Utilizing Kea hook points for modern IP addressing

NANOG 67

Why Kea?

- ISC DHCP is now 21 years old

- Stable, effective, but…
  - Slow by modern standards
  - Flat file lease storage
  - Restarts likely required for config mods
  - Failover only in peer arrangements
  - Oh, those man pages!

Kea

- DHCP server
- modern alternative to ISC DHCP
- standards-compliant
- open-source
- DHCPv4 & DHCPv6
- easily extensible (via Hooks)

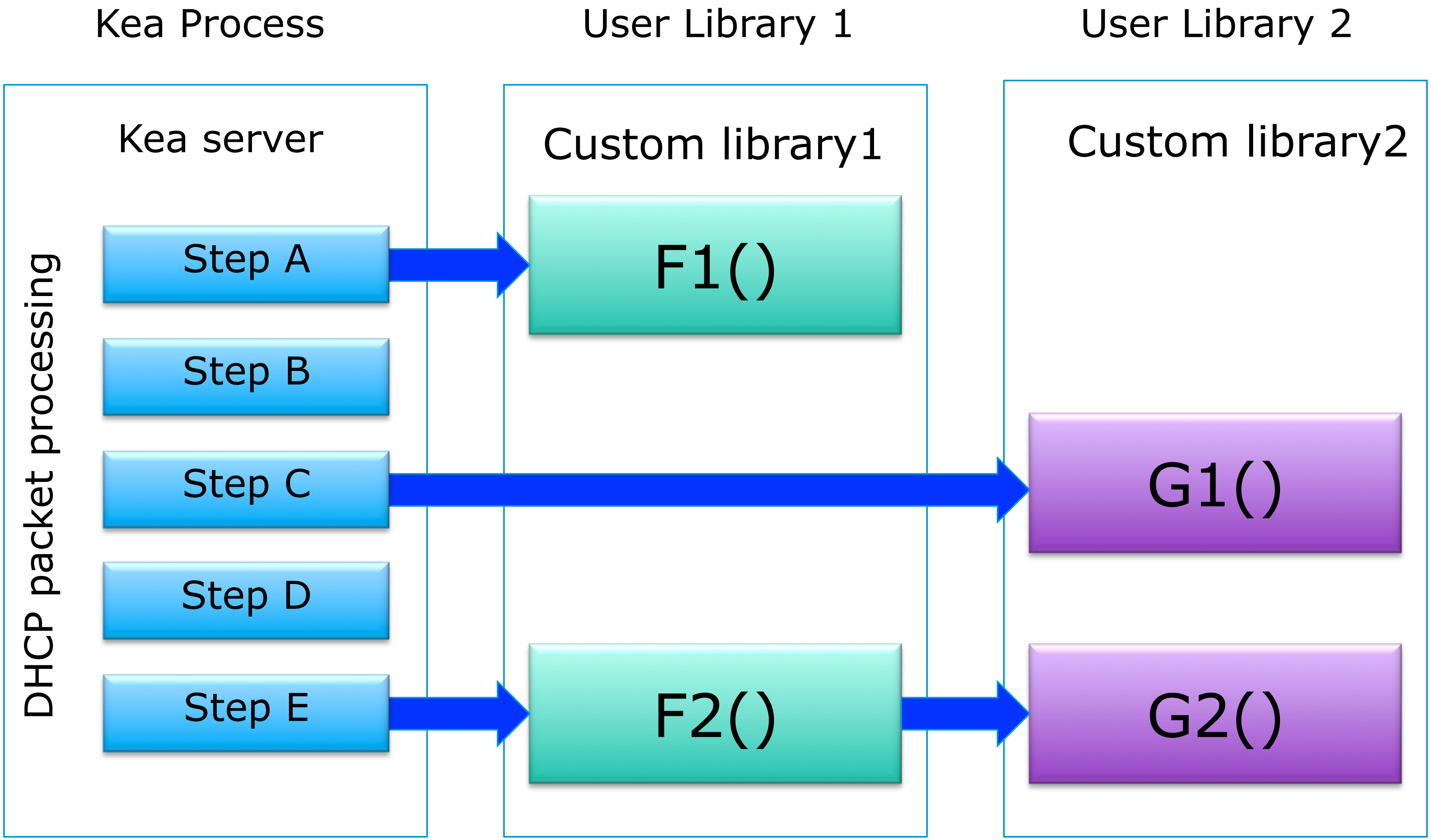
Kea

- Better performance
- Ability to store lease information in a database
- No restart required unless physical interfaces change
- Well-documented

Kea Hooks

- Dynamically Loadable Libraries
- Written in C++
- Functions given control at points in packet processing
- Can access **all** parts of Kea

