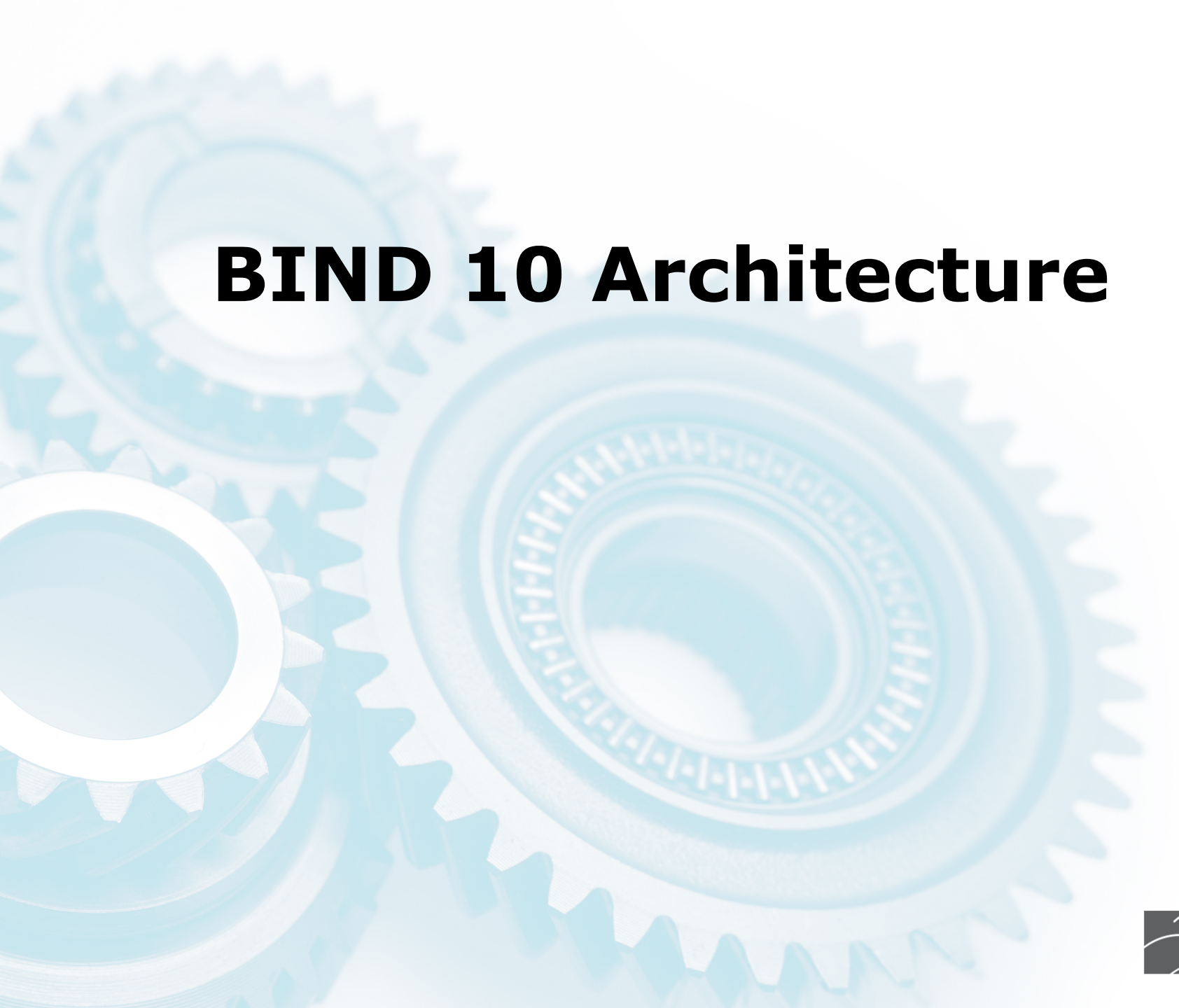
BIND 10 Architecture



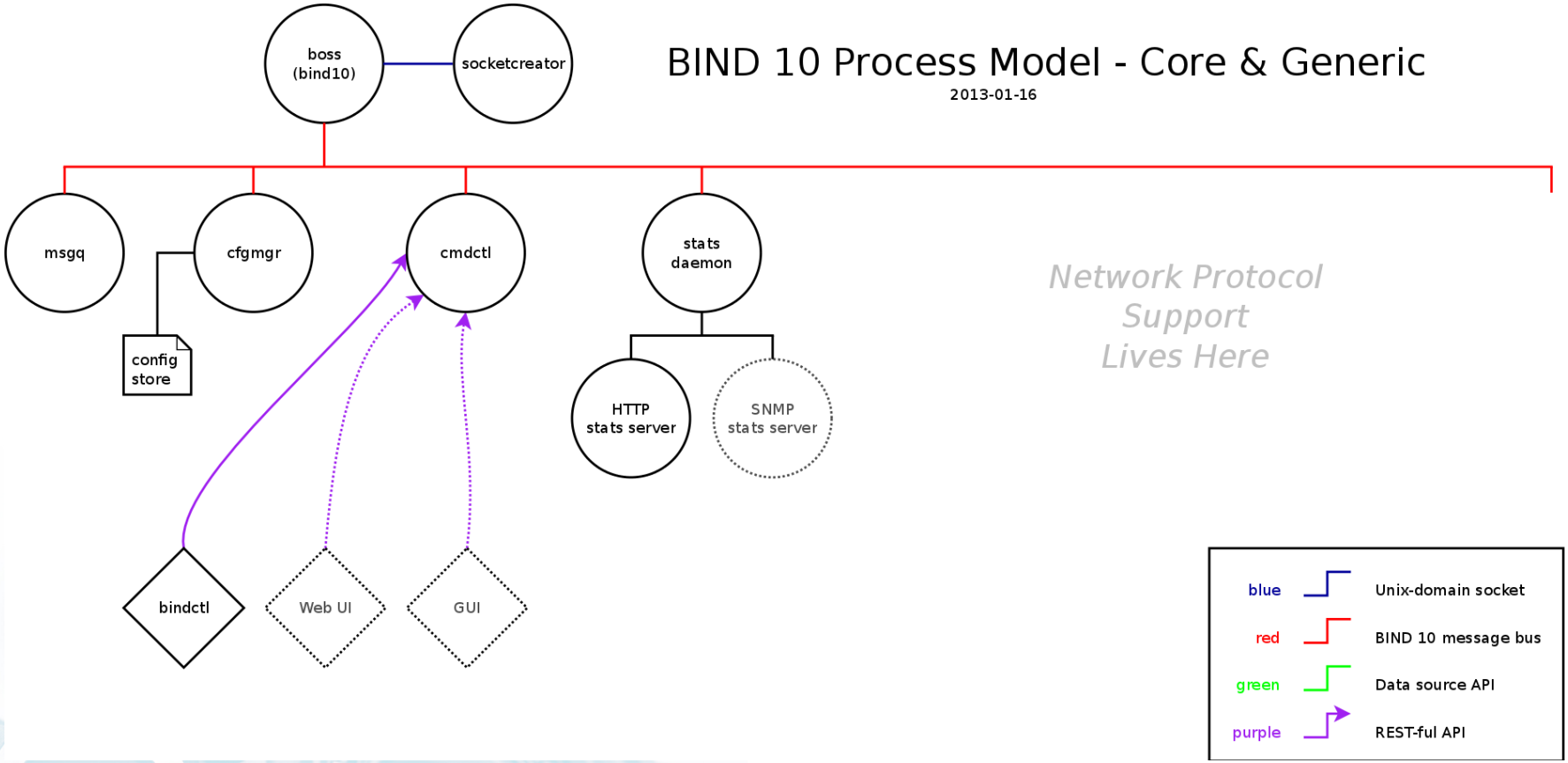
Part the First: Generic BIND 10

Goals that Affect Architecture I

- Customization "out-of-the-box"
  - authoritative-only, recursive-only
  - slave-only, master-only
  - DHCPv4-only, DHCPv6-only
  - enable/disable dynamic DNS
  - support favorite SQL backend
- Customization via code changes
  - non-ISC modules, or modifications
  - bespoke or in-house development

