



# Network Automation at DigitalOcean

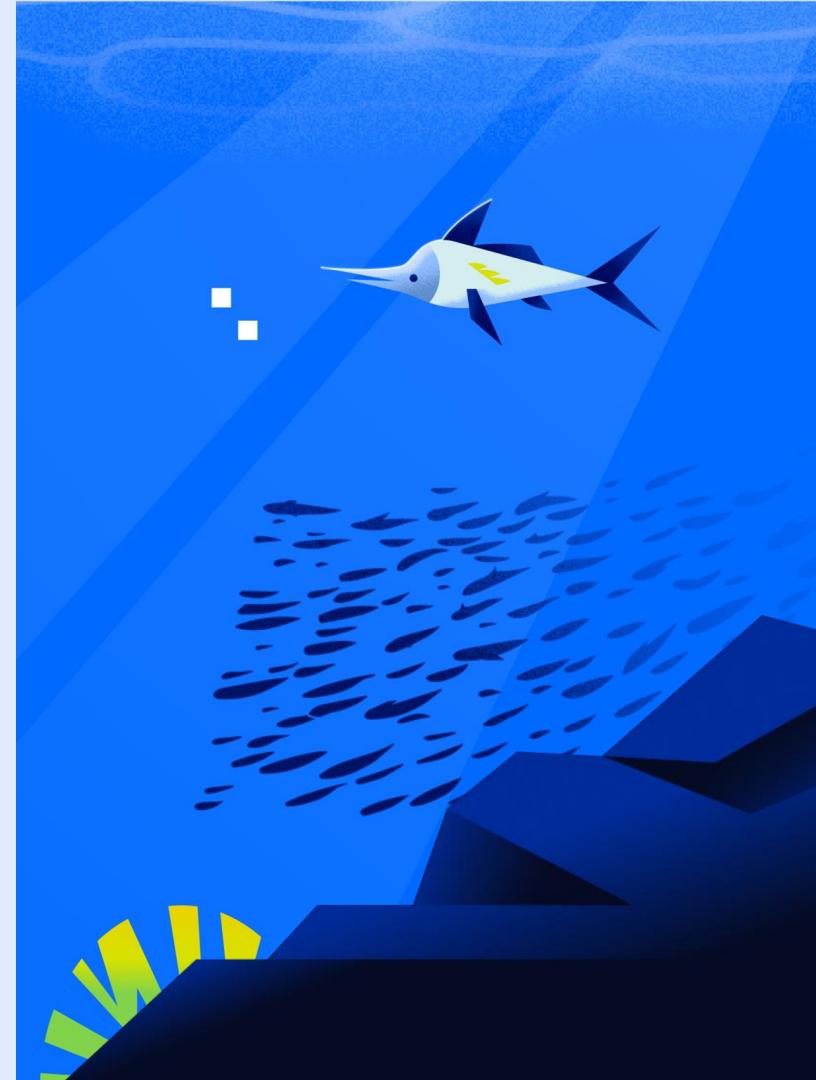
A holistic approach

Denver, November 2024

2024 DigitalOcean. All rights reserved

# Mircea Ulinic

- 5.5 years at DigitalOcean
- Previously at Cloudflare, iBrowse, EPFL
- Automating networks for over 10 years
- 2017 SaltStack contributor of the year
- Maintainer of several open source tools





# A global network



# Today's agenda



NetBox, born at DigitalOcean



# Automate from the ground up!

Scripts > Build

build.BuildRacks

## Build Racks

Starts new or adds racks to existing 25g pod

Run    Source

**Script Data**

Site*	NYC3
Zone*	d
Pod*	5
Rack count*	16
<input type="checkbox"/> Backfill Try to find a contiguous set of racks before appending to end.	
Rack role*	GPU
Rack height*	52
Console Server Type*	CM7148
OOB Switch Type*	EX3400-48T
Spine Switch Type*	QFX5200-32C
TOR / Leaf Switch Type*	QFX5200-32C

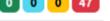
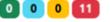
# Data accuracy is hard

Dupes			
Name	Status	Description	Last Run
DuplicateIPAddressesReport	Failed	Report duplicate IP addresses	2024-10-16 00:23
test_duplicate_loopbacks			 0 0 0 2
test_duplicate_management			 0 0 0 6

Inventory			
Name	Status	Description	Last Run
NetworkInventoryReport	Failed	Check that all network hardware has a serial recorded	2024-10-16 00:23
test_device_serial			 0 0 0 109

Prefixes			
Name	Status	Description	Last Run
PrefixesReportCore	Failed	Validate standard requirements for prefixes	2024-10-16 00:23
test_missing_role_assignment			 0 0 0 47
test_missing_vlan_assignment			 3 0 0 1
test_prefix_not_covered_by_aggregate			 1 0 0 25
PrefixesReportIEB	Failed	Validate standard requirements for prefixes	2024-10-16 00:24
test_announce_rose			 0 0 0 11
test_aggregates_radb			 0 1 0 2

