

Kea - Modern DHCP

Vicky Risk

APRICOT 2020

<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

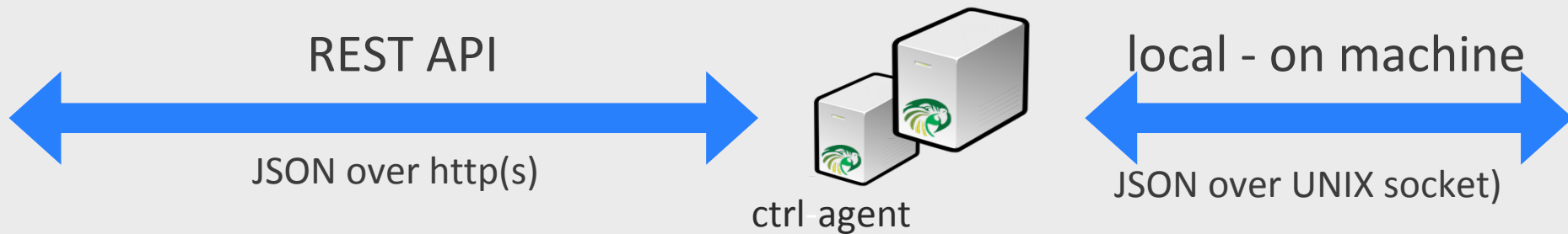
- Deploy capacity quickly with VMs
- Extensible, programmable



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



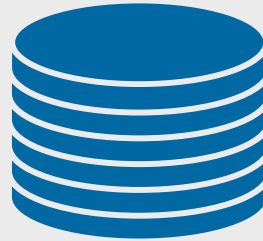
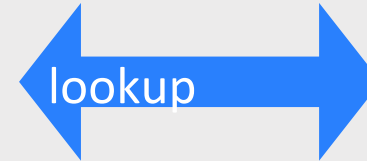
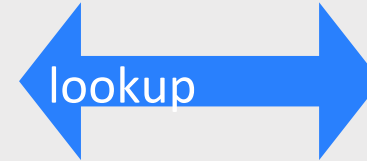
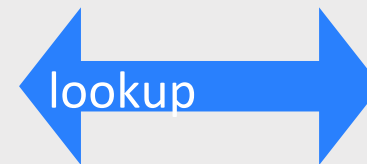
DHCP message
processing

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)