Hooks :: Extending the Server



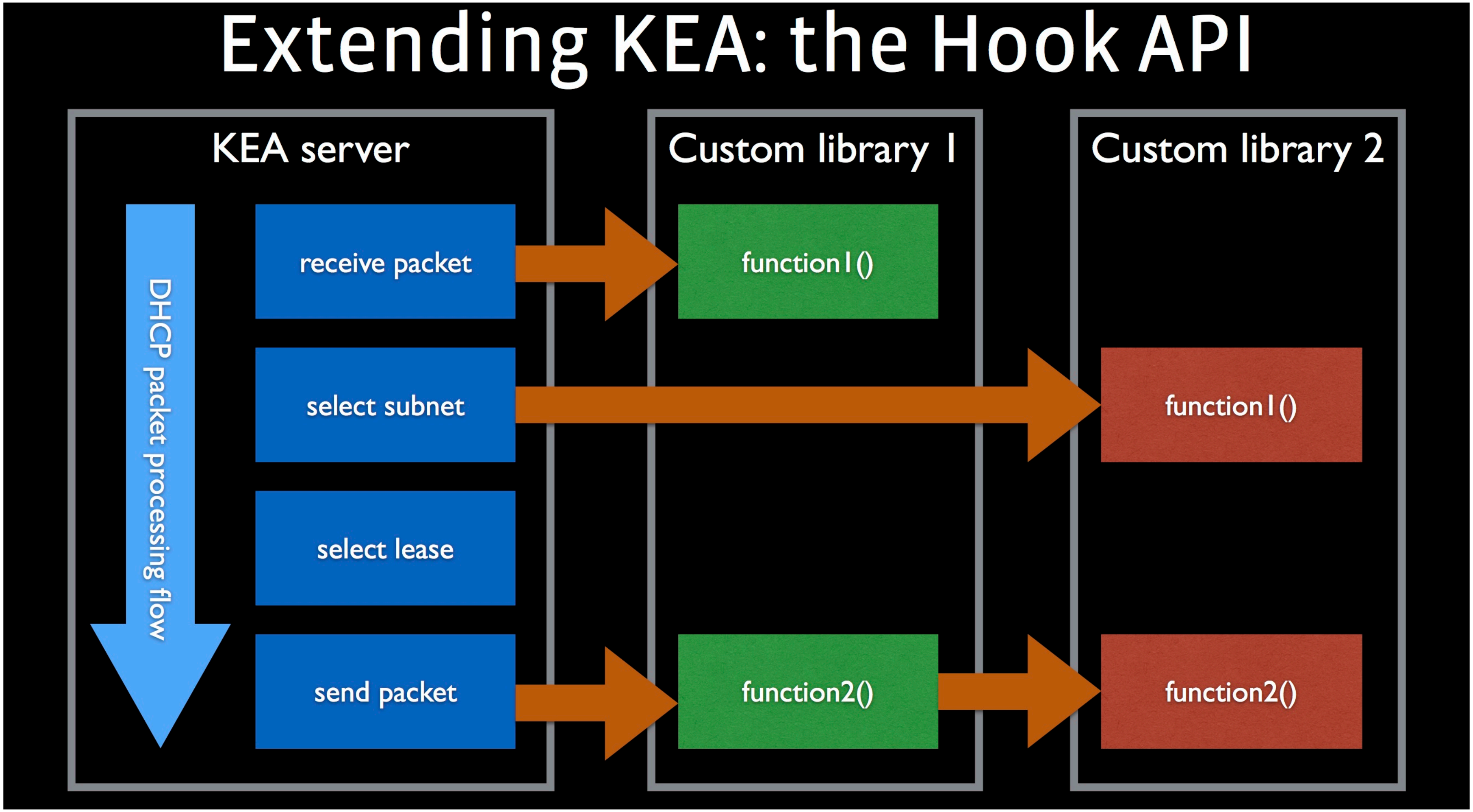
Real-world example

- Facebook has been a very early & open adopter of Kea in their DCs

