Kea

A modern DHCP engine

UKNOF40

Tomek Mrugalski
tomek(at)isc(dot)org

If you never heard about Kea…

- Modern DHCPv4, DHCPv6 and DDNS servers
- Performance
- Scalable (millions of devices)
- On-line reconfiguration (no restarts after config changes)
- Feature rich: shared networks, v6, PD, custom options,…
- **Database Backends**
- **Hooks** (3rd party libraries, like apache modules)
- **REST** management API
- Linux, BSDs, MacOS, …
- Open source (MPL2)
- 1.4.0 beta about to be released (May 2018)

Backends

- Leases, host reservations in DB (1.4)
  - CSV
  - MySQL, PostgreSQL
  - Cassandra
- Configuration in DB likely in 1.5
- SQL data can be modified any time
- All changes applied instantly (no restart)
- Can manipulate the DB directly or
- Use host commands (1.2) and subnets (1.3)

Hooks (1 of 2)

- 1.1: **User Check** – example access control
- 1.2: **Forensic Logging** – audit trail for legal purposes
- 1.2: **Flexible Identifier** – identify hosts by expression, e.g. concat(relay4[2].hex, relay4[6].hex)
- 1.2: **Host Commands** – query, add and delete host reservations using REST interface
- 1.3: **Subnet management** (add, get, update, delete subnets and shared networks via REST API)
- 1.3: **Extra lease commands** (add, get, update, delete, wipe all, get all leases via REST API)

Open source

Premium

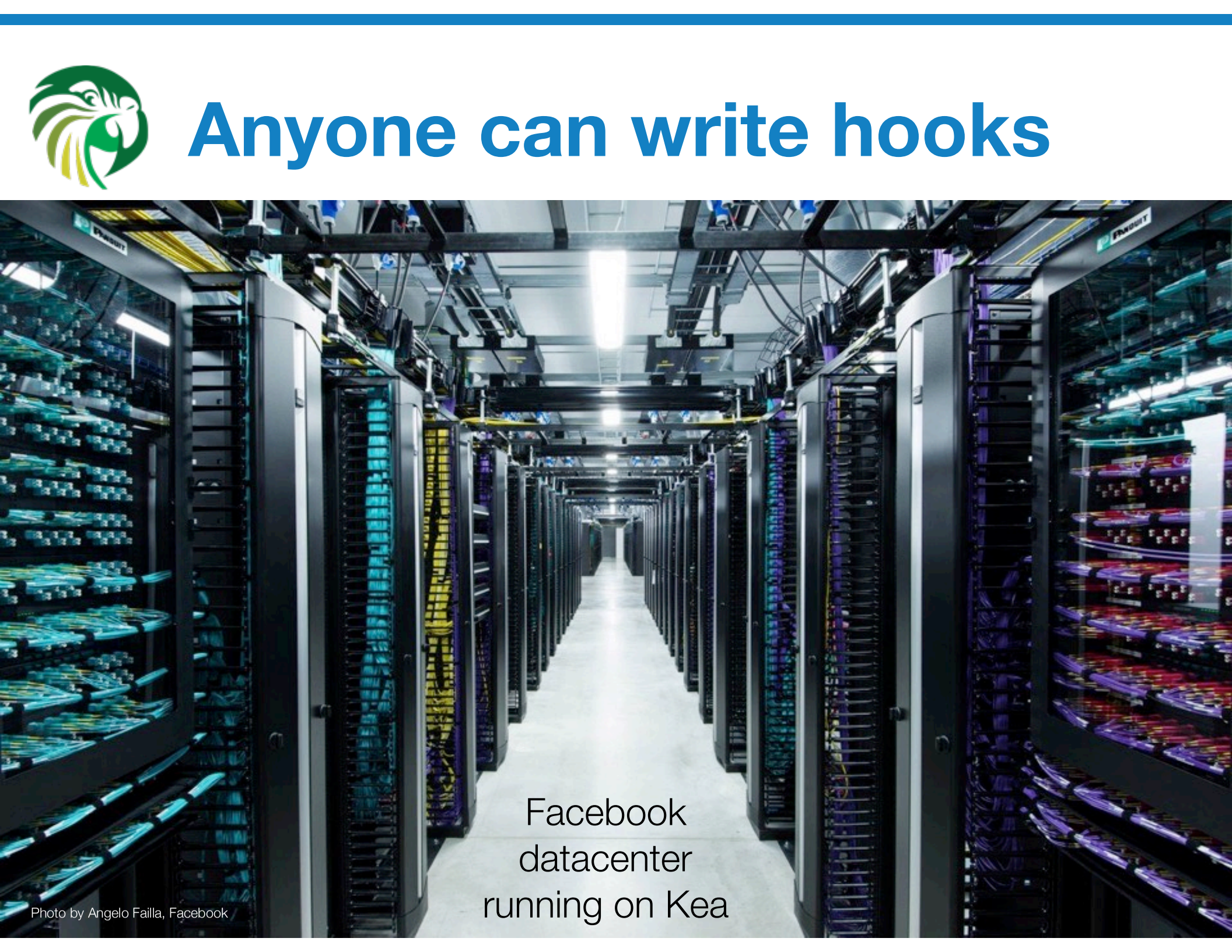
Hooks (2 of 2)

