

# Kea - Modern DHCP

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<https://www.isc.org>





Kea

# When ISC DHCP was developed

- Networks were static
- No shortage of addresses
- DHCPv6 hadn't been invented
- Everything was wired
- No cellphones, no laptops
- Client devices were provisioned centrally, by scanning a bar code



# Modern Networks

- BYOD, roaming, WIFI
- Cattle not pets
- Clouds, fabric, NFV, SDN, Devops, continuous provisioning
- Containers
- Automation



Photo by [Ari Spada on Unsplash](#)



# ISC DHCP

- Proprietary format configuration file
- Local lease database

**Designed to be restarted with every configuration change.**

- OMAPI was added on
- DHCPv6 was added on



# Modern Network Services

- Standardized formats & tooling
- Everything needs a web api

**Plan for automated, continuous provisioning**

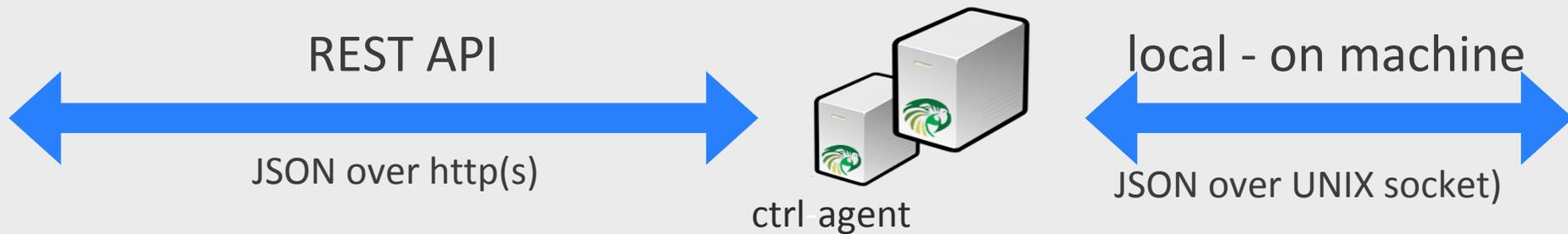
- Deploy capacity quickly with VMs
- Extensible, programmable



# Modern' Kea features

- ✓ Open, JSON file format
- ✓ Local and remote access
- ✓ Extensible with hooks
- ✓ Configuration DB, host DB for controlled automated provisioning, scalability
- ✓ Designed for v6 - HA for v6 as well as v4

# Local & Remote access



```
Command  
"command": "list-commands",  
"device": [ "dhcp6" ]
```

```
Response  
"commands": [  
  "build-report",  
  "config-get",  
  .  
],  
"exit": 0
```

- JSON in, JSON out
- Many available tools
  - jq
  - jsonlint.com
  - jsonviewer.stack.h

# Standard format $\neq$ Standard data model

- YANG models not standardized for DHCP servers, may not be possible
- Kea has YANG/Netconf integration via Sysrepo, immature

# Kea Hook Points

Hook point example: discover packet received,  
<hook> <return>

You can create a hook library to do almost anything, including writing the response packet

ISC Standard open source libraries: Lease  
Commands, High Availability, Flexible options

Premium libraries: Subnet Mgmt, Host  
Commands, Flex-ID, RADIUS, Configuration  
backend



# Kea Hooks



High Availability  
Flex-ID



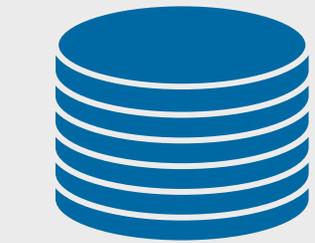
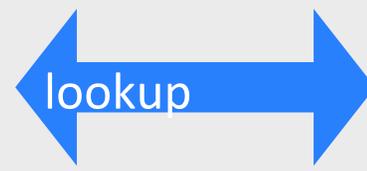
DHCP message  
processing