# Beyond data accuracy: prefix validation

## Report Results

Time	Level	Object	Message
<b>test_announce_roa</b>			
2024-10-18T00:20:28.104650+00:00	Failure	45.55.0.0/16	Prefix registered at arin has valid ROA till 2024-10-31 13:00:39 and expire in 13 days, 12:40:10.895622 days
2024-10-18T00:20:45.909531+00:00	Failure	104.131.0.0/16	Prefix registered at arin has valid ROA till 2024-11-12 14:00:38 and expire in 25 days, 13:39:52.090735 days
2024-10-18T00:20:47.534515+00:00	Failure	104.236.0.0/16	Prefix registered at arin has valid ROA till 2024-11-12 14:00:38 and expire in 25 days, 13:39:50.465545 days
2024-10-18T00:20:52.915463+00:00	Failure	128.199.0.0/20	ROA state for this prefix is not-found: No VRP Covers the Route Prefix
2024-10-18T00:20:53.104538+00:00	Failure	128.199.16.0/20	ROA state for this prefix is not-found: No VRP Covers the Route Prefix
2024-10-18T00:20:53.295306+00:00	Failure	128.199.32.0/19	ROA state for this prefix is not-found: No VRP Covers the Route Prefix
2024-10-18T00:20:53.477827+00:00	Failure	128.199.64.0/18	ROA state for this prefix is not-found: No VRP Covers the Route Prefix
2024-10-18T00:20:53.655785+00:00	Failure	128.199.128.0/18	ROA state for this prefix is not-found: No VRP Covers the Route Prefix
2024-10-18T00:20:53.833663+00:00	Failure	128.199.192.0/18	ROA state for this prefix is not-found: No VRP Covers the Route Prefix
2024-10-18T00:21:03.949736+00:00	Failure	138.68.0.0/16	Prefix registered at arin has valid ROA till 2024-11-12 14:00:38 and expire in 25 days, 13:39:34.050334 days
2024-10-18T00:22:00.089957+00:00	Failure	159.203.0.0/16	Prefix registered at arin has valid ROA till 2024-11-12 14:00:38 and expire in 25 days, 13:38:37.910208 days
<b>test_aggregates_radb</b>			
2024-10-18T00:20:23.319159+00:00	Info	—	Received 976 route objects from RADb
2024-10-18T00:20:23.330858+00:00	Failure	5.42.203.0/24	missing route object
2024-10-18T00:20:23.697065+00:00	Failure	2a12:1840::/29	missing route object

# Peering Manager

The screenshot shows the Peering Manager dashboard with a dark theme. On the left is a sidebar with navigation links: Autonomous Systems, BGP Groups, Internet Exchanges, Provisioning (selected), Policy Options, Devices, Messaging, 3rd Party, and Other. At the bottom of the sidebar are the commit hash (f0a1165097d0 v1.8.3), date (2024-10-18 09:04:53 UTC), and links to API, Docs, and GitHub.

The main area displays four cards:

- Peering Data**
  - Autonomous Systems: 10 networks to peer with
  - BGP Groups: 2 groups of BGP sessions
  - Internet Exchange Points: 1 infrastructure allowing peering
  - Direct Peering Sessions: 6 BGP sessions for transit, PNIs, etc.
  - IXP Peering Sessions: 11 BGP sessions setup over IXP
- Devices**
  - Configurations: 1 template to build router configurations
  - Routers: 3 network devices running BGP
- Messaging**
  - Contacts: 3 people to discuss peering with
  - E-mails: 1 template to build e-mails
- Policy Options**
  - Routing Policies: 3 policies filtering advertised/received routes
  - Communities: 5 tags for traffic engineering

A search bar and a magnifying glass icon are located at the top right of the main content area.