- 1.4: **HA** – high availability solution (heartbeat, failure detection, lease updates, recovering DB from partner)
- 1.4: **Radius** – access control and host reservation using FreeRadius, accounting
- 1.4: **Host Caching** – cache host responses locally from slower backends for extra performance (includes negative caching)
- 1.5: **Limits** - ability to rate limit queries, limit # of leases per subnet, pool, port, device, time restricted leases (valid until, not valid before)

Open source

Premium

ISC



Anyone can write hooks

Facebook datacenter running on Kea

Photo by Angelo Failla, Facebook

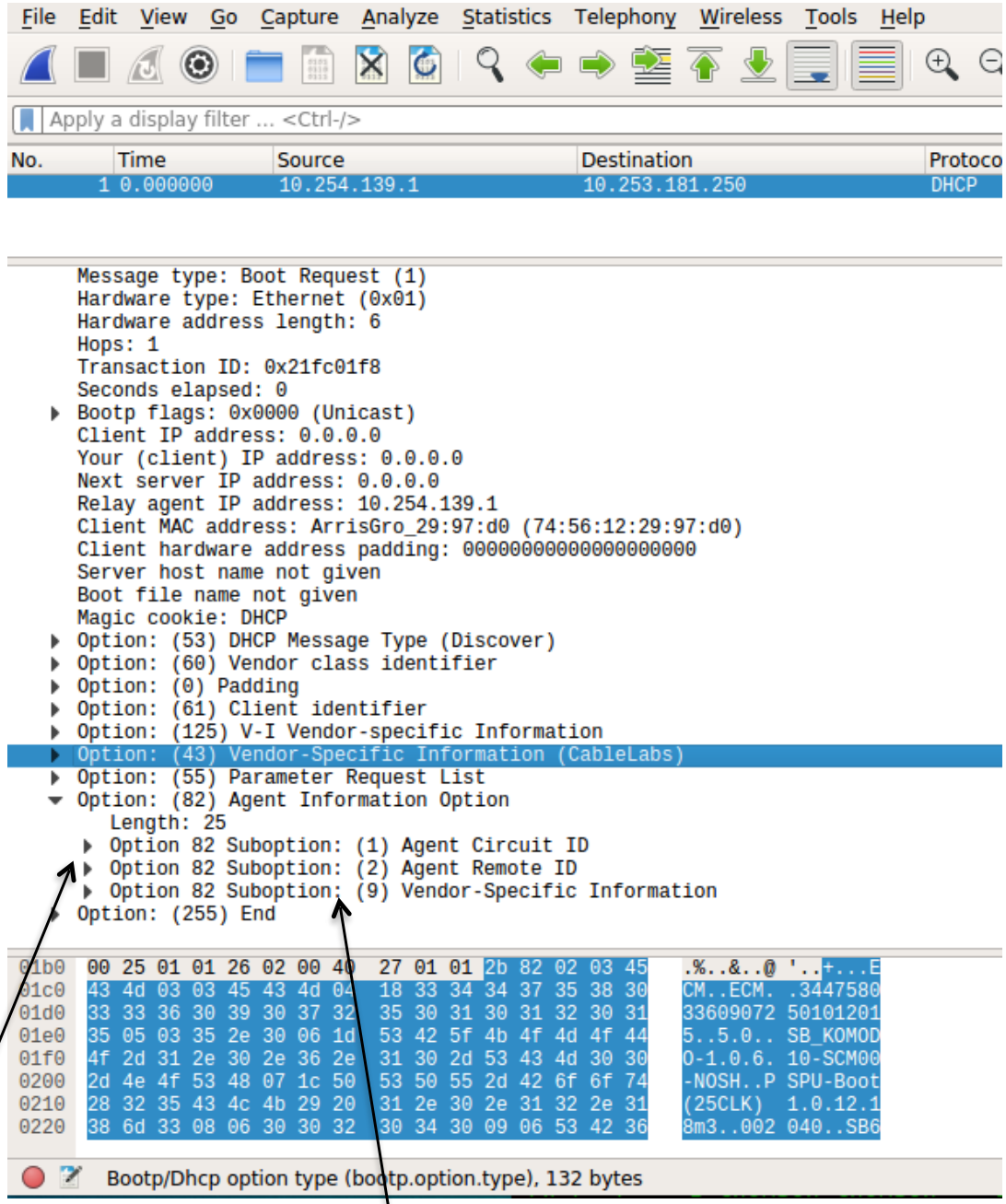
Flex-id (1.2)