Flex Options

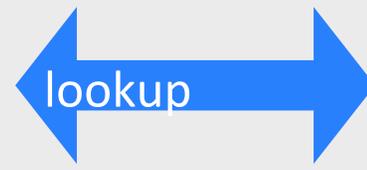


Address Assignment

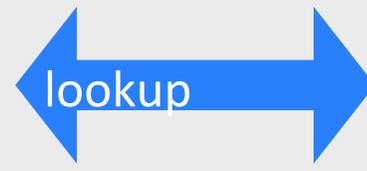
Active Leases



User  
Check



Host DB



Lease DB

KEA Functions

External system



# The backend concept

DHCPv4, DHCPv6  
server



- Leases (addresses, prefixes)
- Host reservations (per host details)
- Options
- Pools
- Subnets
- Shared networks
- Option definitions
- Global parameters

Lease backend

Hosts backend

Configuration backend

CSV, MySQL,  
PGSL, Cass

MySQL, PG

MySQL

# Backend options

- SQL data can be modified **any time**
- **No restart**
- Adapt your provisioning systems to **write directly to the database** .....or
- **Use the API** (some of these require premium hooks libraries)

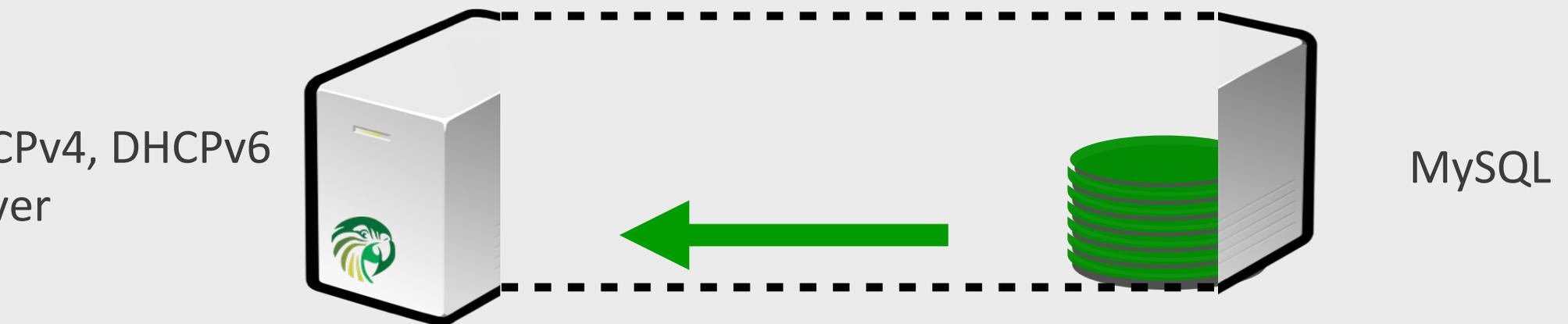


Postgr



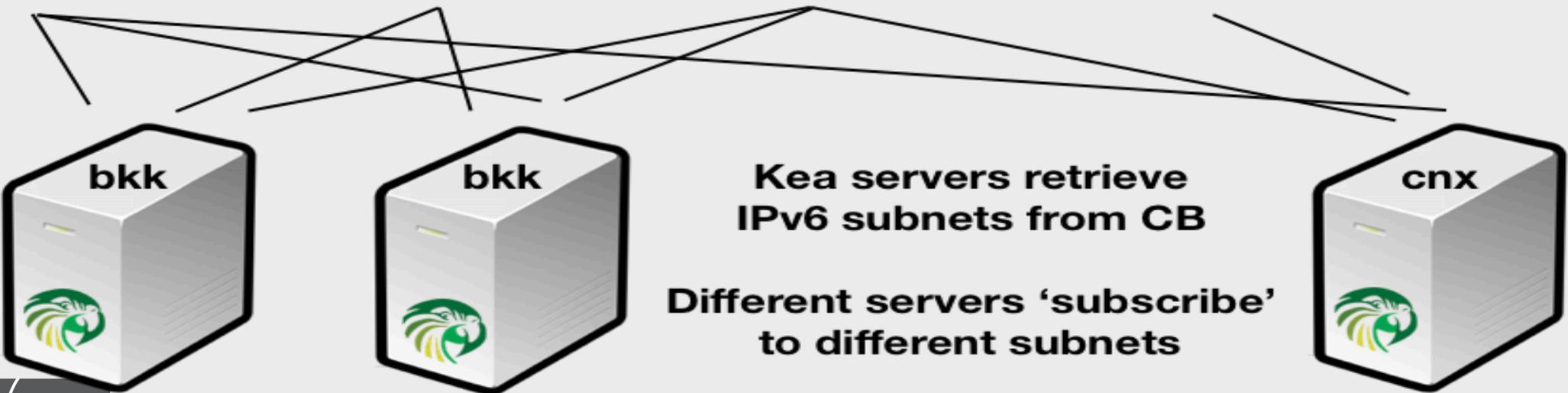
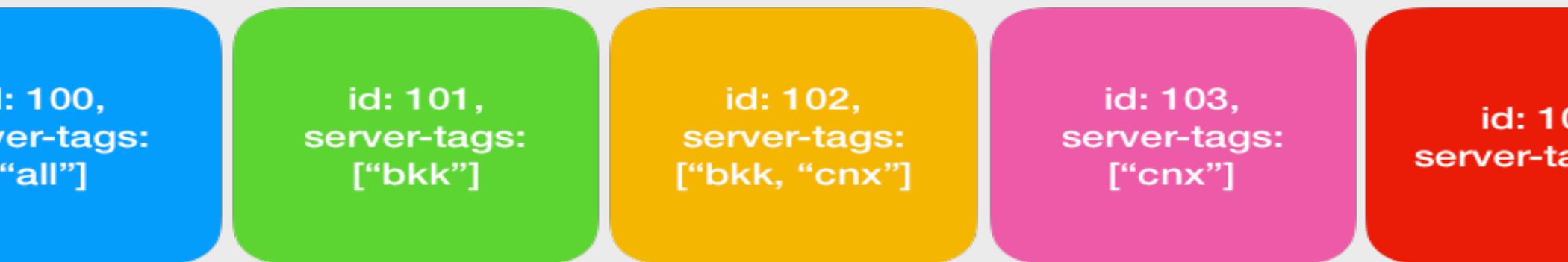
cassa

# Configuration Backend



- Manage configuration in DB. Both Pull and Push supported (configurable refresh interval)
- Co-locate or remote
- Multiple Kea servers can share one MySQL DB
- Works when DHCP servers are on-line or off-line

# Server Tags



# Example /etc/kea/kea-dhcp6.conf configuration file

```
5": {  
  "config_control": {  
    "config_databases": [{  
      "type": "mysql",  
      "name": "kea",  
      "user": "kea",  
      "password": "secret1",  
      "host": "192.0.2.1",  
      "port": 3302
```

```
    "config_fetch_wait_time": 20
```

```
    "hooks_libraries": [{  
      "library": "/opt/kea/hooks/  
      cp_mysql_cb.so"