<https://peering-manager.net/>

# IRRd: internal whois for peering hygiene



<https://irrd.readthedocs.io/>

# Configuration management and orchestration

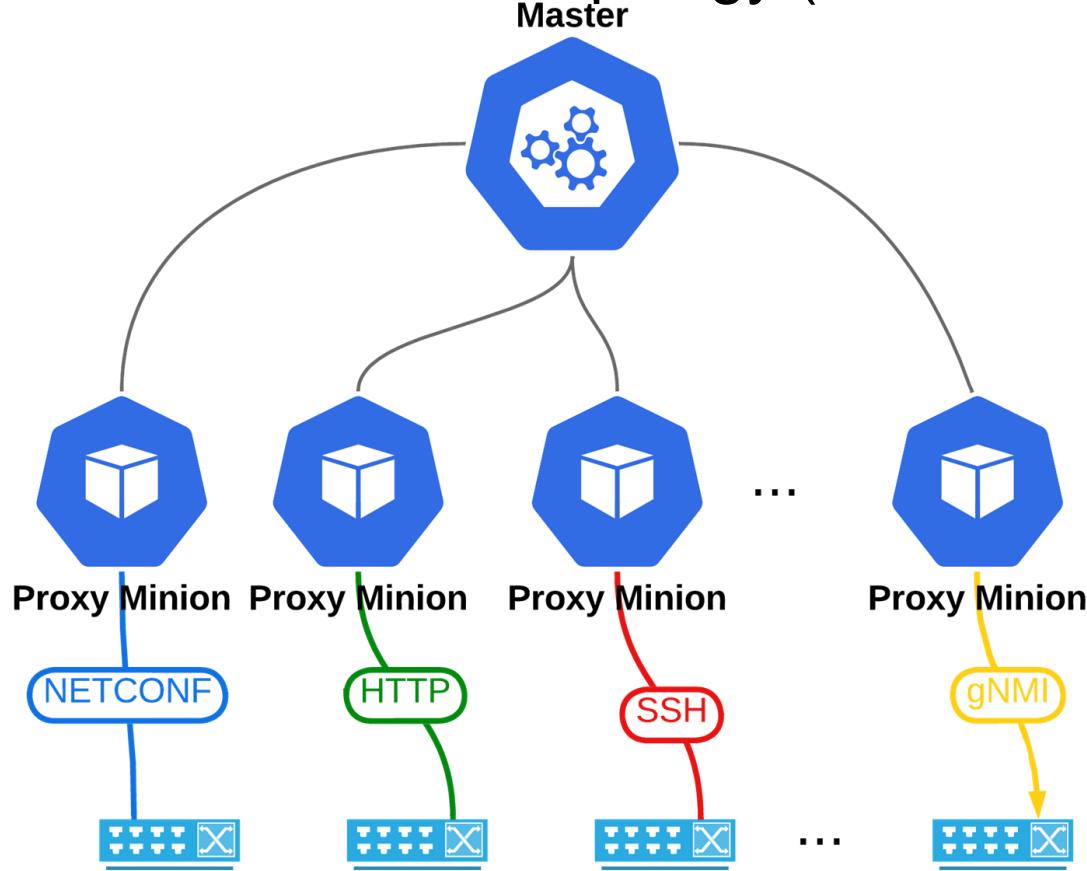


<https://saltproject.io/>

# Why Salt?

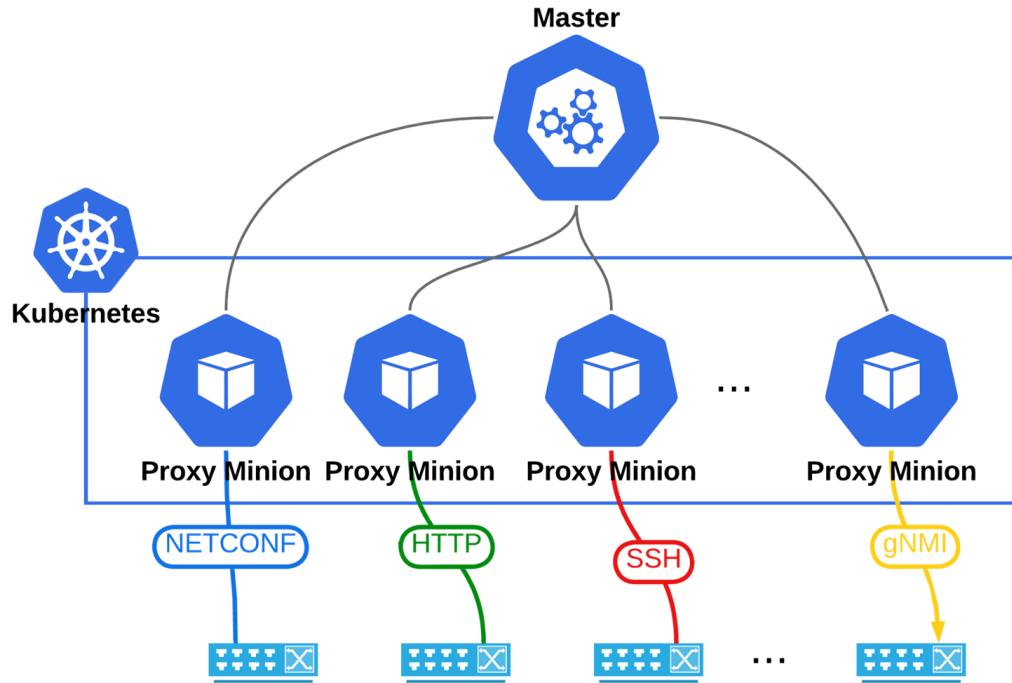
- Vendor agnostic (integration with the [NAPALM](#) library)
- Tried & tested in many large scale environments
- We deploy configuration changes frequently across a portion of the fleet (or entirely sometimes)
- Orchestration and event driven capabilities
- Many integrations out of the box
  - ◆ Easily develop new features using a Turing complete language (Python)
- Rest API
- We also use Ansible & Chef

