HashiCorp Consul

Consul Foundations

Agenda

Consul Enterprise Path to Production

Week 1

Kickoff

- Consul overview & Architectural deep dive

Week 2

Consul Foundations

- Service Discovery, Health Checks & Consul DNS

Week 3

Consul Deployment & Operations

- Deployment, Autopilot, Backup, Telemetry & Monitoring

Week 4

Office Hours

- Open forum for Q&A

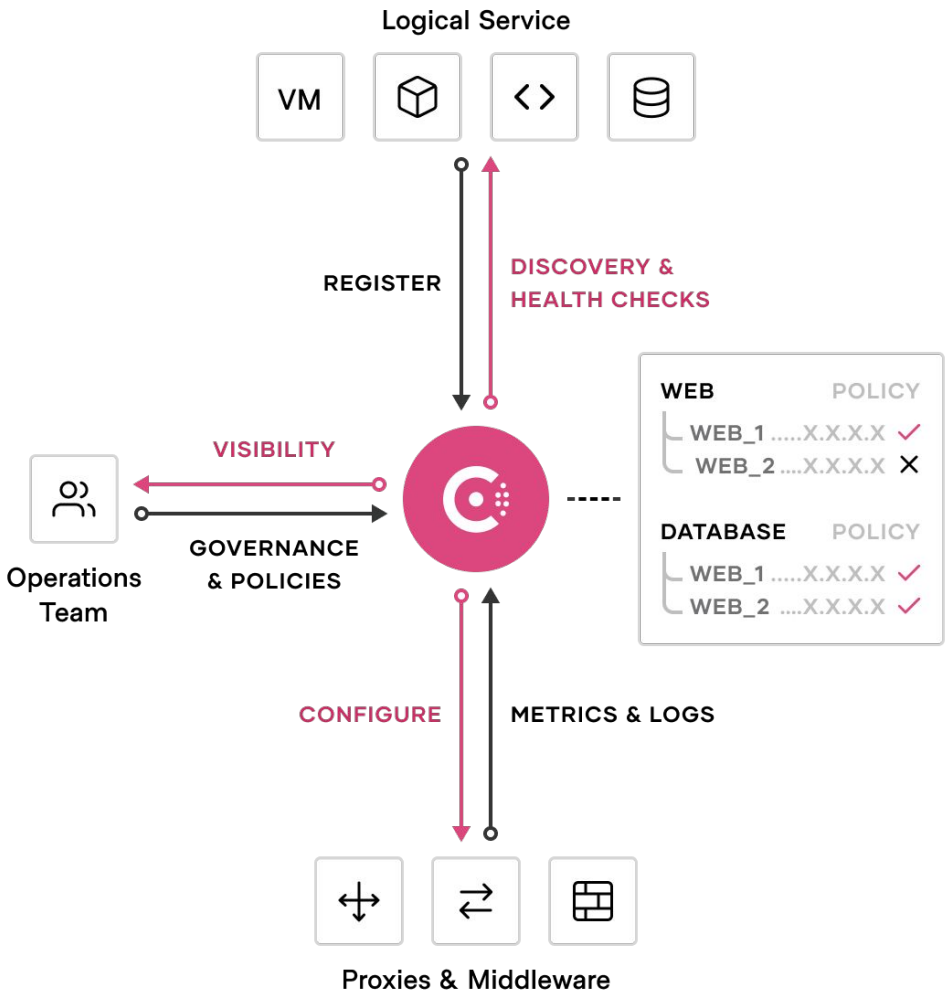
Week 5

Advanced Concepts

- Federation, Network Segments, Namespaces, & Runbooks
- Exit Ramp & Operational Readiness Checklist (asynchronous)