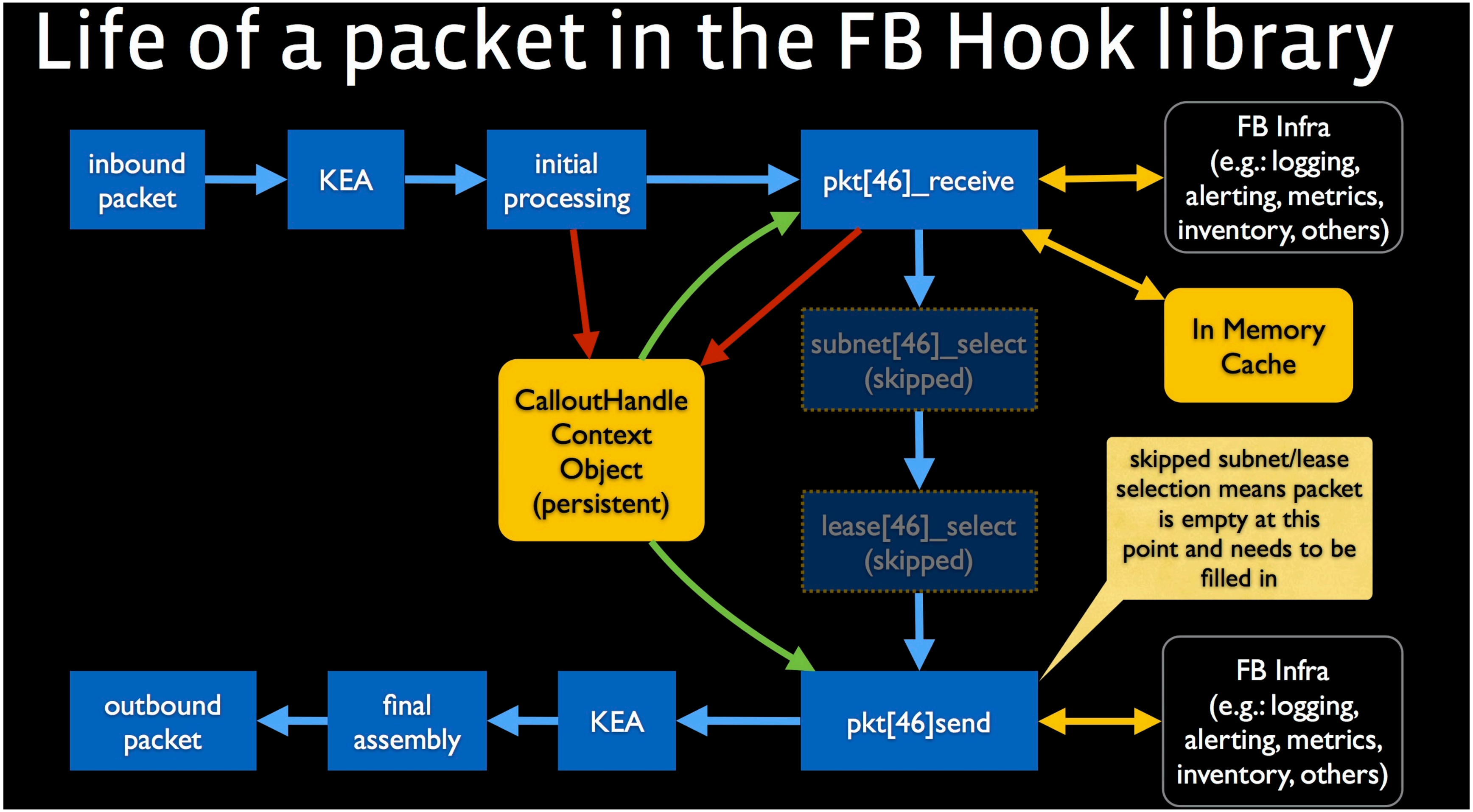
https://code.facebook.com/posts/845909058837784/using-isc-kea-dhcp-in-our-data-centers/