# Salt: network automation topology (with 1 Master)

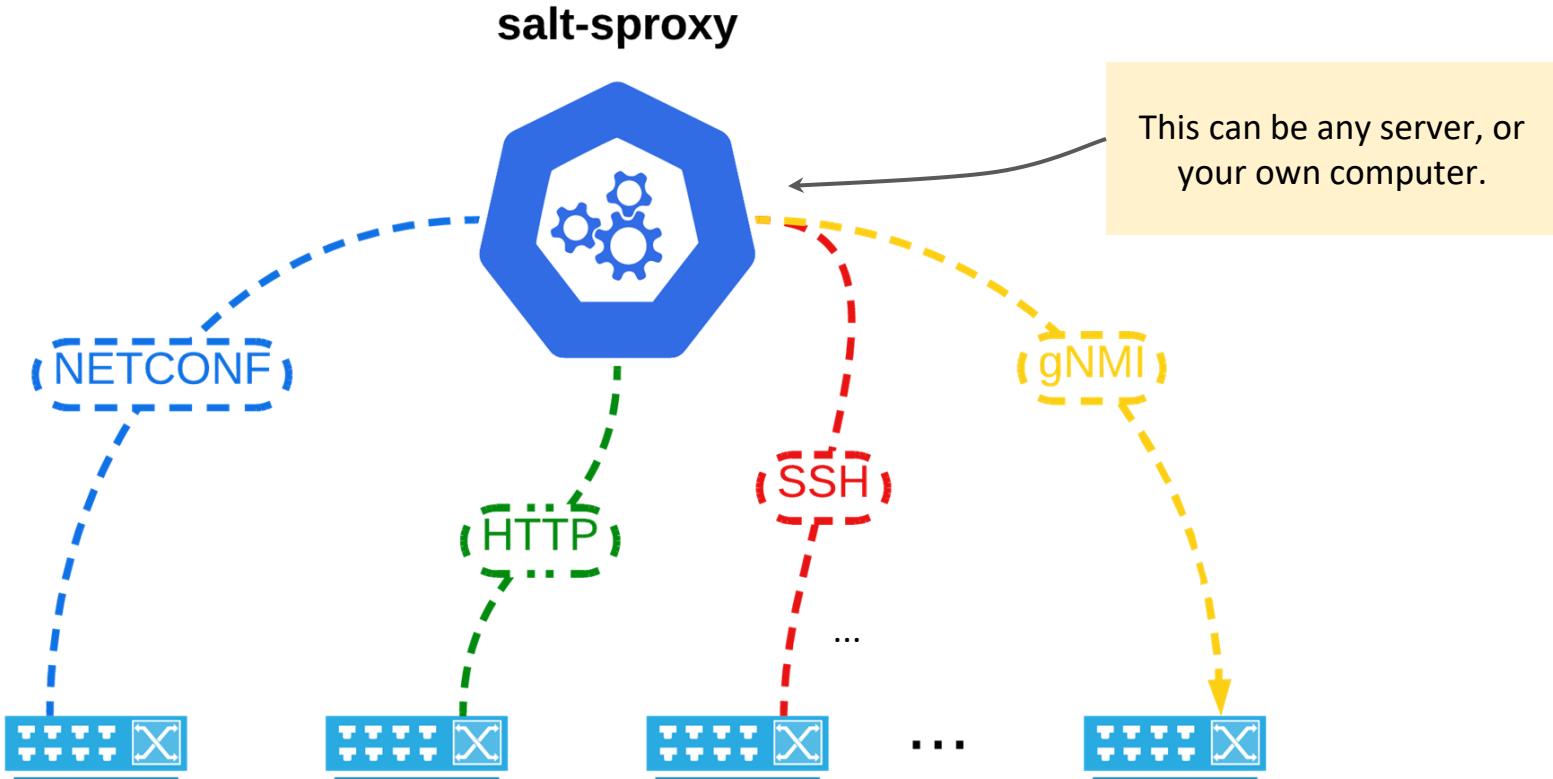


# Everything has a price!

- One Proxy Minion process / service per network device.
- Proxy Minions are running in Kubernetes, deployed regionally.
- Not all our network devices are managed through Proxy Minions. Only about 35% are managed like this.
- Future ideas: Proxy Minions directly on the network devices.