Goals that Affect Architecture II

- Scalability
  - BIND 8/ISC DHCP: single core
  - BIND 9: multiple cores (4-6 or so)
  - BIND 10: 10's or 100's of cores, multiple machines (clustered)
- Robustness
  - Reduce serious software bugs
  - Minimize impact of bugs
  - Reduce “fate sharing”



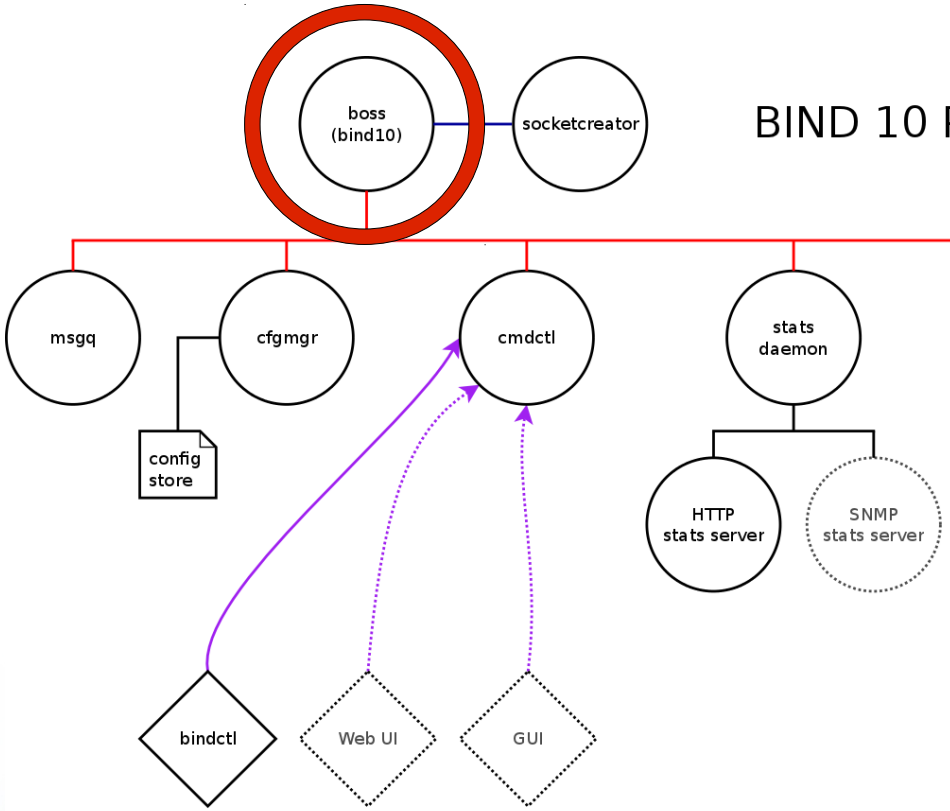
https://bind10.isc.org/wiki/DesignDiagrams

BIND 10

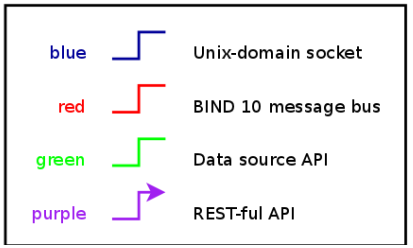
- Core
  - boss
  - msgq
  - cfgmgr

BIND 10 Process Model - Core & Generic

2013-01-16



Network Protocol Support Lives Here



Master^WBoss of BIND

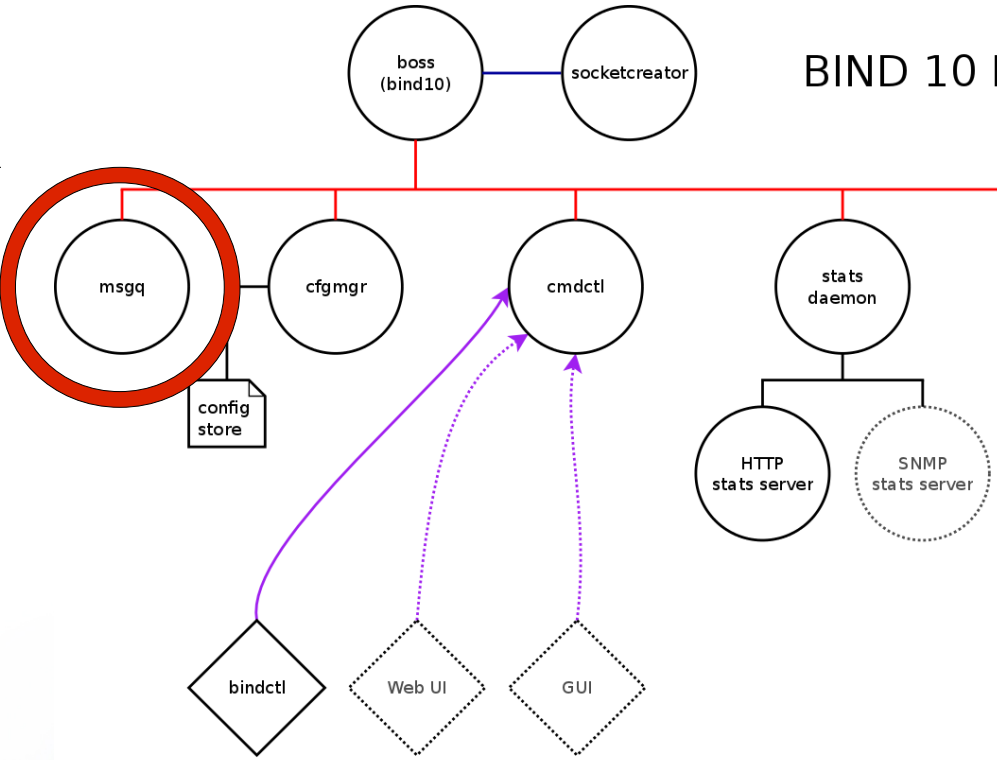
- Handles startup, shutdown
- Restarts processes that die
- Written in Python

An Aside: BIND 10 Languages

- C++ for performance critical parts
  - Modern compiled language
  - Widely used
- Python for... everything else
  - Modern scripting language
  - Widely used
  - Chose Python 3.x
  - Best. Language. Ever.