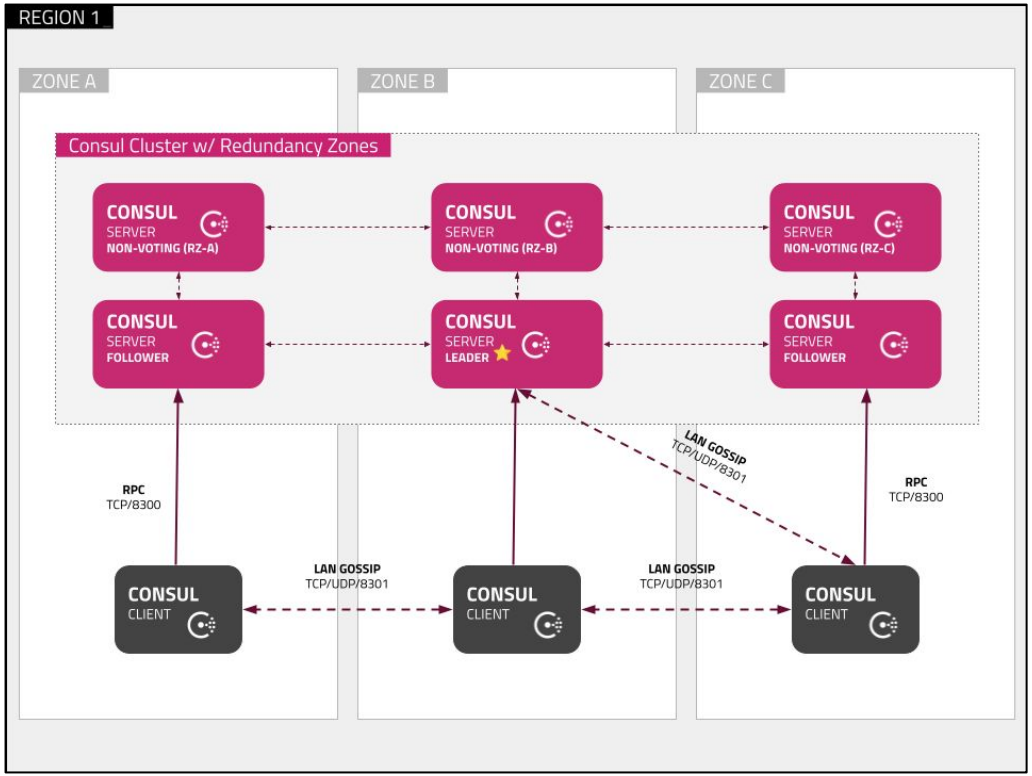
Service Networking

Discover and securely connect any service on any cloud or runtime



Consul Enterprise Reference Architecture

- Provides a highly resilient and scalable deployment for a single Consul cluster
- 6 node cluster with 3 non-voting nodes is capable of withstanding the loss of two nodes or an entire Availability Zone (AZ)
- Uses Consul Enterprise Autopilot and non-voting nodes for redundancy
- [Consul and Kubernetes Deployment Guide]



01

Service Discovery & Registration

Service Registry & Discovery

- Discover, track, & monitor health of services in a network
- Register & maintain a record of all services in a service catalog
- A single source of truth for services to query & communicate with each other
- Dynamically locate any application or infrastructure service to simplify network connectivity

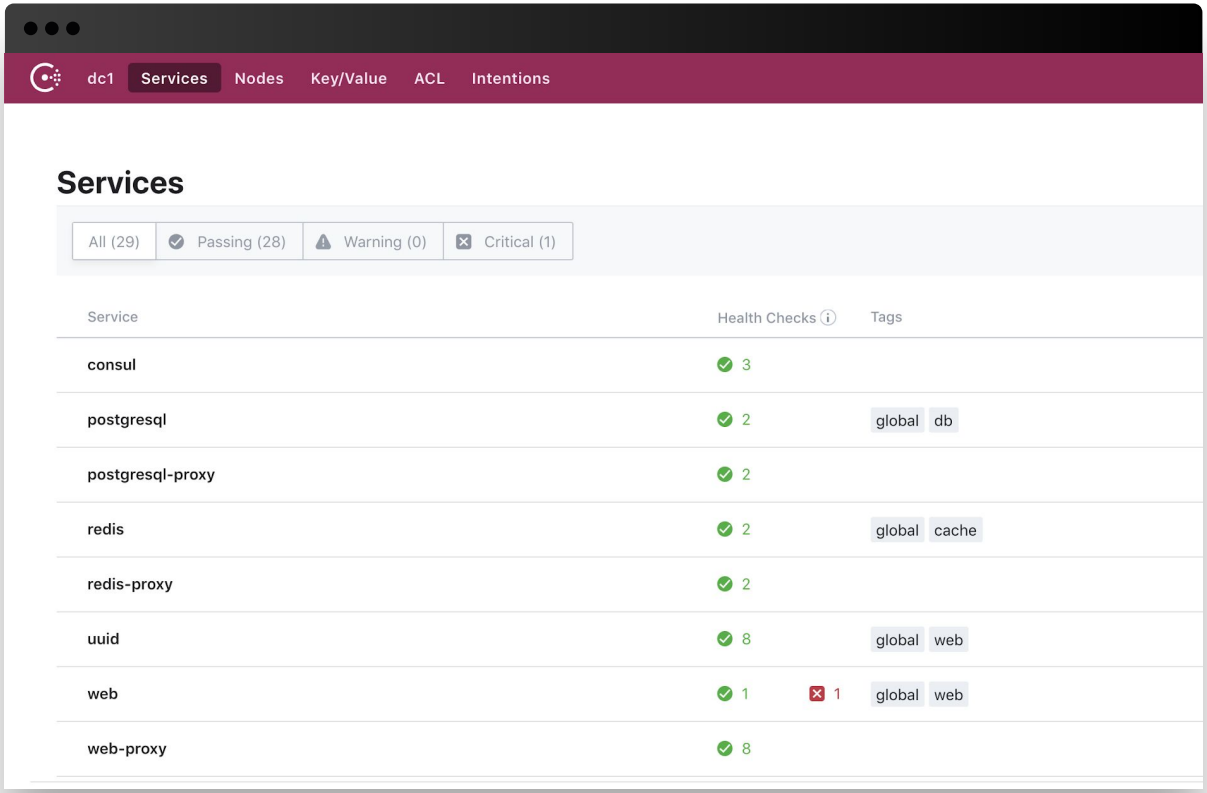
Service Registry & Discovery

- Eliminate the need for East/West Load Balancing
- Enable other Consul use cases
    - Core building block of a Service Mesh
    - Software Load Balancing
    - Network Infrastructure Automation
- Automate Geographic Failover using Prepared Queries

Service Registry

Consul catalog provides a real-time directory which includes:

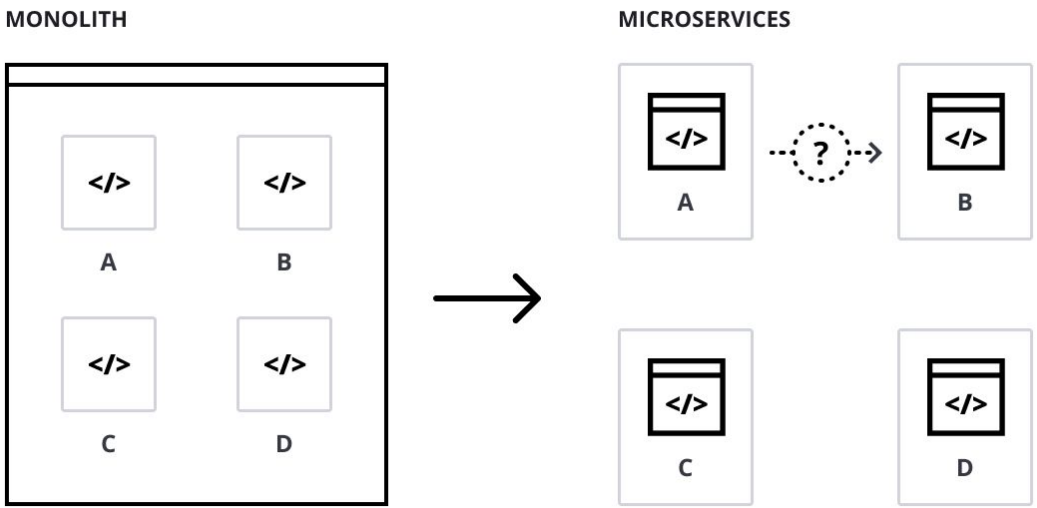
- What services are running
- Service network location
- Service health status
- Platform agnostic views



Service Registry

Microservices cause east-west traffic growth

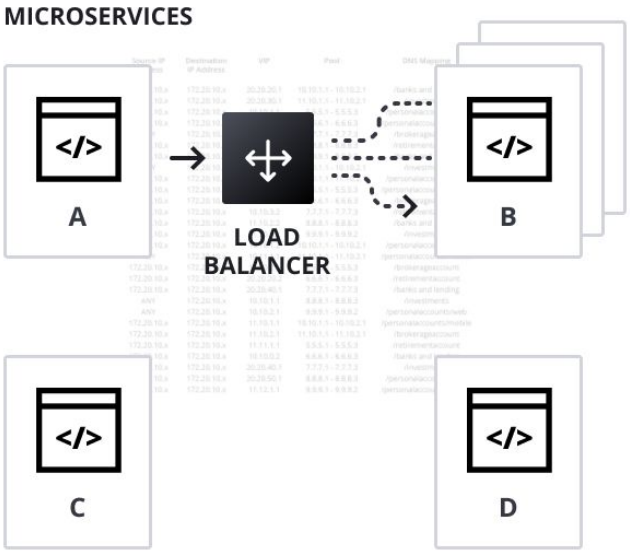
- Microservices communicate over the network in east-west traffic patterns
- Service-to-service traffic needs to be routed dynamically as services scale up and down frequently without long-lived IPs.



Service Registry

Load balancers for east-west traffic scale poorly

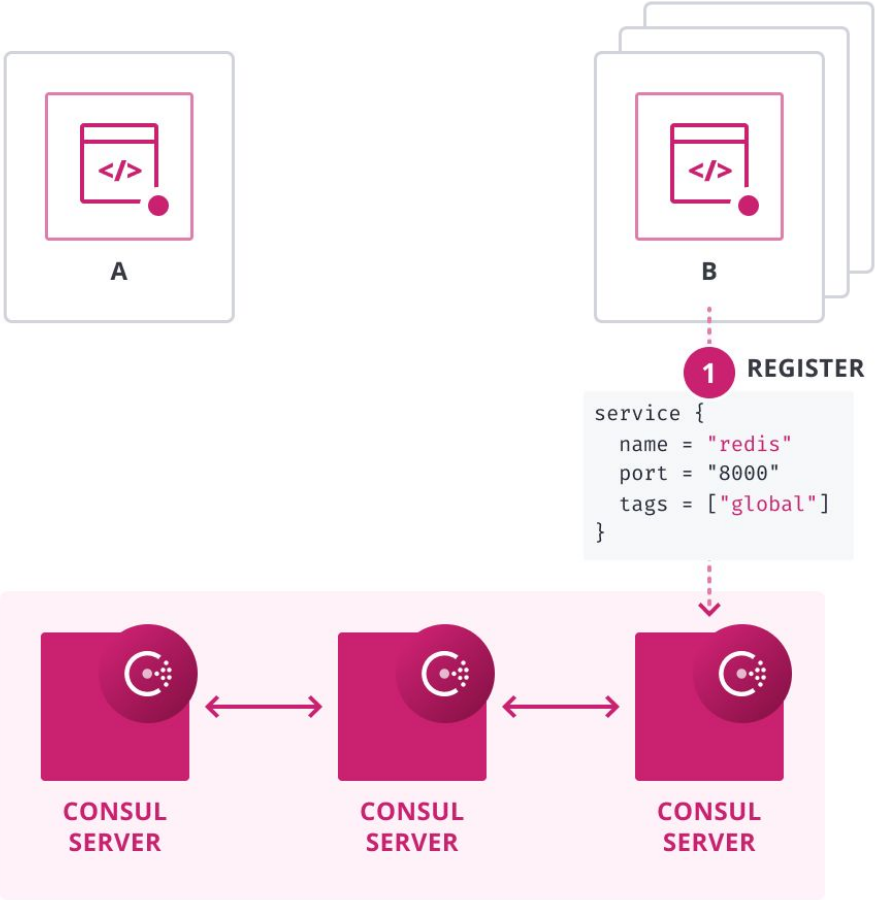
- Load balancers can front a service tier and provide a static IP
- Load balancers add cost, latency, single points of failure, and must be updated as services scale up/down.