https://www.isc.org/blogs/how-facebook-is-using-kea-in-the-datacenter/

Kea Hooks @ facebook



facebook Kea deployment



Life of a packet in the FB Hook library

inbound packet

KEA

initial processing

pkt[46]_receive

FB Infra (e.g.: logging, alerting, metrics, inventory, others)

subnet[46]_select (skipped)

In Memory Cache

CalloutHandle Context Object (persistent)

lease[46]_select (skipped)

skipped subnet/lease selection means packet is empty at this point and needs to be filled in

outbound packet

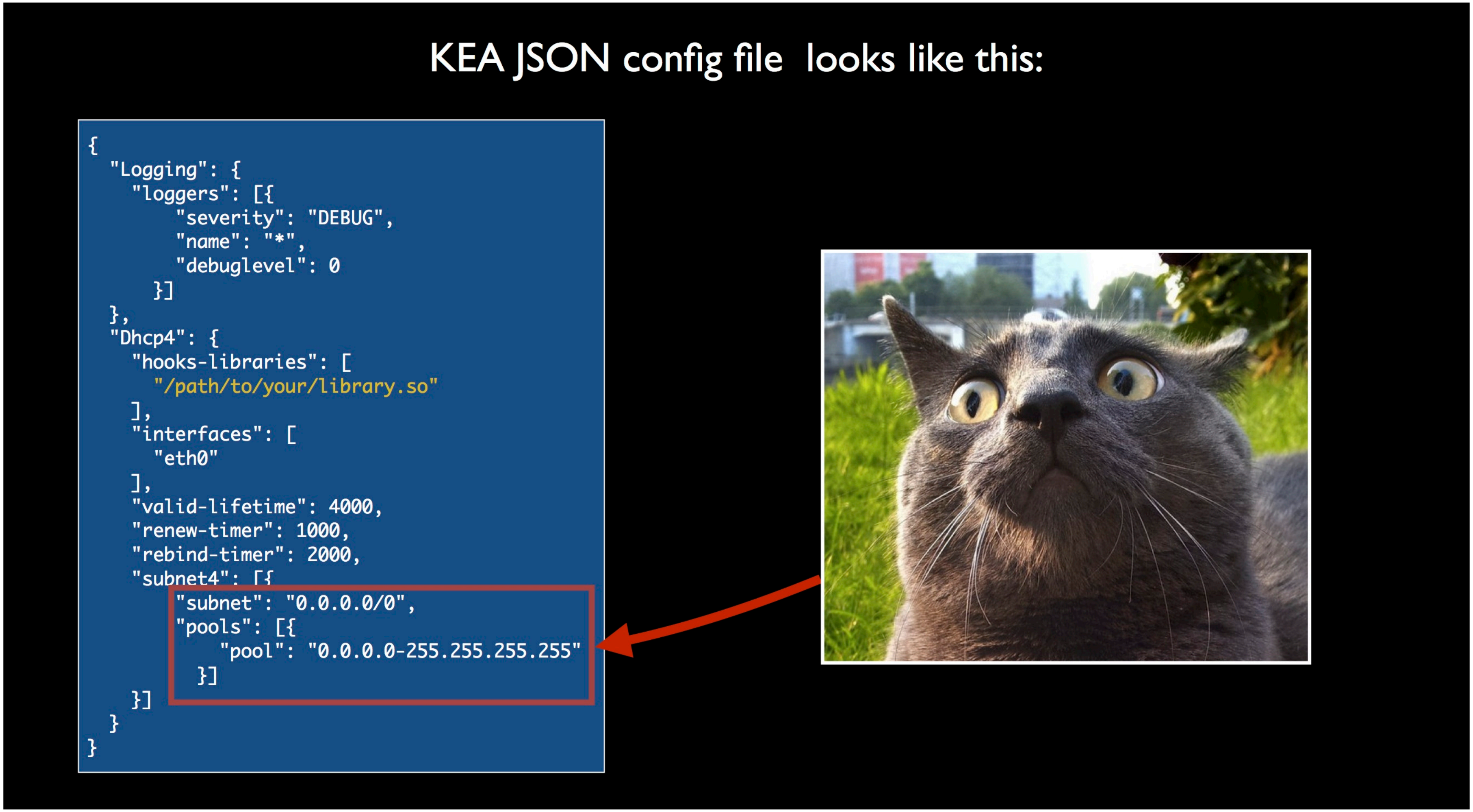
final assembly

KEA

pkt[46]send