BIND 10 Process Model - Core & Generic

2013-01-16



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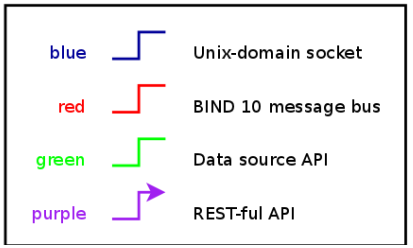
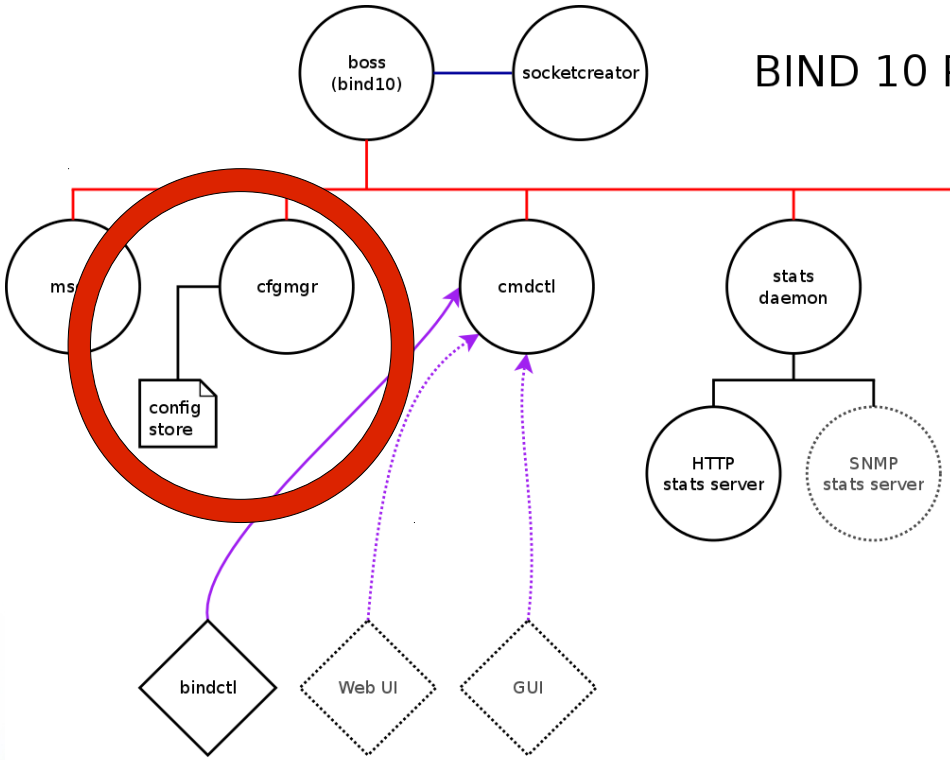


msgq

- Inter-process message bus
- Needed for extensibility
- Like d-bus, also for inter-machine
- Internal message format: JSON
- Unix domain socket connections
- No internal security

BIND 10 Process Model - Core & Generic

2013-01-16



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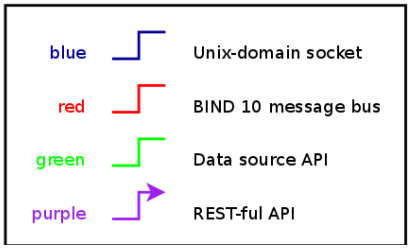


cfgmgr

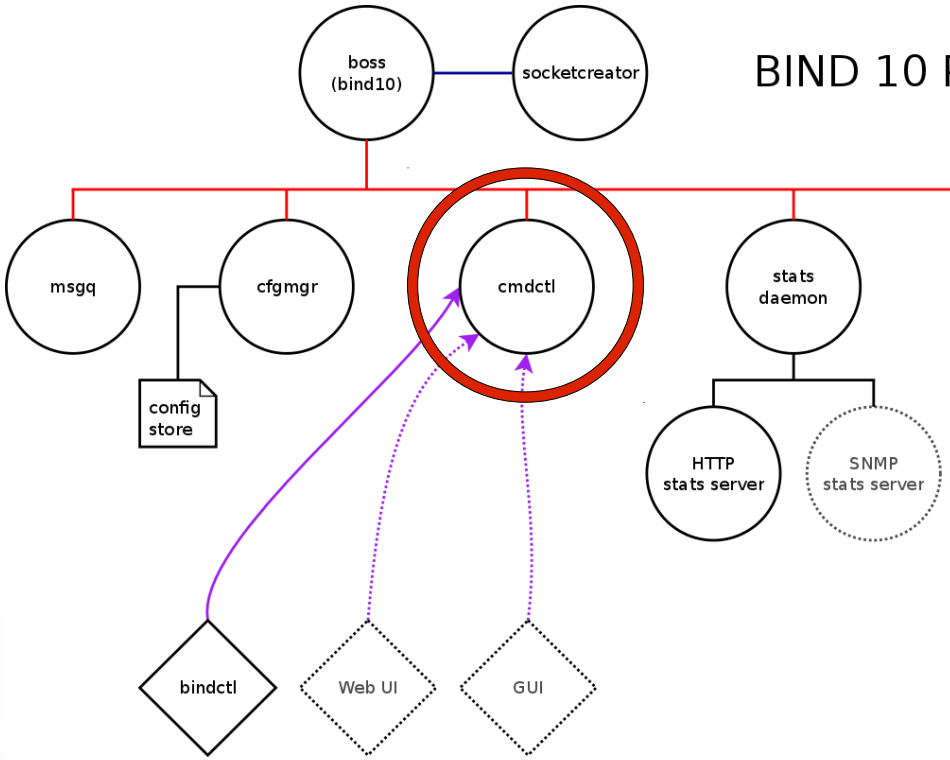
- Configuration manager
- Never need to restart BIND 10
- Flexible, extensible configuration
- Not traditional Unix configuration
  - Changes are immediate & persistent
  - More like a router or an application

BIND 10

- Core
  - boss
  - msgq
  - cfgmgr
- Optional
  - cmdctl
  - auth
  - xfrin/xfrout
  - zonemgr
  - stats
  - ddns/dhcpdns
  - dhcp4/6