Service Registration

Service discovery for connectivity

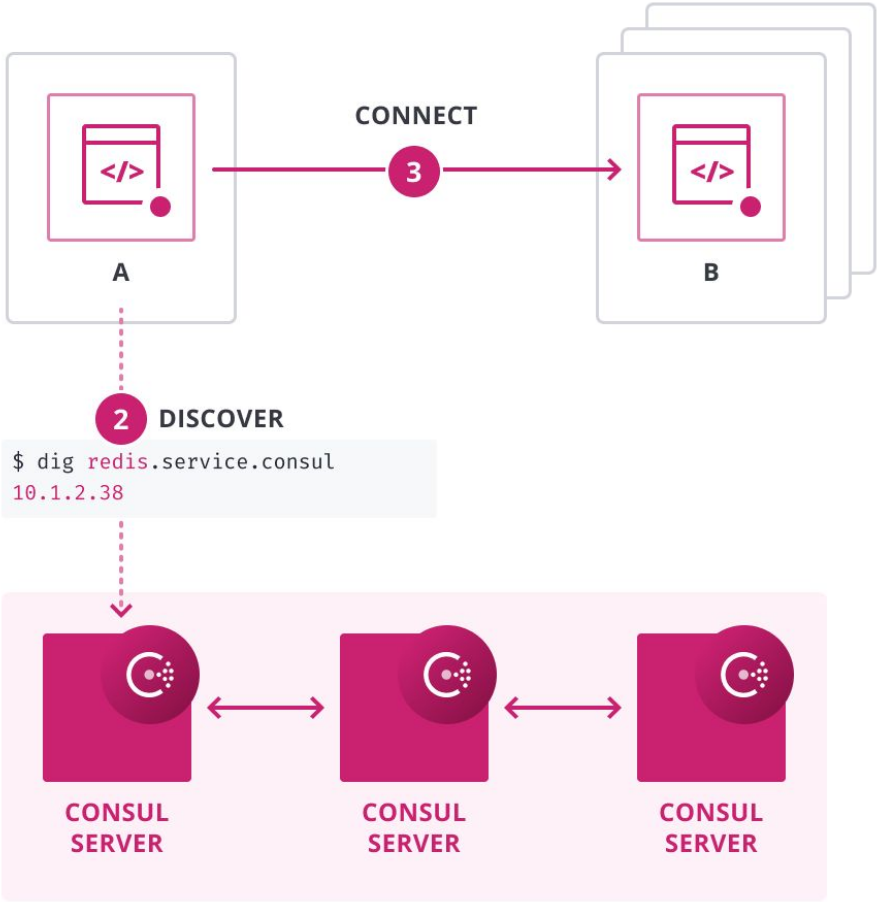
- Consul provides a registry of all the running nodes and services with current health status
- Services can register to mark themselves (IP + port) as available via config files or API



Service Registration

Allow services to connect directly

- For a service to communicate with any other service it queries the registry for the healthy instances of those services
- Two services can connect directly without any operator intervention
- Service catalog can be queried via DNS or API



Service Discovery for Deployment

- Cross Platform Deployment
  - Make applications deployed across multiple platforms and clouds available for consumption
  - Simplify operations
- Blue / Green Deployments
  - On-premise to cloud migration
  - Upgrade of a set of hosts for routine maintenance
- Blue / Green / Yellow / Grey
  - Exposing a specific version of an app
  - Leveraging rich metadata to target specific instances of a service

Define a Service

Sample service definition

```
$ mkdir /etc/consul.d

$ touch /consul.d/web.json

$ cat web.json
 {
   "service": {
     "id": “prod-web”,
     "name": "web",
     "tags": ["rails"],
     "port": 80
   }
 }
```

HTTP API Interface

- The Consul service registry API allows for more complex tasks beyond basic DNS functionality
- API calls can query the service registry for nodes, services, and health check information
- API supports blocking queries, or long polling, for changes
- Automation and IAC tools can respond to service registrations or health status changes to update configurations or traffic routing in real time

```
$ curl http://localhost:8500/v1/catalog/service/web
[
  {
    "ID": "52f73400-a352-80d2-9624-e70cc9996762",
    "Node": "consul-client-2",
    "Address": "10.1.10.38",
    "Datacenter": "dc1",
    "ServiceName": "web",
    "ServiceTags": [
      "rails",
    ],
    "ServiceAddress": "10.1.10.38",
    "ServicePort": 80,
    "ModifyIndex": 31,
  ...
```

