IA (IA\_NA/IA\_PD)
    - One or more IA\_ADDR, IA\_Prefix

# DHCPv6 Release Request Reply

- Configurable behavior at Server to send RELEASE-REQUEST-REPLY
- Status Code Option Position
  - Directly under Reply
  - Inside Client Data Option
  - Inside IA
- Status Code Option Values
  - NotConfigured
  - NotAllowed – to restrict requests from particular relay
  - NoBinding
  - Success

# Glossary

- BBE – Broadband Edge
- BNG – Broadband Network Gateway
- CPE – Customer Premises Equipment
- vCPE – Virtual Customer Premises Equipment
- SP – Service Provider
- RIR – Relay Initiated Release