FB Infra (e.g.: logging, alerting, metrics, inventory, others)

facebook Kea config



KEA JSON config file looks like this:

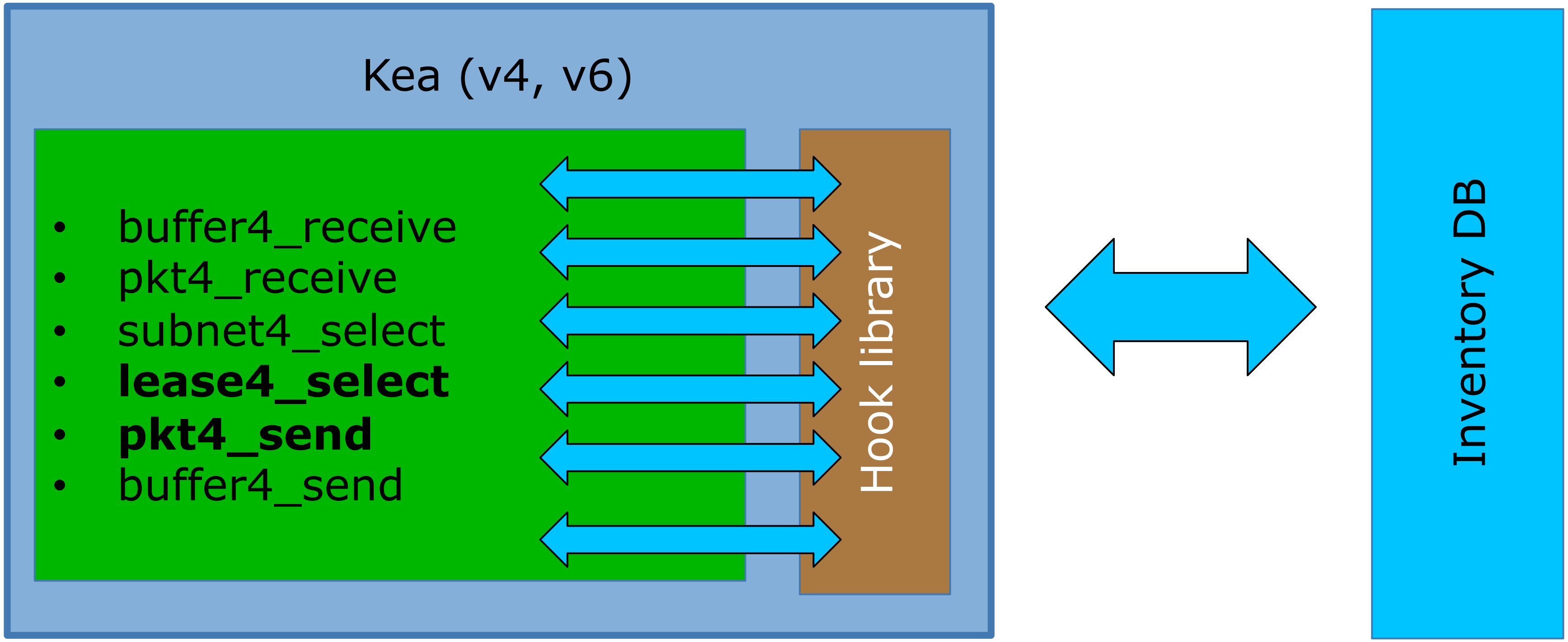
```
{
  "Logging": {
    "loggers": [{
        "severity": "DEBUG",
        "name": "*",
        "debuglevel": 0
      }]
  },
  "Dhcp4": {
    "hooks-libraries": [
      "/path/to/your/library.so"
    ],
    "interfaces": [
      "eth0"
    ],
    "valid-lifetime": 4000,
    "renew-timer": 1000,
    "rebind-timer": 2000,
    "subnet4": [{
        "subnet": "0.0.0.0/0",
        "pools": [{
            "pool": "0.0.0.0-255.255.255.255"
          }]
      }]
  }
}
```