```

```
      "library": "/opt/kea/hooks/  
      cp_cb_cmds.so"
```

- DB credentials
- refresh interval
- CB hook, tells Kea to look at DB for configuration
- CB commands hook, tells Kea to expose REST api

# Use Cases for Configuration D

Sharing configuration

Frequently changing configuration (options, pools, subnets, shared networks)

Automated deployment

Large configuration (100+ subnets)

Large scale deployments



# Kea vs ISC DHCP

	<b>ISC DHCP</b>	<b>Kea</b>
Performance	OK (with ramdisk tricks)	Multi-threading is in development - prospect of 1000's of LPS
Management	OMAPI (custom C interface)	<b>JSON over REST API/http, JSON over Unix socket</b>
High Availability	DHCPv4 failover	<b>HA for DHCPv4 and DHCPv6, multiple options for DB clustering</b>
Extensibility	Shell scripts (out only), configuration language	JSON everywhere, Hooks (C++), stable API
Configuration	Custom complex syntax (almost programming language)	JSON with optional DB storage for some elements
Log Files	Custom	<b>CSV, MySQL, PostgreSQL, Cassandra</b>
Reporting Information	Custom config	<b>JSON, MySQL, PostgreSQL</b>

# Why use Kea?

- Access to data - Database backends
- JSON configuration - many tools Change configuration without restart
- REST API
- Hooks



# Price of Modernity

- Overhead of maintaining databases  
(and for development, of maintaining separate database interfaces)
- Direct SQL manipulation is tricky
- Splitting state across the network introduces contention
- Network and application access delays