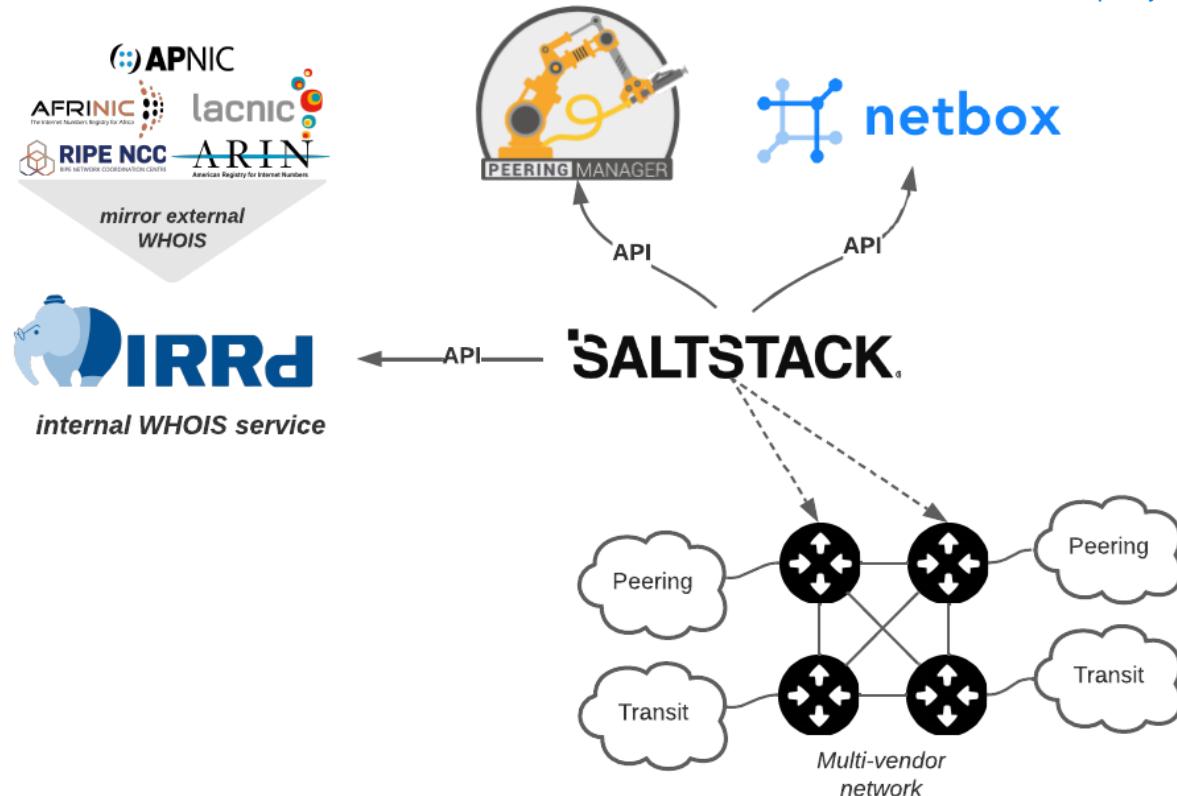


# salt-sproxy: managing devices without Proxy Minions

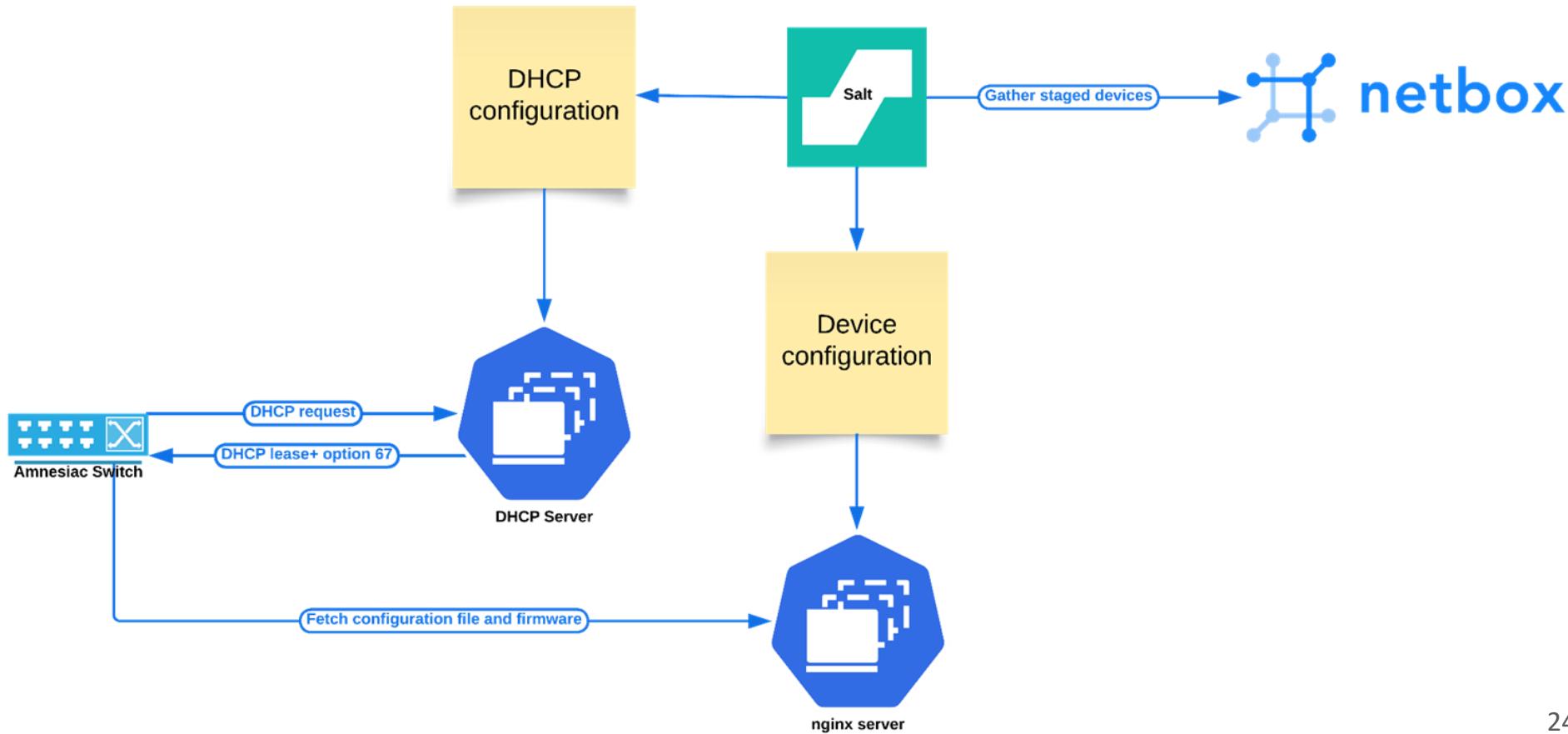


# Salt: configuration management global view

<https://youtu.be/9MMz9t-BG5Y>



# ZTP, simple as



# Monitoring a global network

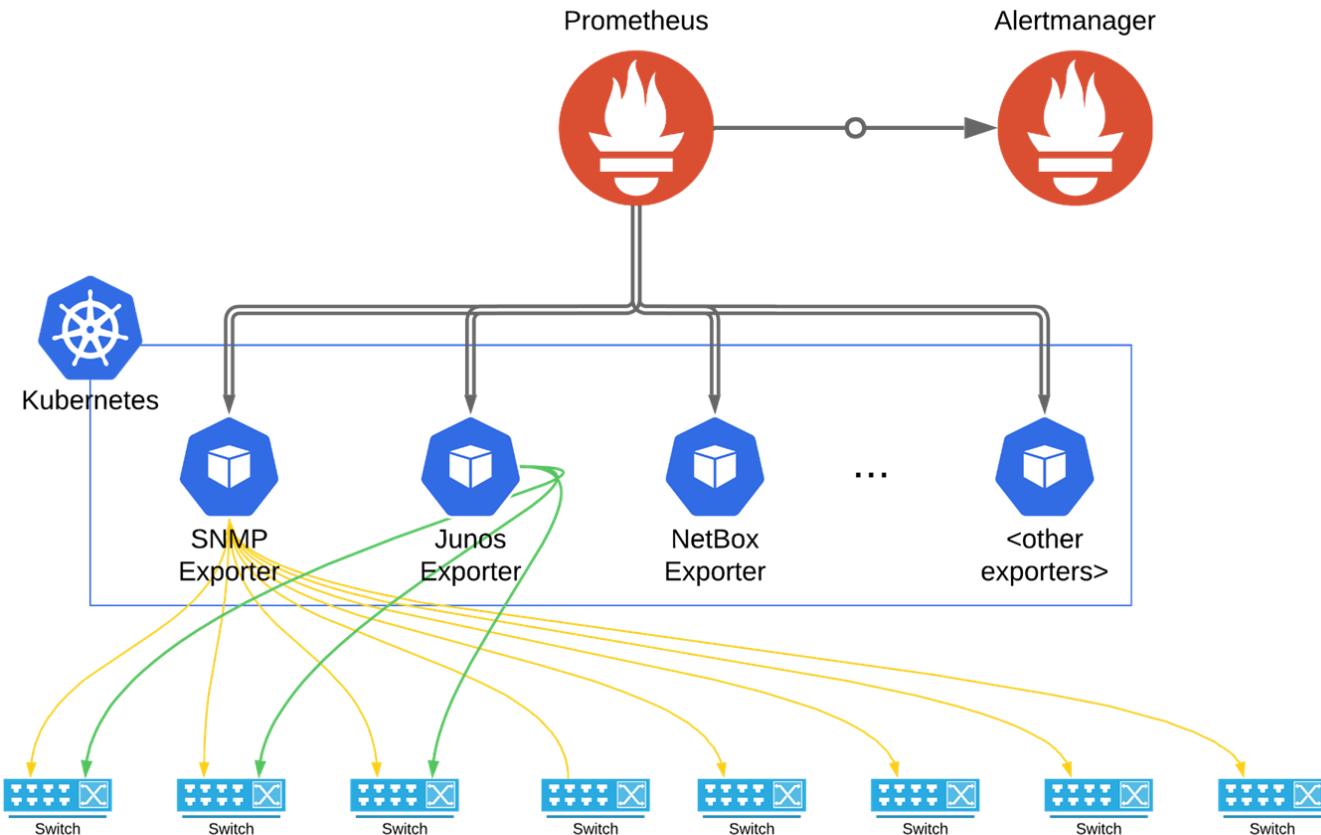
A vibrant underwater illustration serves as the background. The scene features a variety of marine life, including several pink and yellow jellyfish, small blue and orange fish, and green coral reefs. A prominent feature is a glowing, translucent blue network path that curves from the bottom left towards the center, then splits into two branches that extend towards the top right. This path is composed of a series of bright, glowing segments, suggesting data flow or monitoring across a global network.