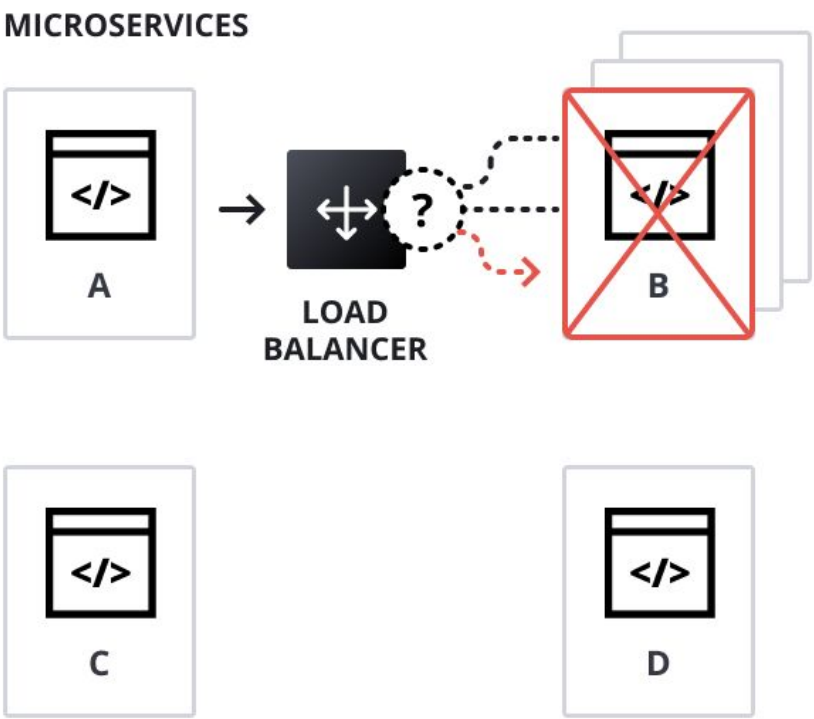
02

Health Checks

Health Checks

Visibility into service health status

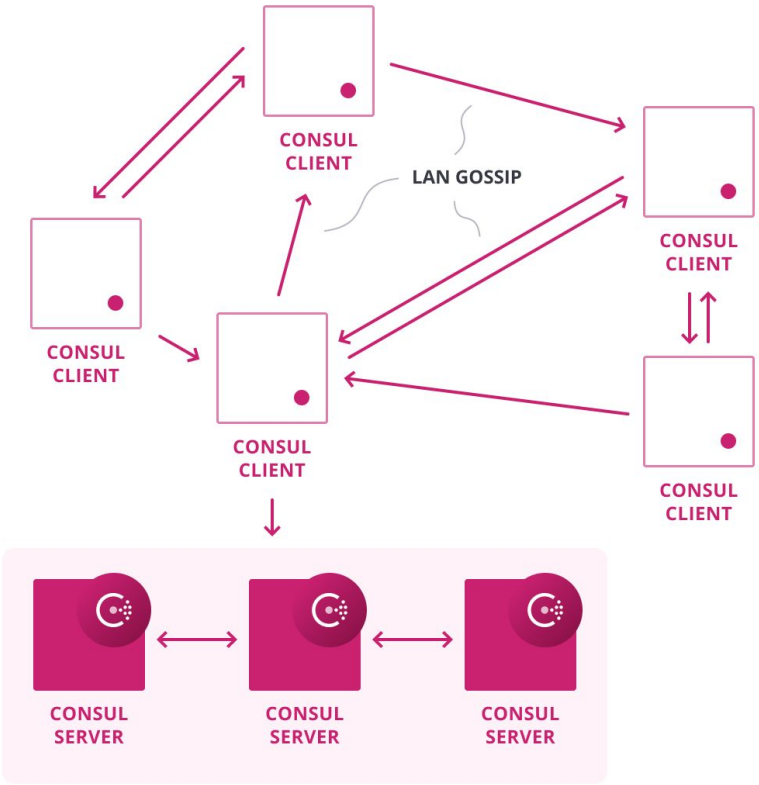
- Health checks are critical to prevent routing to services that are unhealthy
- Centralized approaches relying on heartbeating or periodic updates easily overload servers and lead to scaling issues



Distributed Health Checking

Consul's Gossip Protocol provides a failure detector that scales massively

- Consul Agent runs health check locally
  - Only state changes get pushed to Consul servers
  - Prevents concentrating work on servers
  - Removes unhealthy nodes from service discovery layer
- Rich set of health checks beyond basic liveness



Health Checks

Application-level checks - associated with a specific service

Node checks - monitor the health of the entire node

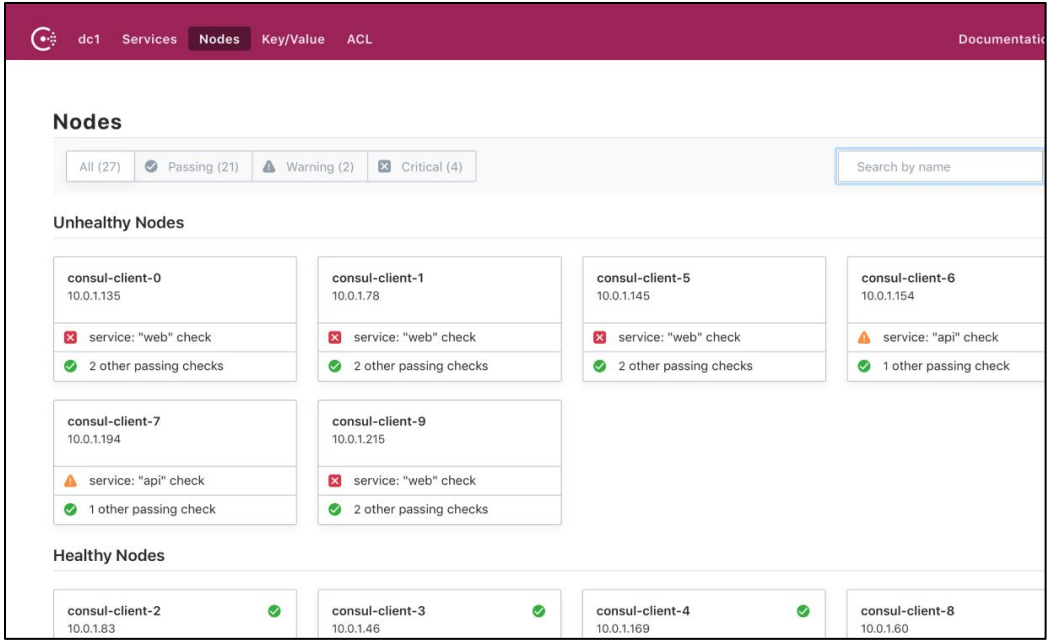
- **Defined via**
  - Configuration file
  - HTTP interface - persist with the node
- **Initially set to “critical”**