# Migrating to Kea

- Painful, but possible
- Migration Assistant available (for ISC DHCP users)
- Configuration only, not leases



ISC webinar

<https://www.isc.org/presentations/>

NANOG'76 talk

[https://pc.nanog.org/static/published/meetings//NANOG76/daily/day\\_2.html#talk\\_1998](https://pc.nanog.org/static/published/meetings//NANOG76/daily/day_2.html#talk_1998)

# Where is Kea popular?

- Access providers (Cable, Fiber)
- Greenfield deployments
- IPv6 networks
- anyone with a lot of static host reservations

Community Fibre Presentation at UKNOF

<https://indico.uknof.org.uk/event/47/contributions/685/>



# 2020 Roadmap

## 1.7.x

- New Open source hook module – Flex Options
- BOOTP
- Prometheus exporter
- Dashboard

## 1.8.x

- Performance improvements
- Multi-threading

# Stork Dashboard

## Configuration inspection

- subnets, pool, shared networks (per server, aggregated list)
- filtering/search mechanism

## Focus on **features Grafana can't easily do**

- Display pool utilization (total, pool, reserved, in use)
- HA/Failover status

## Health status:

- CPU/mem utilization
- Uptime, time since reconfig, version
- # of queries
- Response time

May 2020



# Try our Pre-built Packages

://cloudsmith.io/  
/repos/kea-1-7/  
ackages/

**cloudsmith** REPOSITORIES PACKAGES

Repositories ISC - Internet Systems ... Repository: kea-1.7 Package Groups

Switch to ... Search package groups ...

**Open-Source** — **isc** (ISC - Internet Systems Consortium) / **kea-1-7** — Project

kea-1.7: Kea 1.7.x. This is the current DEVELOPMENT branch of the Kea DHCPv4/DHCPv6/DDNS server. Please note that ISC does not recommend deploying development versions in critical production applications. — Edit

**Note:** Packages in this repository are licensed as [Mozilla Public License 2.0](#) (dependencies may be licensed differently).

**Packages** 329  
**Package Groups** 25  
Signing Keys

Collaborators  
Download Logs  
Edge Caching  
EULA Enforcement  
Event Logs  
Retention Rules  
Statistics

Count	Name	Size	Downloads	Greatest Version
22	isc-kea-admin	5.4 MB	642	1.7.4-risc00125... 2 weeks, 6 days ago
22	isc-kea-ctrl-agent	4.1 MB	598	1.7.4-risc00125... 2 weeks, 6 days ago
22	isc-kea-dev	28.9 MB	506	1.7.4-risc00125... 2 weeks, 6 days ago
2	isc-kea-dhcp-ddns	349.1 KB	79	1.7.4-risc00125... 2 weeks, 6 days ago
2	isc-kea-dhcp4	584.7 KB	36	1.7.4-risc00125... 2 weeks, 6 days ago
2	isc-kea-dhcp6	583.2 KB	36	1.7.4-risc00125... 2 weeks, 6 days ago



All content

# gitlab.isc.org



https://gitlab.isc.org/isc-projects/kea/-/boards?label\_name[]=config-backend

Projects Groups Activity Milestones Snippets

Search on

ISC Open Source Projects > Kea > Issue Boards

Development

Label ~config-backend

Open

22 +

cb\_cmds: inheritance in config file should be overridable in config-backend

bug config-backend

#585

Consider MySQL CB schema changes to make it compatible with NDBCLUSTER

config-backend db low

#593

forbid using empty string as value of shared-network-name parameter in remote-subnet4-set command

api config-backend

#598

interface-id should be empty in subnet and not copied from shared-network if not specified directly

bug comments needed config-backend low removal-candidate

#652

Doing

0 +

Review

3 +

Update cb\_cmds with commands using embedded parameters

Review cb\_cmds config-backend low

#418

Create config backend design

Review config-backend

#88

How configure client-class for pools in db?