facebook hook code

facebook has shared their hook code openly & it can be found within their presentation here:

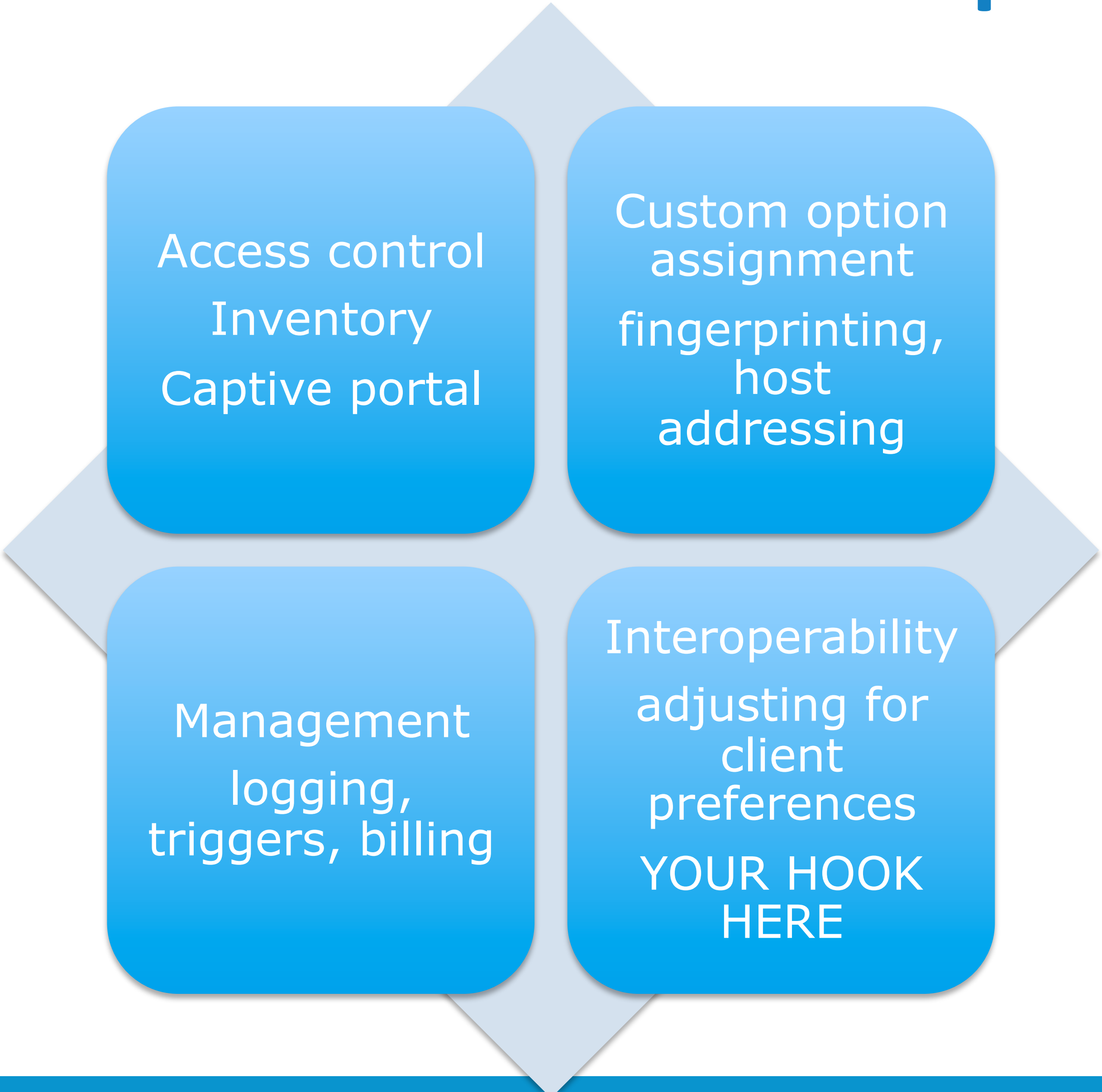
https://www.usenix.org/sites/default/files/conference/protected-files/srecon15europe_slides_failla.pdf