  Can be override by specifying the “status” field in the definition
- **Multiple check definitions**

  Multiple check definitions can be defined in a configuration file

Health Check Types

- **Script + Interval** - Invokes an external application that performs the health check
- **HTTP + Interval** - “GET” request to specified URL, wait specified interval between requests
- **TCP + Interval** - connection attempt to IP/hostname & port, configurable interval between attempts, defaults to localhost if no hostname set
- **UDP + Interval** - send UDP datagrams to the specified IP/hostname & port, configurable interval between attempts



Health Check Types

- **Time to Live (TTL)** - “dead man’s switch” operational mode, check’s state must be updated periodically
- **Docker + Interval** - invoke an external application packed in a Docker Container
- **gRPC + Interval** - gRPC health checking protocol based, updates configured endpoint with configurable interval, can be TLS enabled
- **H2ping + interval** - http2 based ping, assumed to be TLS by default
- **Alias** - check the health state of another node or service

Health Check Definitions

Service-level circuit breaker

- Consul enables services to easily provide circuit breakers with custom scripts

```
{
  "check": {
    "id": "mem-util",
    "name": "Memory Utilization",
    "script": "/usr/local/bin/check_mem.py",
    "interval": "10s"
  }
}
```

```
check = {
 id = "web-app"
 name = "Web App Status"
 notes = "Web app does a curl internally every 10
seconds"
 ttl = "30s"
}
```

03

Consul DNS

Consul DNS

- One of the primary query interfaces for Consul
- Allows applications to use service discovery without any high-touch integration with Consul
- Hosts can use the DNS server directly via name lookups
- Supports both Service and Node lookups

DNS Query Interface

- Commonly used to enable service discovery for legacy applications
- Leverage existing DNS deployments for service discovery
- Defaults to respond in the consul domain, is configurable for multiple domains

```
 dig rails.web.service.consul
; <<>> DiG 9.8.3-P1 <<>> rails.web.service.consul
; (3 servers found)
;; rails options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 9046
;; flags: qr aa rd; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0
;; WARNING: recursion requested but not available

;; QUESTION SECTION:
rails.web.service.consul.    IN    A

;; ANSWER SECTION:
rails.web.service.consul. 0    IN    A    10.1.10.38
```

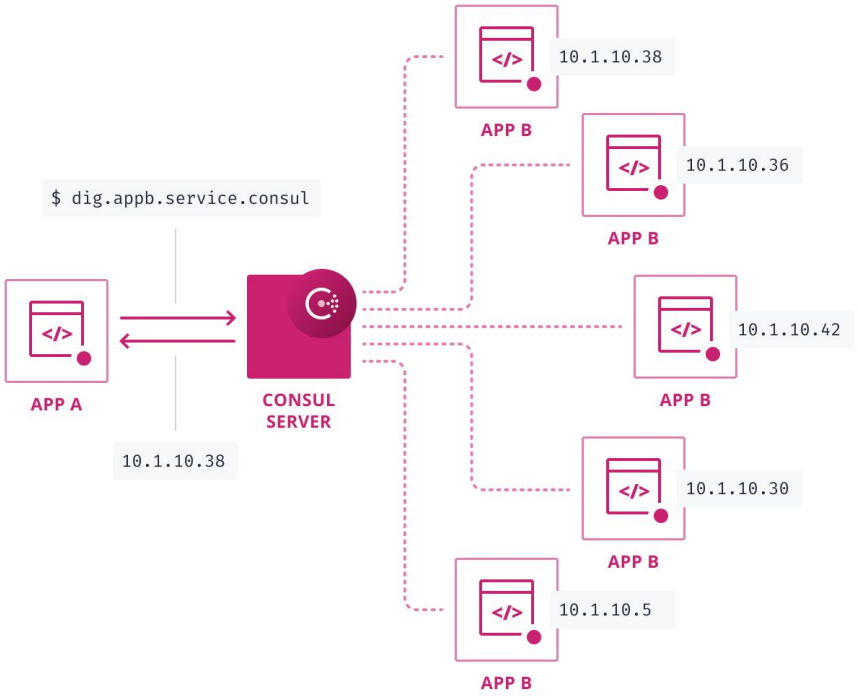
DNS Query Interface

Methods for using the Consul DNS interface

1. Custom DNS resolver library pointed at Consul
2. Set Consul as the DNS server for node(s) and use a recursive configuration so that non-Consul queries also resolve
3. Forward all queries for the "consul." domain to a Consul agent from the existing DNS server

Load Balancing via Consul DNS

- Leverage Consul's zero-touch DNS interface
- Randomized Round-Robin load balancing
- Integrated with health checks, entries for services that fail health checks are automatically filtered out so traffic doesn't route to unhealthy hosts