BIND 10 Process Model - Core & Generic

2013-01-16



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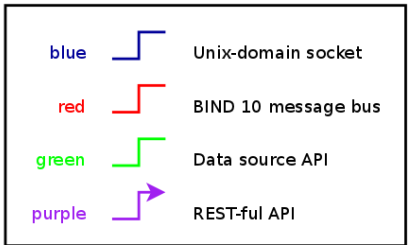
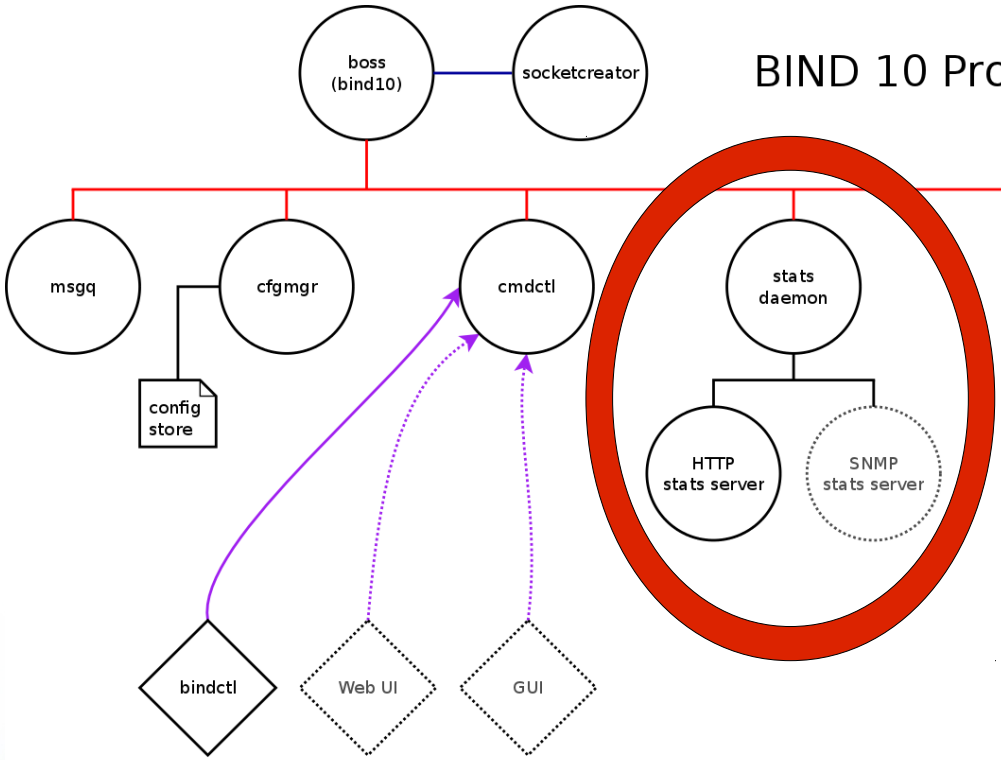


cmdctl

- Used to control the server
- Authenticates users
- Interacts with cfgmgr
  - Gets per-module options
- Interacts with modules
  - Commands like “refresh zone”
- Current client: bindctl (CLI)
- Future clients: web, GUI, wizards

BIND 10 Process Model - Core & Generic

2013-01-16



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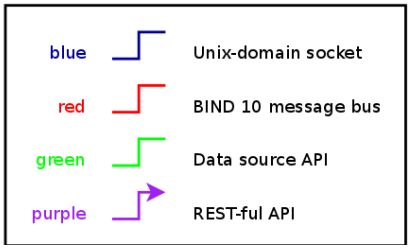
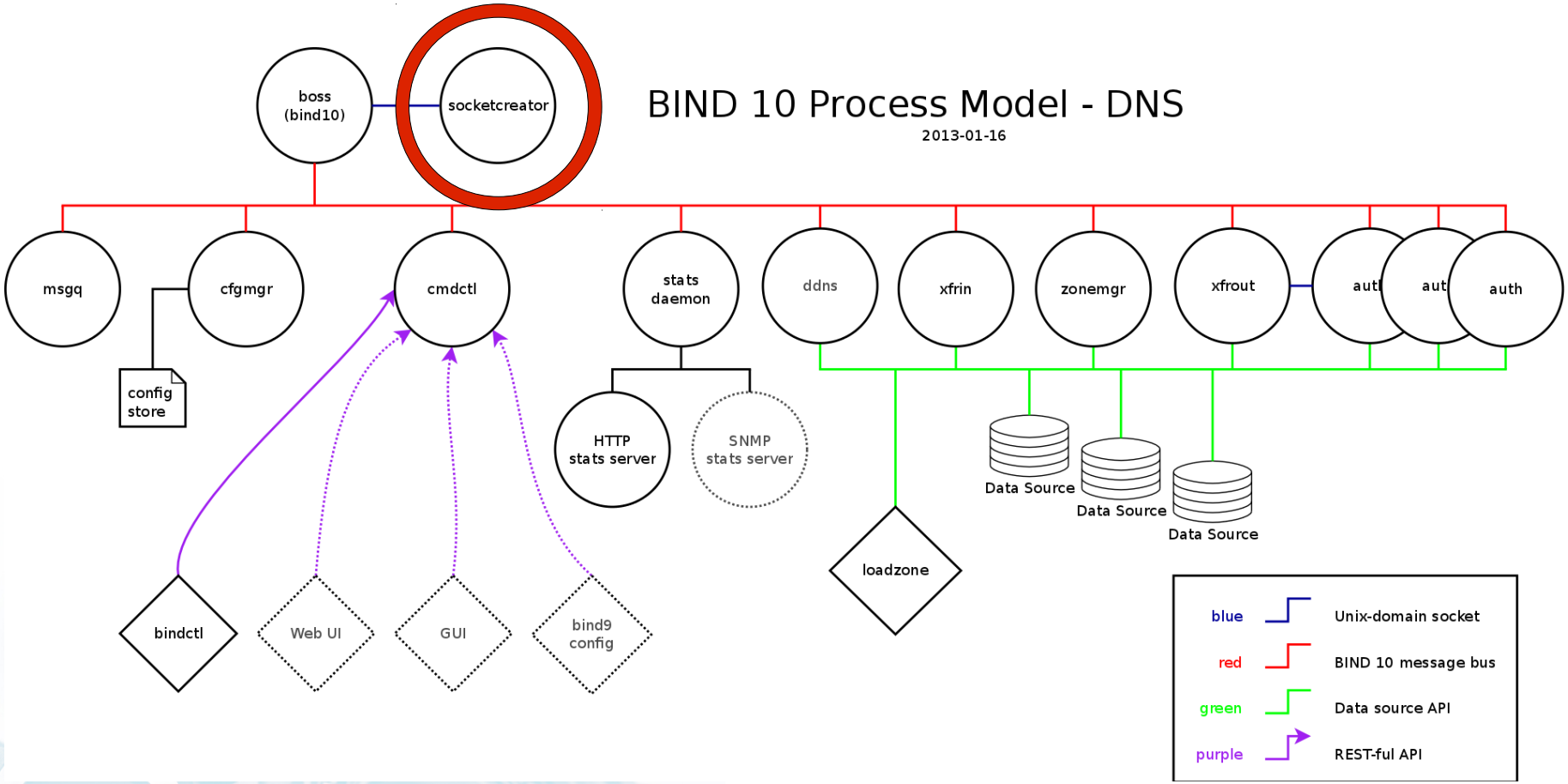


Statistics

- Modules report stats
- Collected by stats daemon
- Presented in various ways:
  - Via bindctl
  - XML over HTTP (BIND 9 style)
  - SNMP (planned)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2013-01-16
boss
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purple
REST-ful API

Privileged Socket Creator

- Ports < 1024 restricted to root
  - DNS runs on port 53
- We want to drop permissions ASAP
- We want port 53 at any time!
  - Administrator may reconfigure
- Solution: Privileged Socket Creator
  - Small, single purpose C++ program
  - Uses file descriptor trick to send sockets around

Supporting Library: Logging

- Messages have unique identifiers
  - Only used 1 place in code
  - Have short and full explanations
- log4cplus
  - Like log4j Java library
  - Can turn logging off per module
- Message manual

http://bind10.isc.org/docs/bind10-messages.htm

Extending BIND 10: Hooks

- Allows targeted behavior changes
  - E.g. Modify reply packets
  - E.g. Invoke back-end processes
- Similar to plug-in or extensions
- Loadable at run-time
  - C++ initially, then Python
  - May extend to other languages
- Provide API for developers

Part the Second: BIND 10 DNS

Supporting Library: Data Sources

- Idea stolen from PowerDNS
- Back-end for authoritative DNS
- Currently SQLite or in-memory
- Plans:
  - MySQL, PostgreSQL
  - Berkeley DB
- Used by auth, xfrin, xfrout, loadzone, ddns