- Flexible Identifier

How to identify hosts:

- **Open source**
- MAC, duid, circuit-id, client-id

- **Premium**
- Almost anything could be used (35 different expressions)
- Options (client, relay, vendor)
- Fixed fields
- Concat, substring
- Meta-data (interface name, src/dst IP, …)



concat(relay4[1].hex, relay4[2].hex)

REST API (1.2/1.3)

Overview:

- Command Channel (Unix socket)
- REST interface (http/https)
- JSON commands, JSON responses
- kea-shell provided (python 2.x, 3.x example)

Manipulate:

- Whole **config** (config-get/set/test/write)
- **Shared networks, subnets** (subnet4/6-list/add/get/del)
- **Host Reservations** (reservation-get/add/del)
- **Leases** (lease4/6-get/add/update/del/wipe)
- **Statistics** (statistic-get/reset/get-all)
- **Server** (list-commands, shutdown, version-get, build-report, leases-reclaim, etc.)

More to come in future releases

```
{
    "command": "subnet6-add",
    "arguments": {
        "subnet6": [ {
            "id": 234,
            "subnet": "2001:db8:1::/64",
            ...
        } ]
    }
}
```

Command

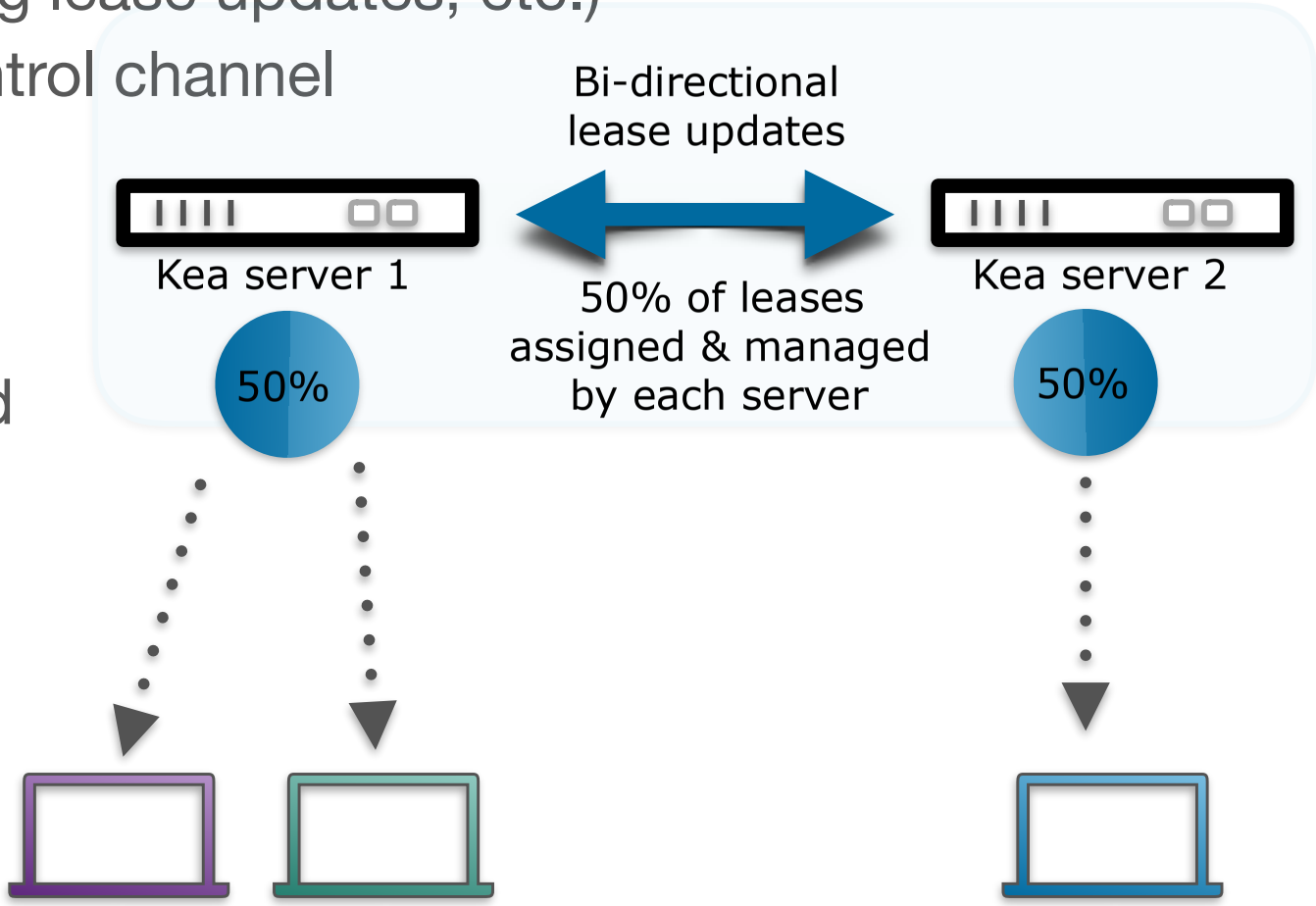
```
{
    "result": 0,
    "text": "IPv6 subnet added",
    "arguments": {
        "subnet6": [
            {
                "id": 234,
                "subnet": "2001:db8:1::/64"
            }
        ]
    }
}
```

Response

ISC

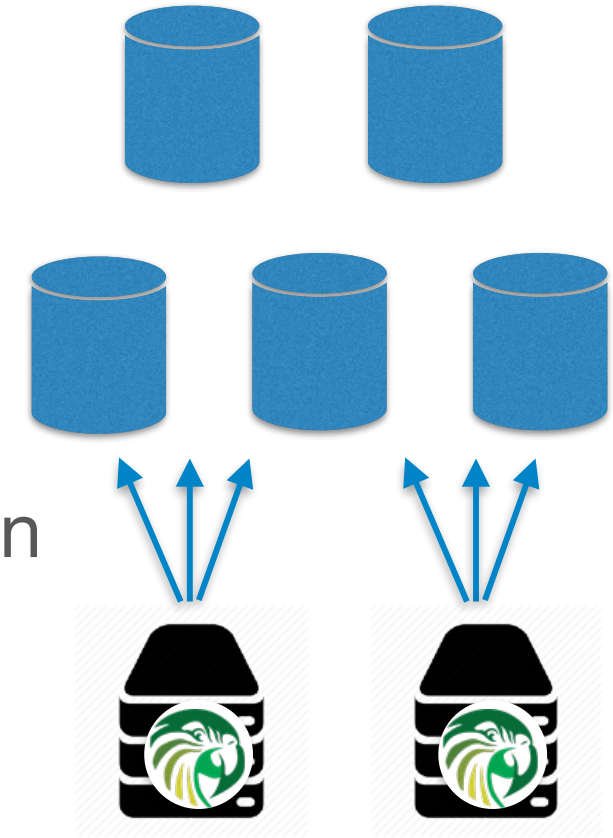
High Availability (1.4)