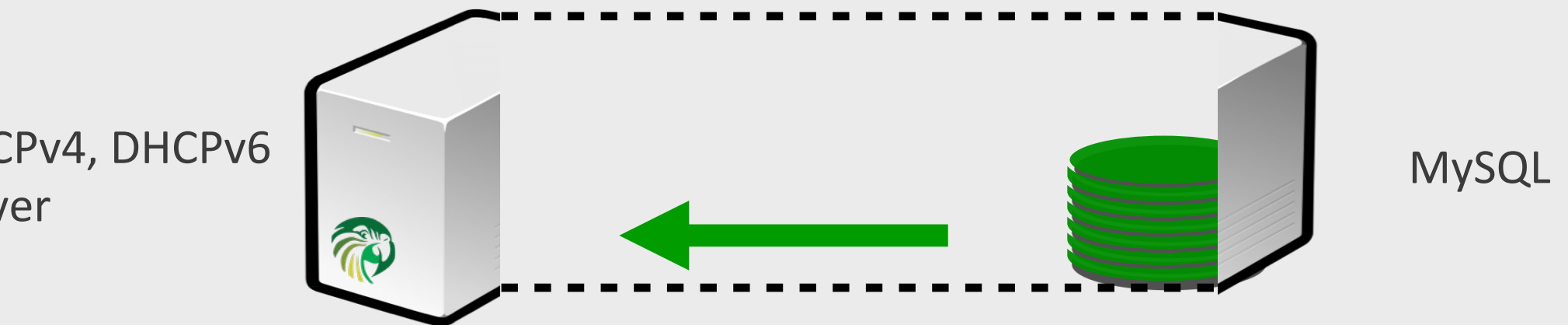


Postgr



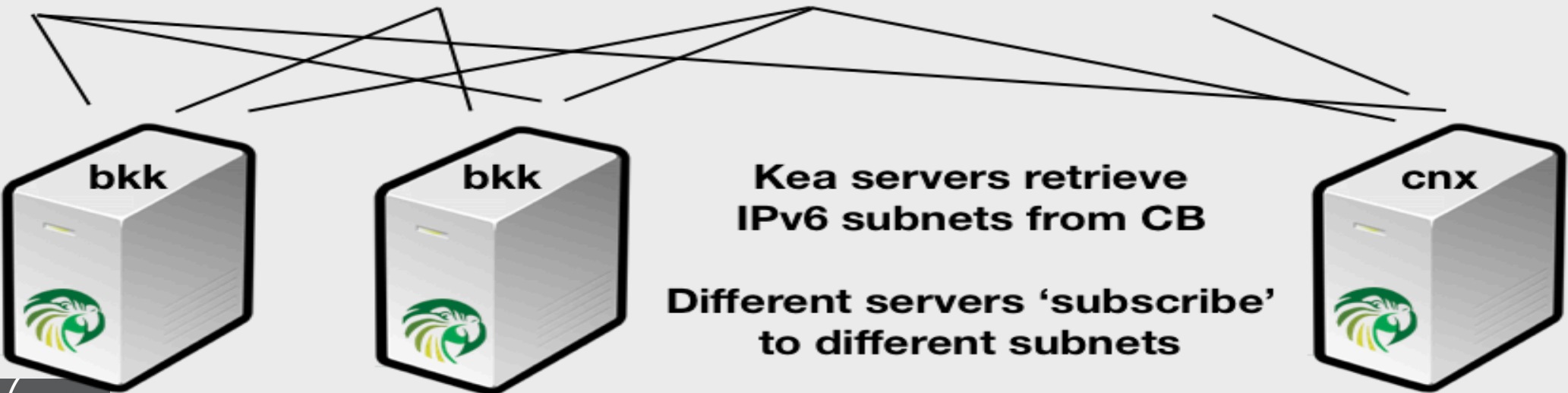
cassa

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

	ISC DHCP	Kea
Performance	OK (with ramdisk tricks)	Multi-threading is in development - prospect of 1000's of LPS
Management	OMAPI (custom C interface)	JSON over REST API/http, JSON over Unix socket
Availability	DHCPv4 failover	HA for DHCPv4 and DHCPv6, multiple options for DB clustering
Flexibility	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 file information	Custom	CSV, MySQL, PostgreSQL, Cassandra
Configuration information	Custom config	JSON, MySQL, PostgreSQL

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

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/

The screenshot shows the CloudSmith web interface for a repository named 'kea-1-7'. The header includes the CloudSmith logo and navigation links for 'REPOSITORIES' and 'PACKAGES'. The breadcrumb trail indicates the current location: 'Repositories > ISC - Internet Systems ... > Repository: kea-1.7 > Package Groups'. A search bar is present for finding package groups. Below the search bar, there is a description of the repository: 'Open-Source' (with a help icon), 'isc (ISC - Internet Systems Consortium) / kea-1-7 - Project' (with an external link icon). The description text reads: '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'. A yellow note below states: 'Note: Packages in this repository are licensed as Mozilla Public License 2.0 (dependencies may be licensed differently)'. On the left sidebar, there are menu items: 'Packages' (329), 'Package Groups' (25), 'Signing Keys', 'Collaborators', 'Download Logs', 'Edge Caching', 'EULA Enforcement', 'Event Logs', 'Retention Rules', and 'Statistics'. The main content area displays a table of package groups with columns for 'Count', 'Name', 'Size', 'Downloads', and 'Greatest Version'. Each row includes a green circular icon with a count, the package name, size, download count, version, and age, and a green download icon.

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/

Project site: 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

My email: vicky@isc.org





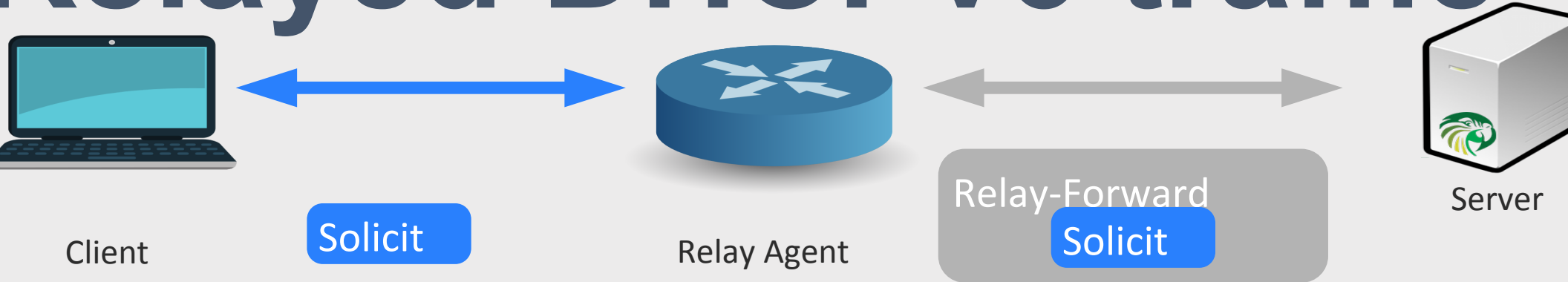
DHCPv6 quirks

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: 01d0bfaf00010000000010001507292c00000270d0e000003...  
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 for details