Data Source: SQLite

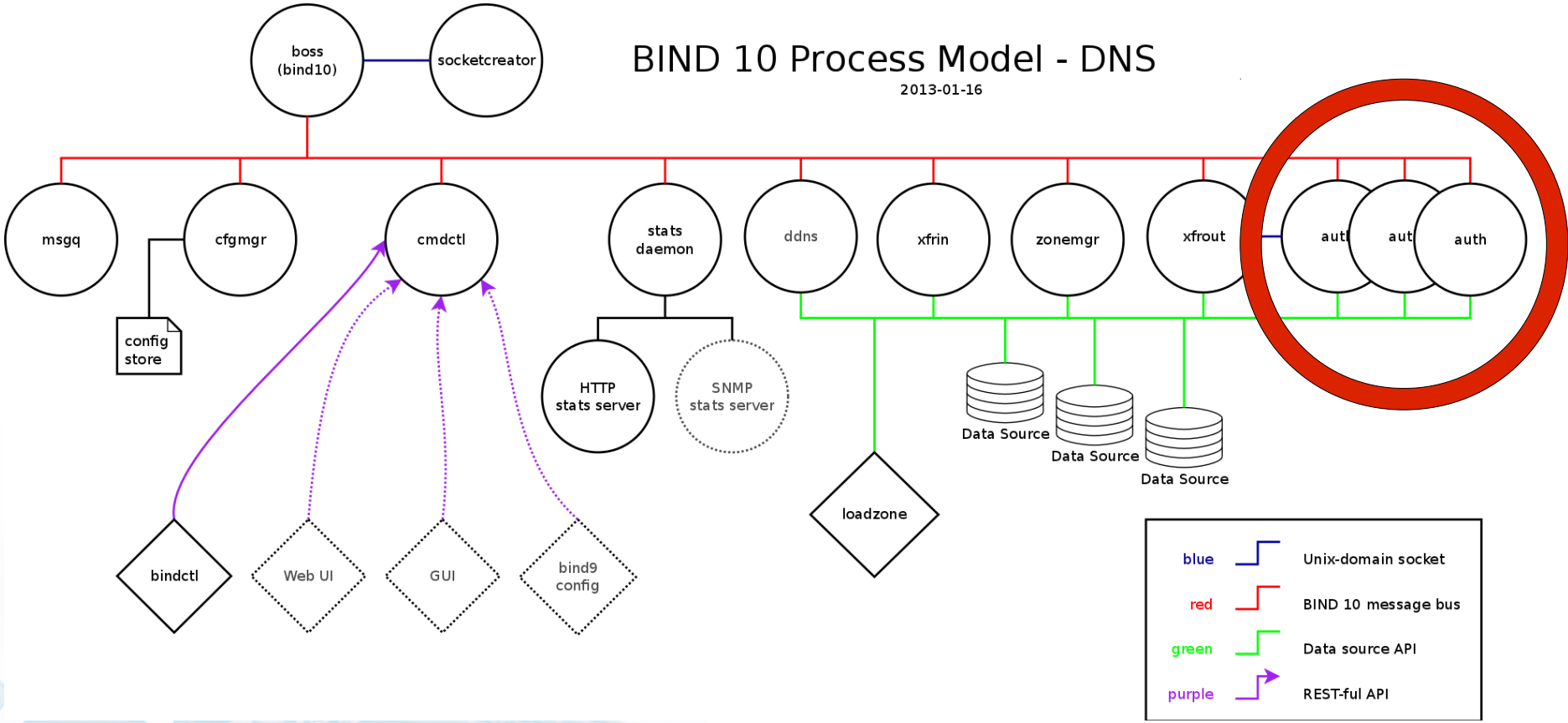
- Simple for administrators
  - "built-in", only file name needed
- Performance: reasonable
  - Much slower than in-memory
  - Good single-access performance
  - Collapses under heavy writing
- Pre-defined schema
- "instant on" for zones

Data Source: In-memory

- Based on BIND 9 red/black trees
- Performance reasonable
  - Similar to BIND 9
- Memory footprint good
  - Much smaller than BIND 9
  - Currently no shared memory
- Zones have to be loaded
  - Basically like BIND 9

Supporting Library: libdns++

- Low-level DNS messages (packets)
- C++ implementation
- Python wrapper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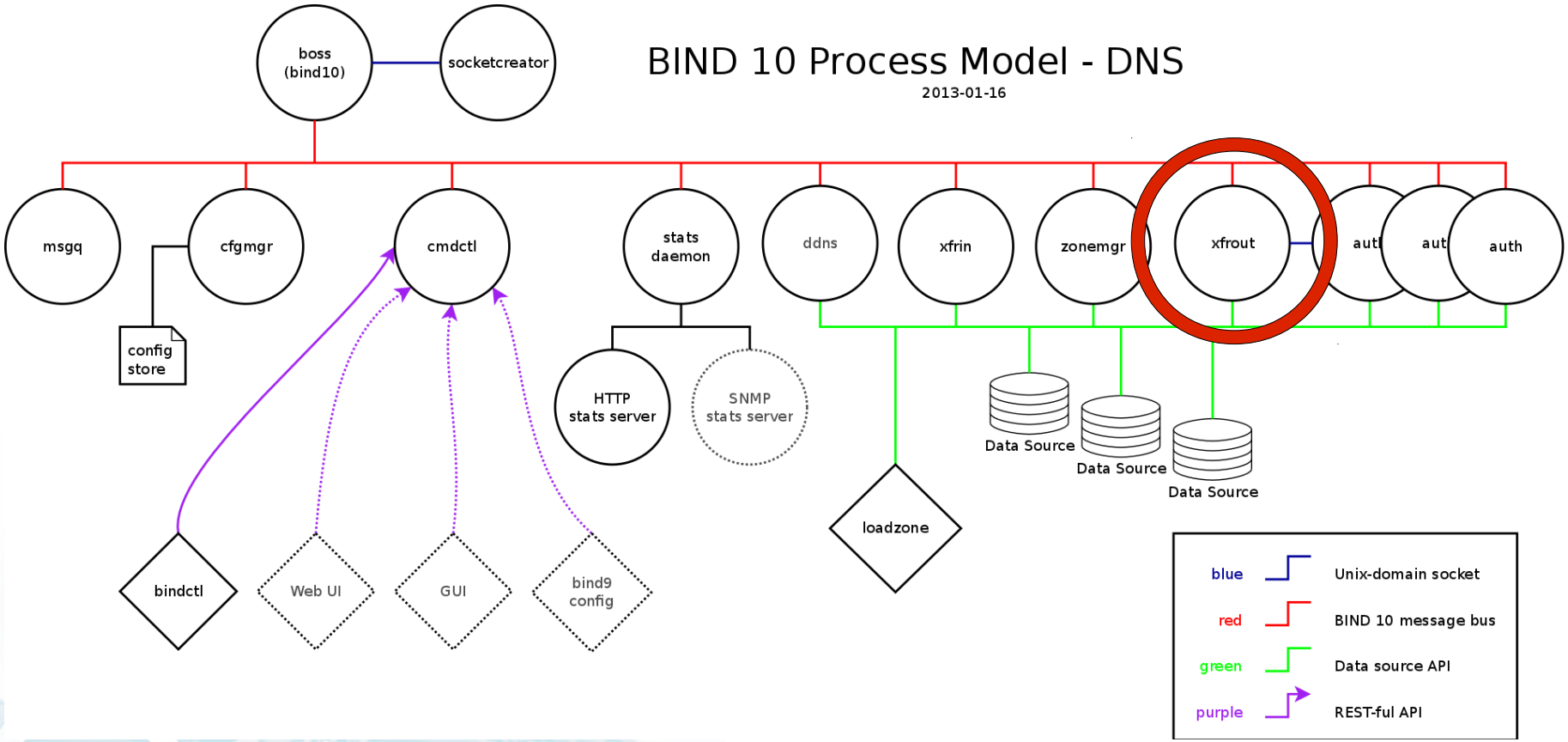
auth