- **Load balancing** or **hot standby**
- RESTful API based
- Hook points (sending lease updates, etc.)
- Heartbeats over control channel
- Lease updates via lease_cmds hook
- Failure detection based on ‘secs’ field
- Auto-sync of lease database
- Backup server
- 50/50 LB split
- V4 and V6



Apache Cassandra (1.4)

- Distributed non-relational NoSQL database
- Massive scalability without a single point of failure
- Replication factor
- Can operate with at least one node surviving
- CQL
- Data denormalization



HA	NODES	FAILURES
	2	1

RF	NODES	FAILURES
1	1	0
2	3	1
3	5	2
4	7	3
	…	

RF = 2N + 1 can survive N failures

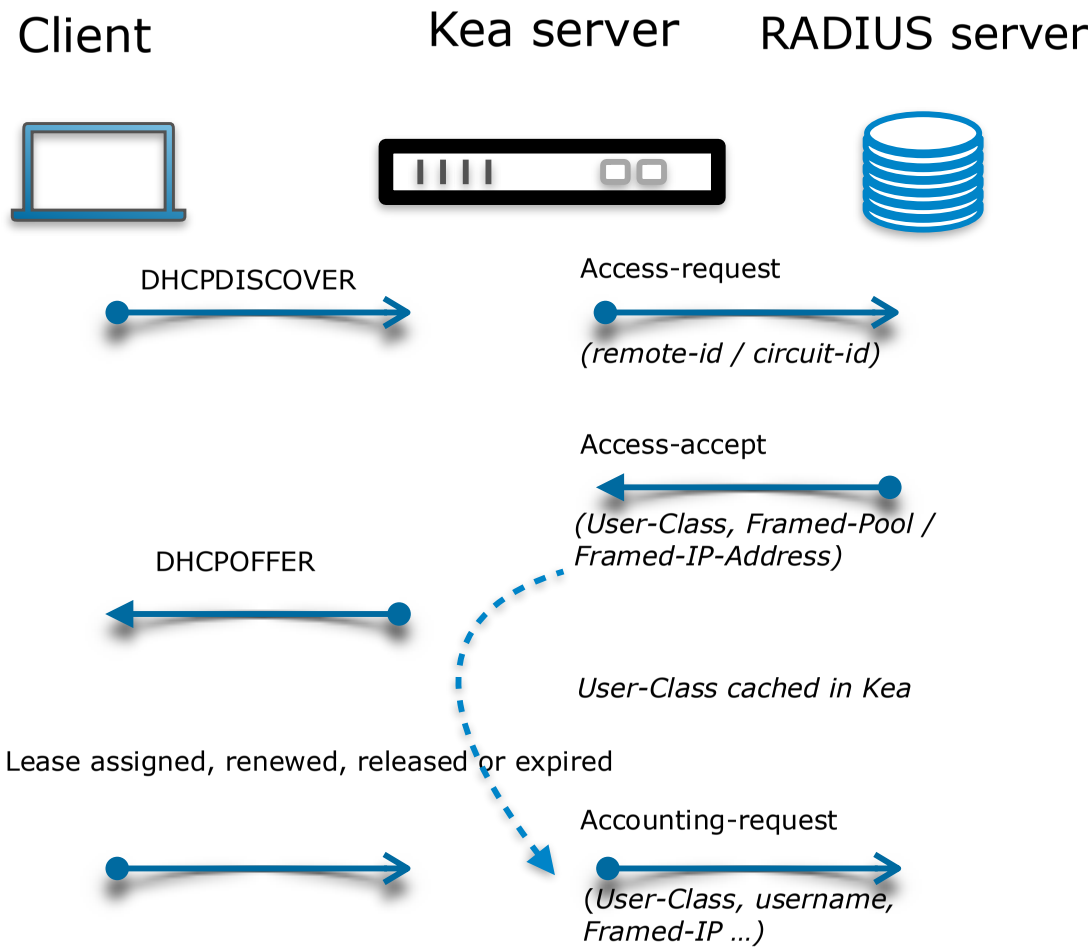
1.4 coming up

- 1.4.0 beta: **May 14th**, 1.4.0 final: June 15th
- Improved shared networks performance
- Improved classification
  - member(foo) && !member(bar) && (relay4[2].hex == ‘abcd’)
- Fixed statistics when run multiple instances with the same DB
- Many smaller bugfixes and improvements
  (100+ tickets closed and counting)