Stateless DHCP!?



- Facebook specific hook lib extracts addresses from DB
- Effectively “stateless” DHCP
- DB changes are applicable immediately (no config sync delay, no restart, no reconfiguration downtimes)

Additional Hooks Examples



Access control

Inventory

Captive portal

Custom option assignment

fingerprinting, host addressing

Management

logging, triggers, billing

Interoperability

adjusting for client preferences

YOUR HOOK HERE

anycast DHCP!?

- Kea can store lease info in a database (MySQL, PostGreSQL, more to come)
- Multiple Kea servers can speak to the same DB
- DHCP Failover may no longer be painful!!! Instead of failover pairs, we can have many servers. We can even have them answering on the same address.

Building a Kea hooks Library

```
g++ -I /usr/include/kea -L /usr/lib/kea/lib -fpic -shared -o example.so \
   load_unload.cc pkt4_receive.cc pkt4_send.cc version.cc \
   -lkea-dhcpsrv -lkea-dhcp++ -lkea-hooks -lkea-log -lkea-util \
   -lkea-exceptions
```

Debugging Hooks Issues

- Crash may indicate mismatched libraries.
  - Rebuild with new version of Kea updated version() but not everything?
- Memory growth may suggest hook library not freeing memory.

Debugging Hooks Issues

- Can the application work without hooks?
- Enable hooks debug logging.
  - Logger name: “hooks”
  - 40 – load/unload of libraries
  - 45 – when hook callouts are executed
  - 55 – details on each callout

References

- kea.isc.org
- http://kea.isc.org/docs/kea-guide.html
- https://lists.isc.org/mailman/listinfo/kea-users
- http://kea.isc.org/wiki/Install (OS package list)
- https://kb.isc.org/article/AA-01381/0/Kea-1.0-Quick-Start-Guide.html

References

Kea documentation:

http://kea.isc.org/wiki

Developer's guide:
http://git.kea.isc.org/~tester/kea/doxygen/