- Authoritative DNS server

  DNS library
+ data sources
+ I/O
+ bit of logic

- Scales via multiple processes
  - Idea stolen from NSD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xfrout

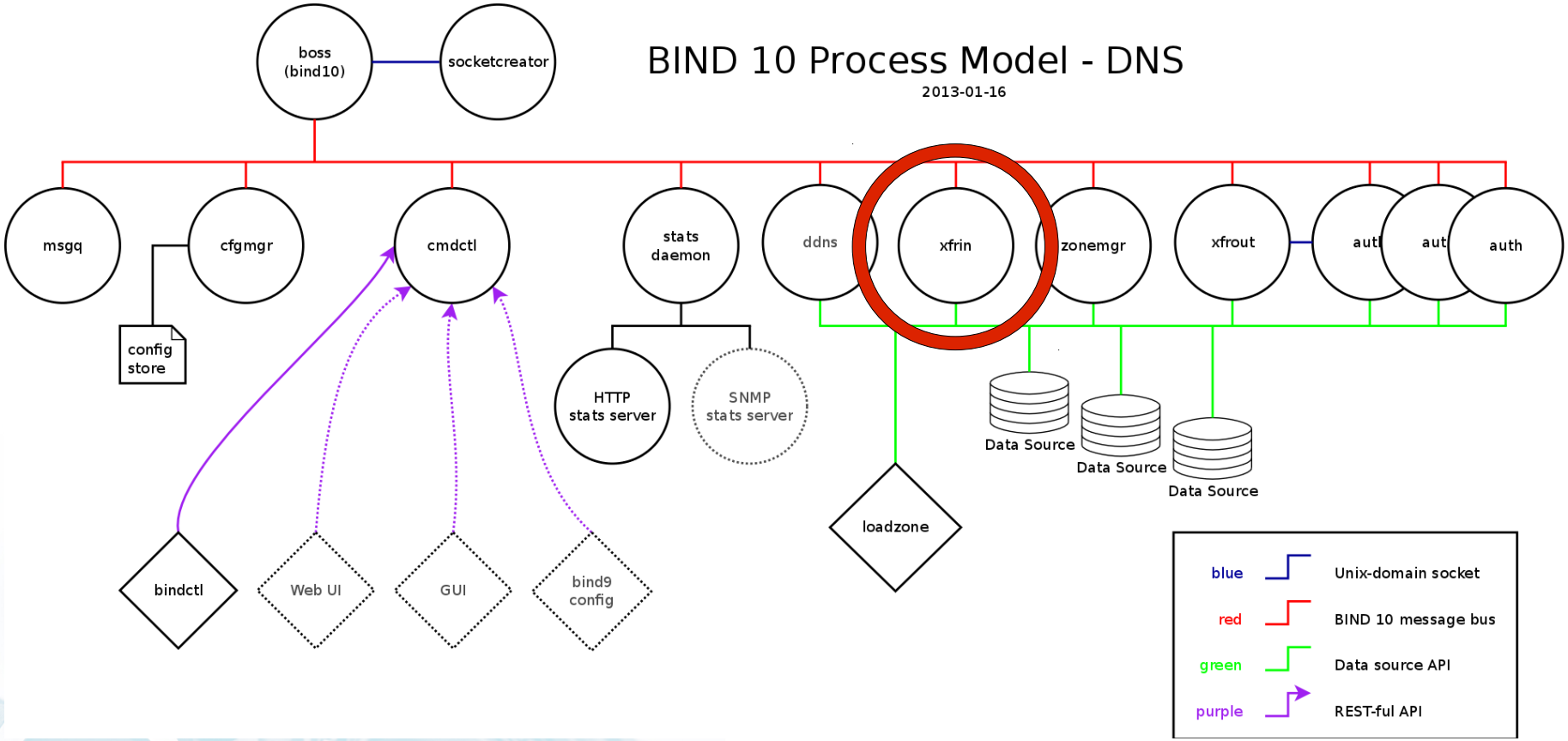
- AXFR/IXFR out, to act as a master

  DNS library
+ data sources
+ I/O
+ bit of logic

- Scales via multiple threads
  - New design with processes pending

A Final Aside: Passing Around Open Files

- AXFR/IXFR messages come to auth
- UDP packets can be forwarded
- TCP connections must go to xfrout
- Send file descriptor via `sendmsg()`:
  - `SOL_SOCKET`, `SCM_RIGHTS`
- Works on Linux, Solaris, BSD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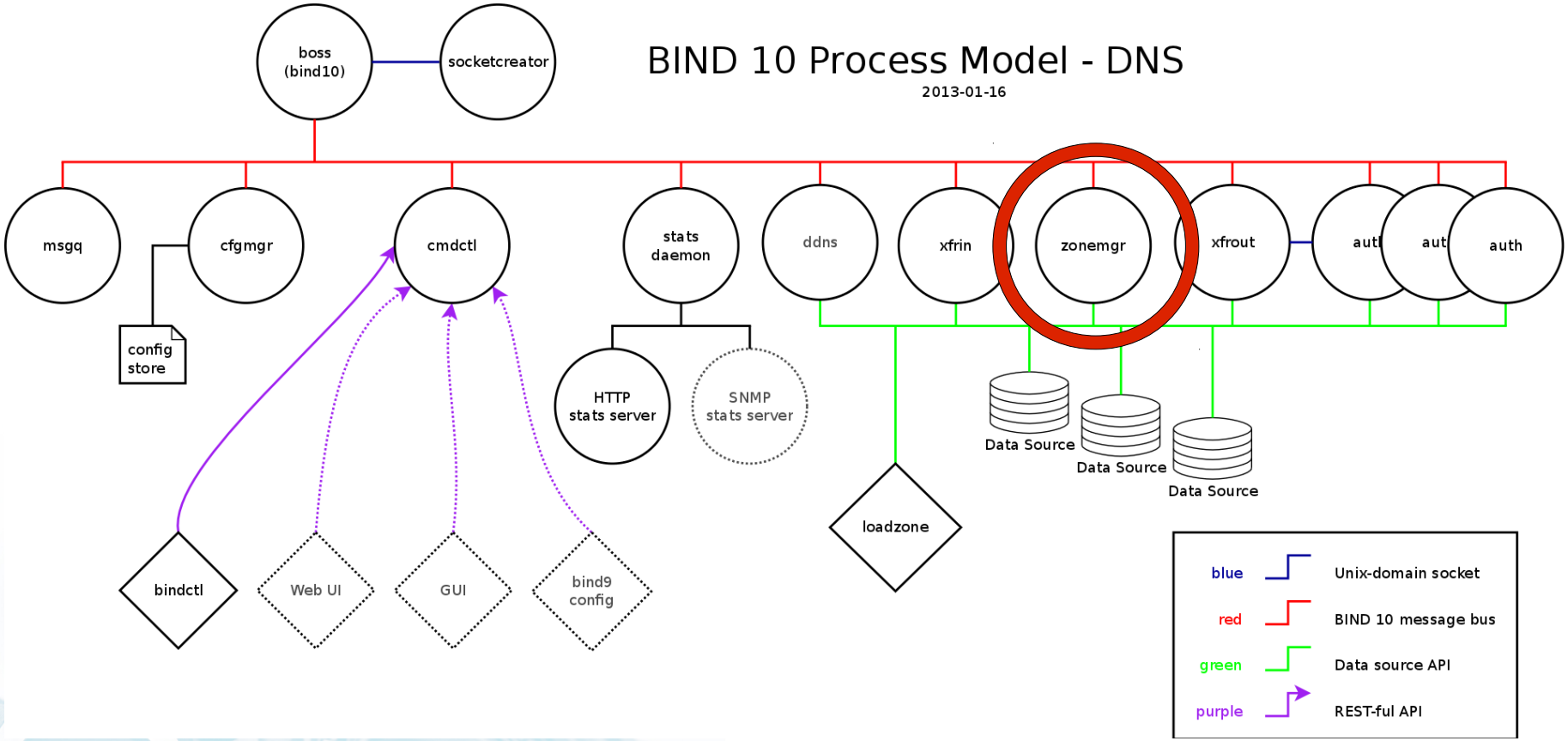
xfrin