Review config-backend medium

#659

<https://gitlab.isc.org/isc-projects/kea/>

# References



Website: [isc.org/kea/](https://isc.org/kea/)

Project site: [gitlab.isc.org/isc-projects/kea](https://gitlab.isc.org/isc-projects/kea)

Documentation: <https://kea.readthedocs.io>

<https://kb.isc.org/docs/kea-performance-optimization>

<https://kb.isc.org/docs/kea-dhcpv6-design-considerations>

<https://kb.isc.org/docs/understanding-client-classification>

Upcoming APNIC Kea webinar: [tinyurl.com/apnic-kea](https://tinyurl.com/apnic-kea)

My email: [vicky@isc.org](mailto:vicky@isc.org)





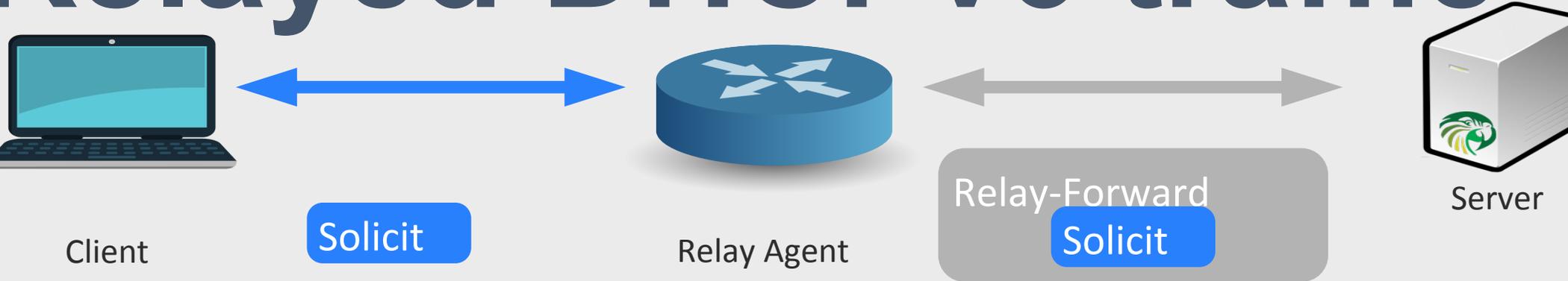
# DHCPv6 quirks

Relays

MAC vs DUID

Prefix Delegation

# Relayed DHCPv6 traffic



<https://www.cloudshark.org/captures/ed586947ac56>  
<https://www.cloudshark.org/captures/a93239e296bc>

(single relay)  
(two relays)

```
Frame 1: 144 bytes on wire (1152 bits), 144 bytes captured (1152 bits) on interface 0  
Internet II, Src: PcsCompu_00:ff:92 (08:00:27:00:ff:92), Dst: IPv6mcast_01:00:02 (33:33:00:01:00:02)  
Internet Protocol Version 6, Src: fe80::a00:27ff:fe6d:ee67, Dst: ff02::1:2  
Datagram Protocol, Src Port: 547, Dst Port: 547
```

```
Message type: Relay-Forward (12)  
Hopcount: 0  
Link address: 3000::1005  
Peer address: fe80::a00:27ff:fe6d:ee67  
Interface-Id  
Relay Message  
Option: Relay Message (9)  
Length: 38  
value: 01d0bfaf0001000000001307292c00000270dccc0003...  
DHCPv6  
Message type: Solicit (1)  
Transaction ID: 0xdafbfaf  
Client Identifier  
Identity Association for Non-temporary Address
```

- Up to 8 relays
- Usually 1
- CMTS
- Each relay adds extra encapsulation layer

# Prefix Delegation

- A. Dynamic
- B. Static reservations
- C. Managed host reservations in SQL db
- D. Assign prefixes via RADIUS

# DRUIDS



# MAC vs DUID

- IPv6 got rid of the MAC address as client identifier
  - This was a big mistake!
- IPv6 uses DUIDs - unique identifier, one of 4 types:
  - LLT (MAC + time)
  - EN (Enterprise-id)
  - LL (MAC)
  - UUID
- Kea has a solution:
  - RFC6939 (client-link-layer address option)
  - Extract MAC address from 5 different sources, configurable
  - See [https://kea.readthedocs.io/en/v1\\_6\\_0/arm/dhcp6-srv.html#mac-hardware-addresses-in-dhcpv6](https://kea.readthedocs.io/en/v1_6_0/arm/dhcp6-srv.html#mac-hardware-addresses-in-dhcpv6) for details