04

Consul KV & Service Configuration

Hierarchical Key Value Store

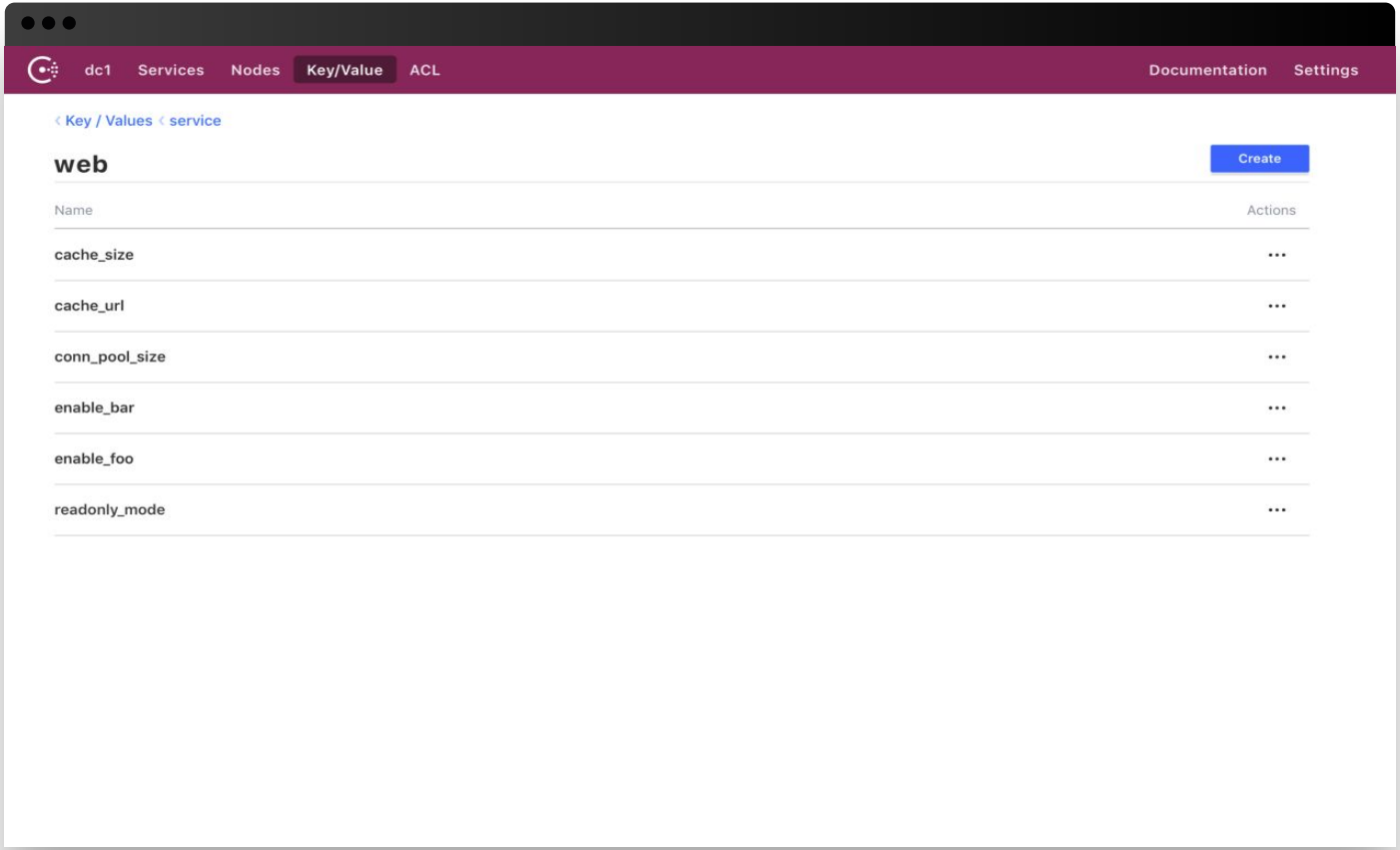
Store and retrieve dynamic configuration, feature flagging, coordination and more metadata

- Highly-available, globally accessible key-value store
- Folder-like architecture allows for easy organization
- ACLs to enforce policy and access
- Bulk export and import of key value pairs
- Accessible via HTTP API
- Can be used via the CLI or tools like curl
- Automated backup via snapshot agent

```
$ consul kv put service/web/enable_foo true
Put successfully!

$ consul kv get service/web/enable_foo
true
```

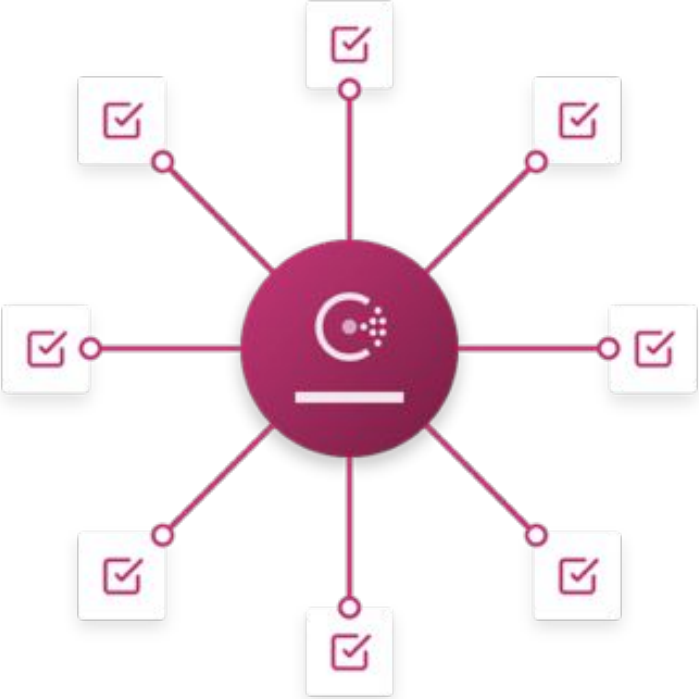
K/V Store Web UI



Service Configuration

Dynamic configuration across distributed services in milliseconds

- **Improve Productivity** by avoiding manual updates to thousands of service instances
- **Reduce Risk** by pushing consistent configuration changes across all distributed services in real-time
- **Reduce Cost** by eliminating the need for config management tools for runtime configuration



Watches

React to changes dynamically

Watches are the simplest way to react to changes using Consul

- Watch for changes in K/V, services, nodes, health checks, and events
- Invoke external handlers when a change is detected. The handler can be any executable, letting operators customize behavior