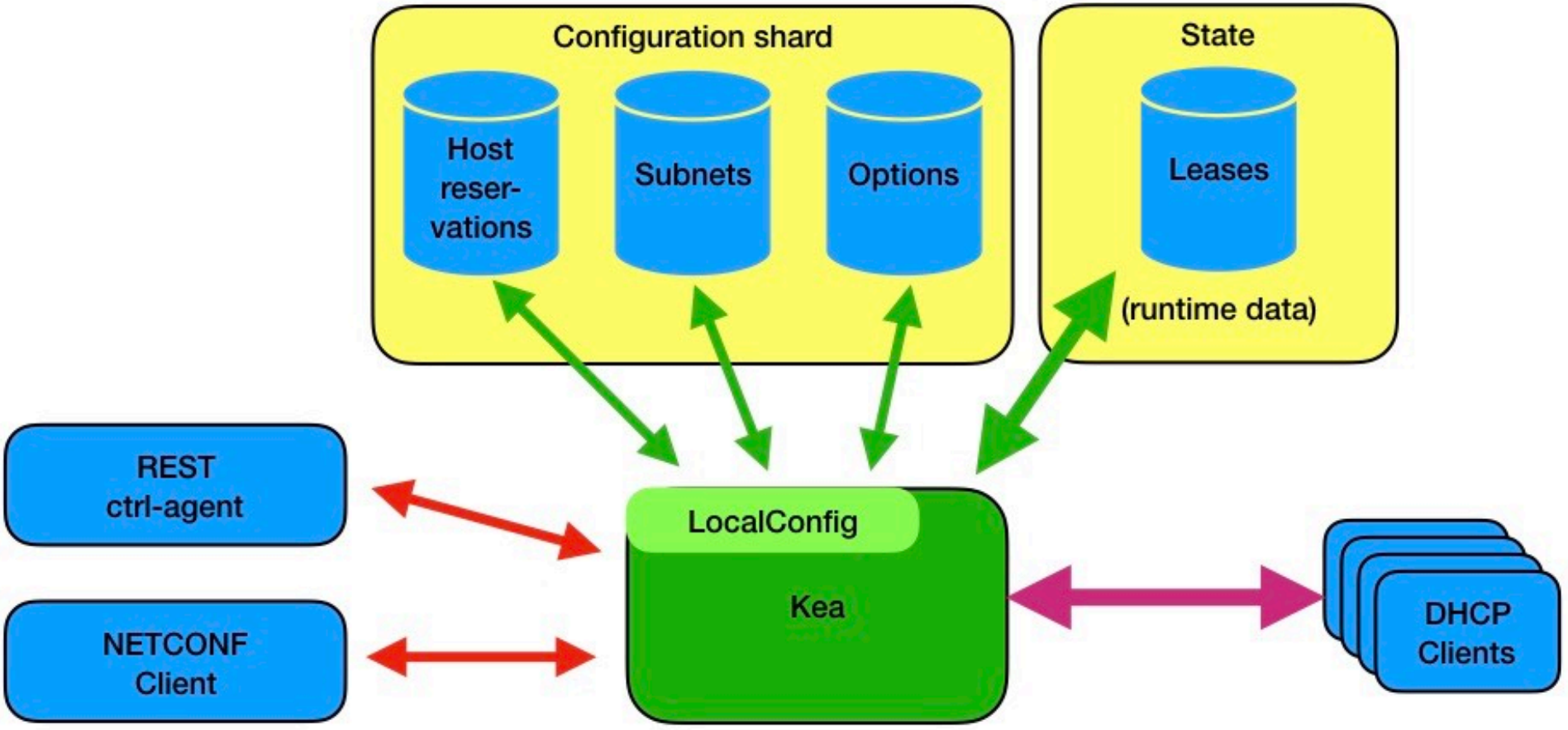
kea.isc.org/roadmap

RADIUS Integration (1.4)