# Prometheus based monitoring system

- Platform managed by a separate team ❤️
  - ◆ They run Prometheus and Alertmanager for us
  - ◆ Automatic service discovery based on NetBox
- We maintain many Prometheus exporters
  - ◆ Generally deployed in every geo region
  - ◆ Running in Kubernetes
  - ◆ In-house developed Prometheus exporter for NetBox  
Metrics, used to correlate metrics (e.g., on device status)
- No streaming telemetry yet. 😞



# Prometheus based monitoring system



# Alerta: dashboard aggregator for alerts

The screenshot shows the Alerta web application running at [localhost:8081/#/alerts?status=open&environment=Production](http://localhost:8081/#/alerts?status=open&environment=Production). The interface has a header with tabs for 'Recent' and 'Top 10', and a search bar. Below the header is a navigation bar with 'Configuration', 'Jane Bloggs', and 'About' links, along with an 'Auto Update' button.

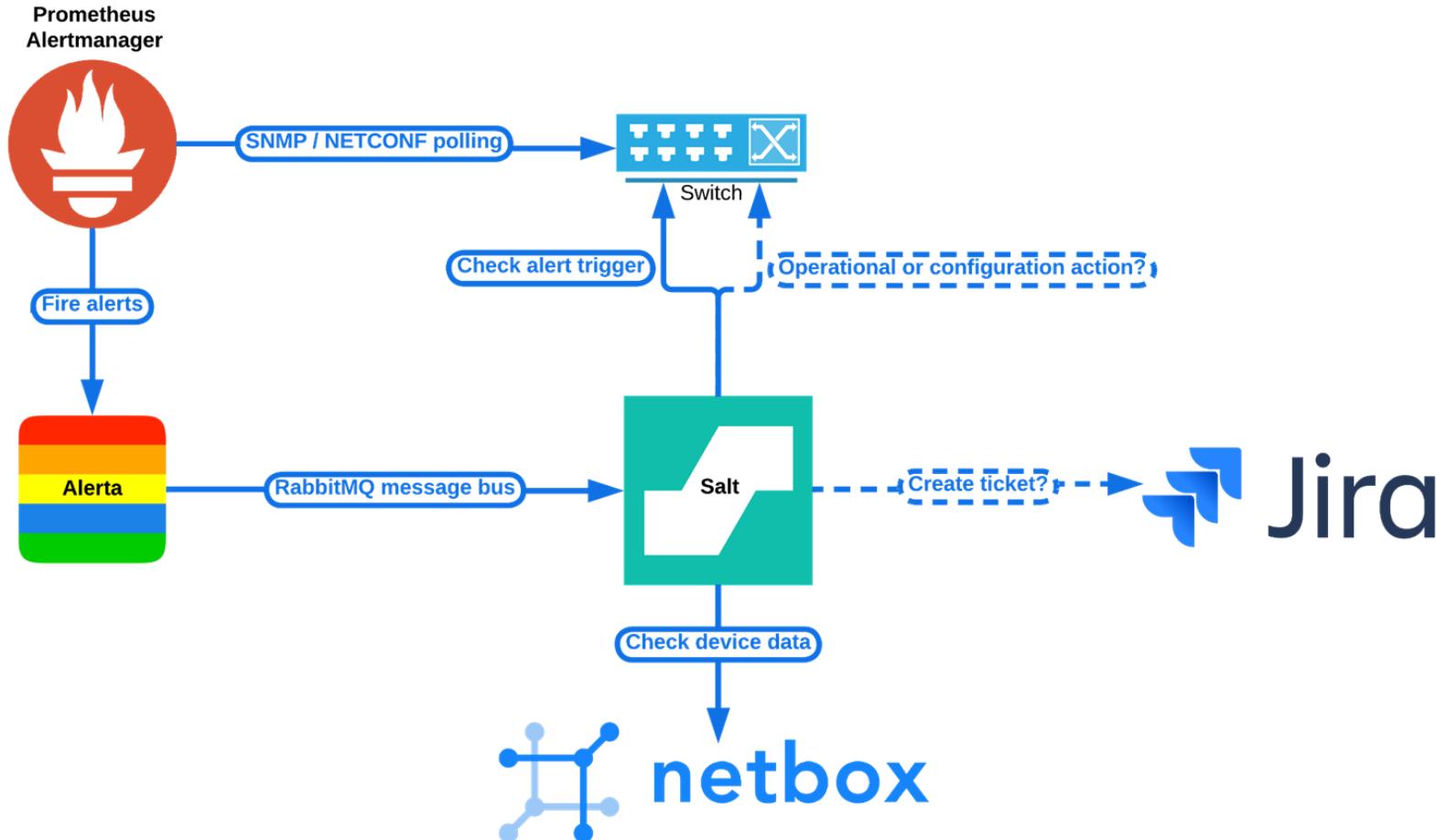
The main content area displays a table of alerts. The columns are: Severity, Status, Last Receive Time, Dupl., Environment, Service, Resource, Event, Value, and Text. The table shows 14 rows of alerts, each with a status of 'Open'. The severity levels range from Critical (red) to Indeterminate (grey). The environment column shows 'Production' for all alerts. The service column includes 'Tornskel', 'Ockley', 'Notestack', 'Extremes', 'Deployinator', 'kue', 'Support', 'stylebot', 'Macto', 'jslint.vim', 'Firetray', 'spine.contacts', 'Phnx', 'PxLoader', 'Yschool', 'bbb', 'Jsconfus', 'webglreport', 'Photoswipe', 'RealTimeMonitor', 'Wireit', 'currency.io', 'Zia', 'openstreetbugs', 'Nodelint', and 'LightFace'. The event column lists various error types like 'breachOfConfidentiality', 'InputOutputDeviceError', 'dataSetOrModemError', etc. The value column is mostly 'n/a'. The text column contains placeholder text from the Banksy 'Commodification of Art' series.