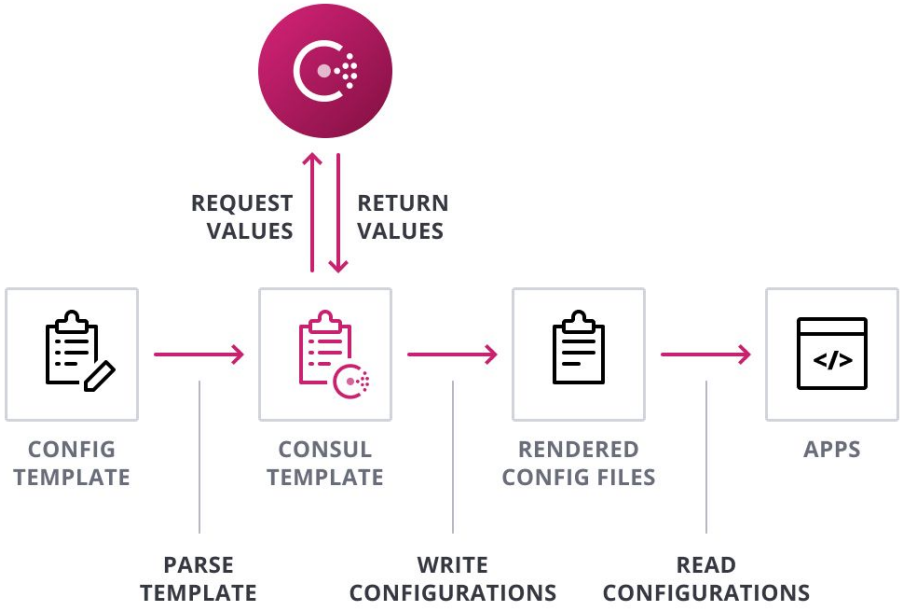
```
$ consul watch -type key

{
  "type": "key",
  "key": "foo/bar/baz",
  "handler_type": "script",
  "args": ["/usr/bin/my-service-handler.sh", "-redis"]
}
```

Consul Template

Link 3rd party config files to Consul K/V

- Standalone application that populates values from Consul and dynamically renders updates to third party configurations
- Automatically triggers a reload of third party tools when the template is updated



Next Steps

Tutorials

https://developer.hashicorp.com/consul/tutorials

Step-by-step guides to accelerate deployment of Terraform Cloud

Consul

Home | Documentation | Tutorials | Install

Search ⌘/ctrl K | Sign In | Sign Up

Consul Home

Tutorials

Overview

Get Started

Consul on HCP

Consul on Kubernetes

Consul on VMs

Use Cases

Kubernetes Service Mesh

Microservices

Network Automation with CTS

Service Discovery & Health

Service Mesh & Gateways

Certification Prep

Associate Prep

Associate Tutorials

Production

Application Resiliency

Developer / Consul / Tutorials

On this page

Learn Consul fundamentals

Service Mesh

Network Infrastructure Auto...

All Tutorials

Deploy a fully managed service mesh

Sign up for HCP Consul →

Learn Consul fundamentals

3 tutorials

Get Started with HCP Consul

Quickly get hands-on with HashiCorp Cloud Platform (HCP) Consul using the HCP portal quickstart deployment, lear...

4 tutorials

Get Started with Consul on Kubernetes

Install Consul on Kubernetes and quickly explore service mesh features such as service-to-service permissions with...

3 tutorials

Get Started on VMs

Consul is a networking tool that provides a fully featured service mesh and service discovery. Try Consul locally.

Service Mesh

Explore common service mesh tasks.

7 tutorials

Secure Service Communication

Authenticate service-to-service communication with mTLS and authorization with Access Control Lists...

3 tutorials

Observability

Collect and visualize mesh metrics to better understand communication between services.

9 tutorials

Traffic Management

Traffic routing with Consul service mesh, gateways, and Envoy proxies.

Network Infrastructure Automation

Additional Resources

- Consul Service Registration Tutorial (VMs)
- Register Services on Kubernetes
- Register and Discover Services within Namespaces
- Service Definition Documentation
- Find Services with Consul DNS
- Consul DNS Caching
- Consul Health Checks Documentation & Examples
- Consul KV Learn Guide
- Consul Template & Load Balancers

Need Additional Help?

Customer Success

Contact our Customer Success Management team with any questions. We will help coordinate the right resources for you to get your questions answered.

customer.success@hashicorp.com

Technical Support

Something not working quite right? Engage with HashiCorp Technical Support by opening a ticket for your issue at:

support.hashicorp.com

Discuss

Engage with the HashiCorp Cloud community including HashiCorp Architects and Engineers

discuss.hashicorp.com

Upcoming Webinars

Consul Deployment & Operations

Take a deep dive into deployment and operational best practices including: Consul Autopilot, the Consul Agent and ACLs, Backup, Disaster Recovery, and Telemetry and Monitoring

Office Hours

An open forum with Consul Subject Matter Experts to answer questions that have arisen during the program and your deployment

Advanced Concepts

A detailed examination of Consul Federation, Namespaces & Admin Partitions, content also cover cluster operations and runbooks along with managing geographic failover and prepared queries

Action Items

- If not done, please share to customer.success@hashicorp.com
  - Authorized technical contacts for support
  - Stakeholders contact information (name and email addresses)
- Email raquel.peterson@hashicorp.com summarizing where you are at with your Consul deployment & implementation
- Deploy first cluster(s) and start onboarding first use case

Q&A

Thank you

customer.success@hashicorp.com

www.hashicorp.com/customer-success