- AXFR/IXFR in, to act as a slave

  DNS library (Python)
+ data sources
+ I/O
+ bit of logic

- Scales via multiple threads
  - New design with processes pending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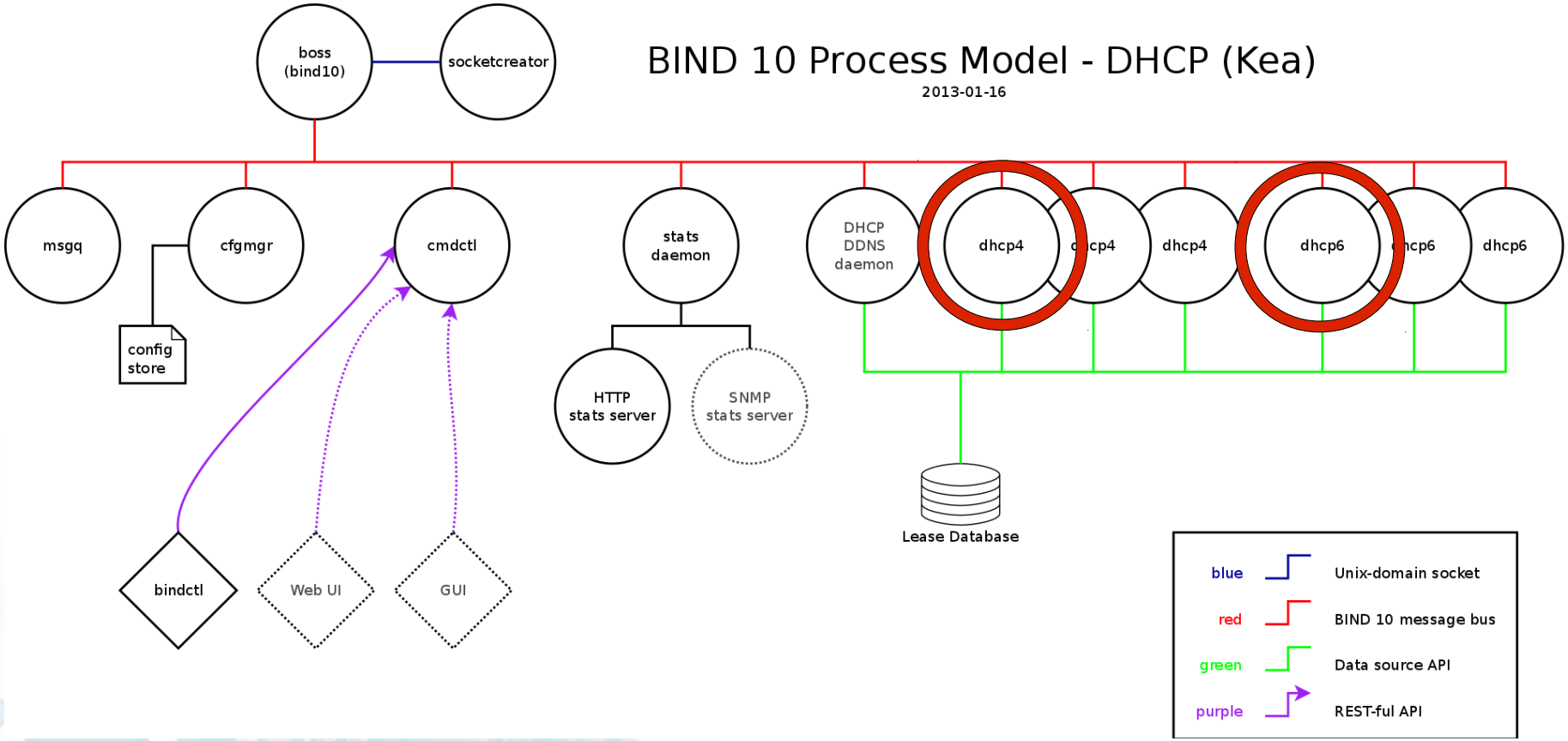
zonemgr

- Zone manager, times slave refresh
- Data sources
- That's it!
  - Will be collapsed into xfrin

Part the Third:
BIND 10 DHCP (a.k.a. *Kea*)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DHCP4/6 Daemon Processes