- Authentication
  - Access control
  - Address Reservation
  - Class assignment
- Accounting
- Attributes customizable
- FreeRadius based
- DHCPv4 and DHCPv6



DB Configuration Storage (1.5)



kea.isc.org/wiki/CentralizedConfigNetconf

YANG/NETCONF (1.5)

```
<server xmlns="…">
 <server-config>
  <network-ranges>
    <option-set-id>1</option-set-id>
    <network-range>
     <network-range-id>1</network-range-id>
     <network-description />
     <network-prefix>2001:db8::/56</network-prefix>
     <option-set-id>2</option-set-id>
     <address-pools>
      <address-pool>
       <pool-id>1</pool-id>
       <start-address>2001:db8::1</start-address>
       <end-address>2001:db8::ffff</end-address>
       <renew-time>20</renew-time>
       <rebind-time>90</rebind-time>
       <valid-lifetime>150</valid-lifetime>
       <preferred-lifetime>120</preferred-lifetime>
      </address-pool>
     </address-pools>
    </network-range>
  </network-ranges>
 </server-config>
</server>
```

Configuration

```
container network-ranges {
    description "This model supports a hierarchy ...";
    list network-range {
      key network-range-id;
      leaf network-range-id {
        type uint32;
        mandatory true;
      }

      container address-pools {
      description "A container that describes the …";
      list address-pool {
        leaf start-address {
          type inet:ipv6-address-no-zone;
          mandatory true;
          description "start address";
        }
        leaf end-address {
          type inet:ipv6-address-no-zone;
          mandatory true;
          description "end address";
        }
        leaf valid-lifetime {
          type yang:timeticks;
          mandatory true;
          description "valid liftime for IA";
        }
        ...
    }
```

YANG model

TreeView for YANG model

Module: ietf-dhcpv6-server@2018-03-04, **Namespace:** urn:ietf:params:xml:ns:yang:ietf-dhcpv6-server, **Prefix:** dhcpv6-server
Impact Analysis for ietf-dhcpv6-server@2018-03-04

Element [+] Expand All [-] Collapse All	S	Type	Path
ietf-dhcpv6-server	m	module	
server	c	container	/dhcpv6-server:server
server-config	c	container	/dhcpv6-server:server/dhcpv6-server:server-config
serv-attributes	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:serv-attributes
option-sets	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:option-sets
network-ranges	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges
option-set-id	le	leafref	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
network-range	li	list	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
network-range-id	le	uint32	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
network-description	le	string	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
network-prefix	le	inet:ipv6-prefix	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
option-set-id	le	leafref	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
address-pools	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
pd-pools	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
host-reservations	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:network-ranges/dhcpv6-serve
relay-opaque-paras	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:relay-opaque-paras
rsoo-enabled-options	c	container	/dhcpv6-server:server/dhcpv6-server:server-config/dhcpv6-server:rsoo-enabled-options
server-state	c	container	/dhcpv6-server:server/dhcpv6-server:server-state
dhcpv6-server:notifs			

ISC

Useful links

- **Kea project homepage**: http://kea.isc.org
- **Documentation**: http://kea.isc.org/docs/
  - User's Guide - 100+ pages of guidance with examples for users, REST API documentation, and user documentation for premium hooks (easy to see if you would benefit from purchasing them)
  - List of all log messages - with an explanation what happened and why, a nod towards the mainframe era
  - Developer's Guide - for developers and contributors, explains the internals, also includes Hooks interface API
- **Kea business page**: http://isc.org/kea
  - High level overview, premium hooks white papers, ISC DHCP vs Kea comparison, support links, 24/7 support available
- **The source code**: http://github.com/isc-projects/kea
  - Source code for premium hooks is also provided to purchasers

Q&A

Questions?

Suggestions?

Tomatoes?