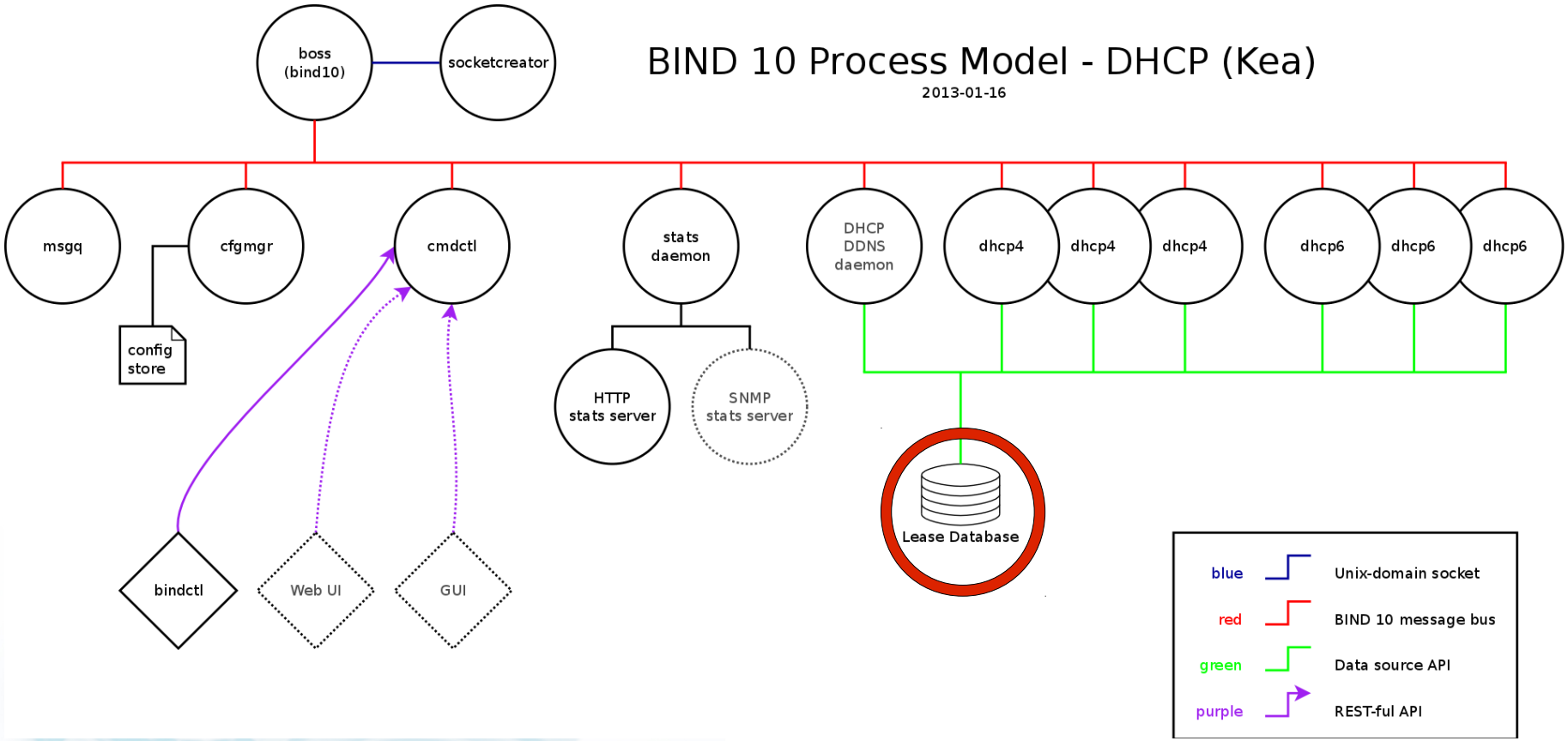
- Manage dynamic IPv4 and IPv6 address spaces
- Assign, renew, release IPv4 and IPv6 leases
- Assigns additional configuration options requested by IPv4/IPv6 hosts
- Dynamically reconfigurable

DHCP4/6 Multiple Processes

- Current thinking for scalability:
  - Divide queries between multiple processes
  - Receptionist process to route packets from a given client to the same daemon process to cope with state issues.
- Planned for 2013

Supporting Library: libdhcp++

- Low-level DHCP messages (packets)
- C++ implementation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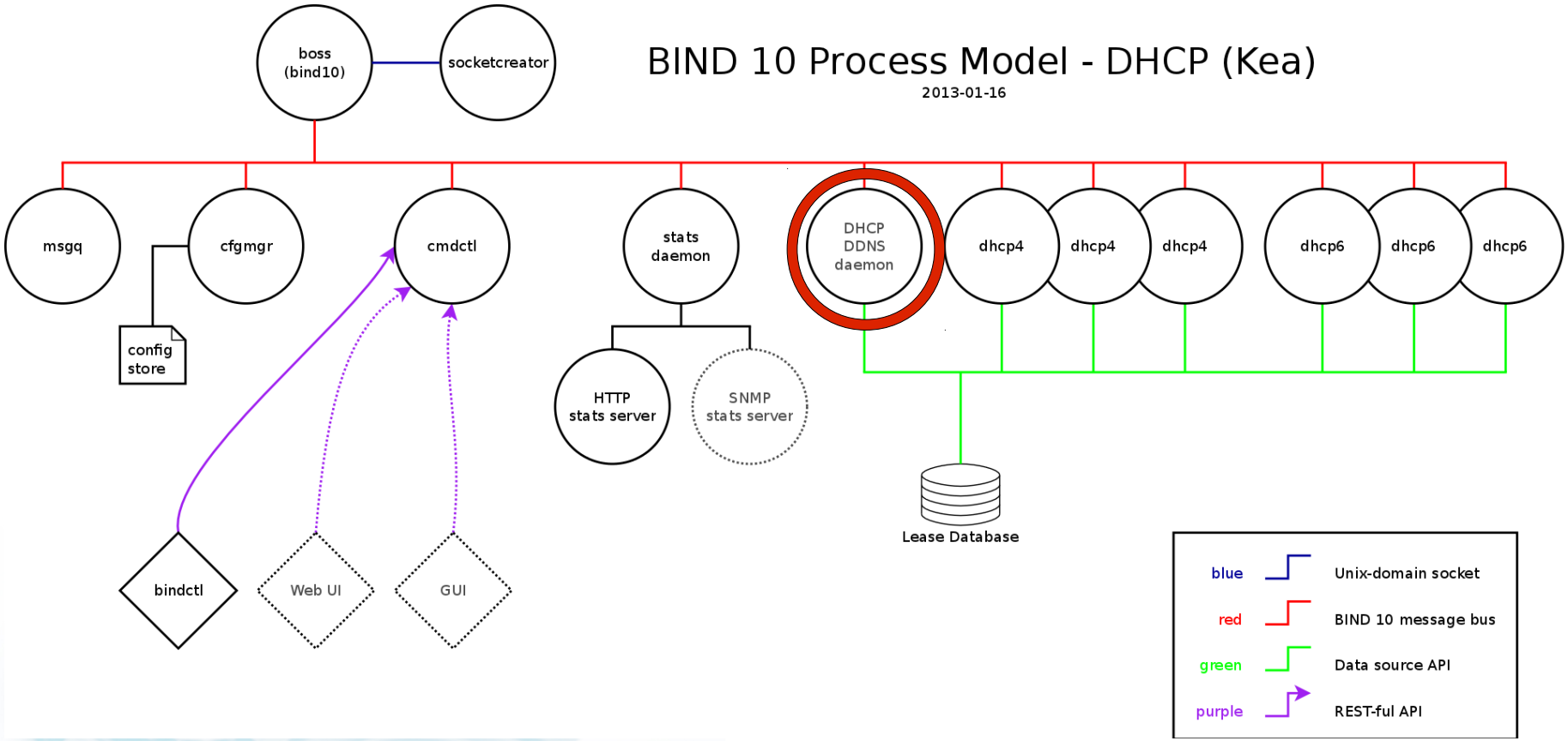
Lease Database

- Leases held in a database
- Abstraction layer allows for different backends
  - MySQL currently implemented
  - In-memory backend available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DHCP DDNS Daemon

- Will handle addition/removal of name/address translations from forward and reverse DNS zones
- Implementation scheduled for 2013

DHCP Hooks

- Set of hooks to be included in the code:
  - Call out to user code at defined points in packet processing
  - Replaces “conditional” configuration processing in DHCP4
- API designed
- Implementation scheduled for 2013

http://bind10.isc.org/wiki/DhcpHooks

perfdhcp

- Utility to measure performance of DHCP servers
- Simulates multiple clients
- Measures round-trip time and throughput.

http://bind10.isc.org/wiki/DhcpBenchmarking