Severity	Status	Last Receive Time	Dupl.	Environment	Service	Resource	Event	Value	Text
↑ Critical	Open	Fri 16 Oct 00:55	0	Production	Tornskel	Ockley	breachOfConfidentiality	n/a	Marfa Godard Banksy voluptate cred. Cray gastrop
↑ Critical	Open	Fri 16 Oct 00:40	0	Production	Notestack	Extremes	InputOutputDeviceError	n/a	Aesthetic chia biodiesel, shabby chic Brooklyn Mar
↑ Major	Open	Fri 16 Oct 00:56	0	Production	Deployinator	kue	dataSetOrModemError	n/a	Nihil crucifix tousled, shabby chic cardigan et me
↑ Major	Open	Fri 16 Oct 00:40	0	Production	Support	stylebot	fileError	n/a	Commodo roof party gluten-free placeat. Forage qu
↑ Major	Open	Fri 16 Oct 00:39	0	Production	Macto	jslint.vim	cableTamper	n/a	Hella squid dolor readymade Banksy, master cleans
↑ Minor	Open	Fri 16 Oct 00:55	0	Production	Firetray	spine.contacts	ianError	n/a	Laboris gastropub artisan occaecat, tattooed VHS
↑ Minor	Open	Fri 16 Oct 00:39	0	Production	Phnx	cssSandpaper	communicationsProtocolError	n/a	Church-key veniam commodo, put a bird on it try-ha
↑ Warning	Open	Fri 16 Oct 00:55	0	Production	Friar	PxLoader	communicationsSubsystemFailure	n/a	Odio minim laborum, cupidatat Shoreditch biodiesel
↑ Warning	Open	Fri 16 Oct 00:55	0	Production	Yschool	bbb	adapterError	n/a	Sustainable PBR cardigan Brooklyn, listicle elit o
↑ Indeterminate	Open	Fri 16 Oct 00:56	0	Production	Jsconfus	webglreport	adapterError	n/a	Neutra vegan tilde, proudest keytar swag dreamcatcher
↑ Indeterminate	Open	Fri 16 Oct 00:55	0	Production	Photoswipe	RealTimeMonitor	dteDceInterfaceError	n/a	Roof party listicle cilium, enim Tumblr DIY artis
↑ Indeterminate	Open	Fri 16 Oct 00:55	0	Production	Wireit	currency.io	configurationOrCustomizationError	n/a	Biodiesel labore 8-bit, odio eu American Apparel
↑ Indeterminate	Open	Fri 16 Oct 00:55	0	Production	Zia	openstreetbugs	proceduralError	n/a	Sustainable selvage slow-carb brunch bespoke odio
↑ Indeterminate	Open	Fri 16 Oct 00:55	0	Production	Nodelint	LightFace	outputDeviceError	n/a	Meh qui brunch, twee mixtape Shoreditch dolor Pi

Showing 14 out of 14 alerts

<https://alerta.io/>

# Salt: not just configuration management!



# Salt: not just configuration management!

 Datacenter Operations / DCOP-30620

## SFO2: Please replace SFP on sfo2-a4-spine3::et-0/0/21

[Edit](#) [Add comment](#) [Assign](#) [More](#) [Done](#) [Email](#)

**Details**

Type:	Hardware Investigation	Resolution:	Done
Priority:	Medium	Fix Version/s:	None
Affects Version/s:	None		
Component/s:	None		
Labels:	<code>alert_id=b5b2b270-d5a9-4e4a-a3aa-be4166d1982c</code> <code>asn=4201010400</code> <code>auto_close=true</code> <code>cable_id=20755</code> <code>connected_device=sfo2-a4-tor5b</code> <code>connected_interface=et-0/1/2</code> <code>device_tag=net-6010</code> <code>event=ifOperStatus</code> <code>host=sfo2-a4-spine3</code> <code>if_name=et-0/0/21</code> <code>oob_device=sfo2-a4-oobsw4</code> <code>pdu=sfo2-a4-pdu4a</code> <code>pdu=sfo2-a4-pdu4b</code> <code>pod=4</code> <code>rack=A4R4</code> <code>rack_facility=SCL2:01:NA:001.M07:01.03</code> <code>region=sfo2</code> <code>role=spine-switch</code> <code>service=Interface</code> <code>team=infra-network</code> <code>zone=a</code>		
Datacenter:	SFO2		
Inventory Used:	None Used		
Cable ID:	20755		
Create to complete (Days):	0.551		

**Description**

It looks like there's a transceiver failure on sfo2-a4-spine3::et-0/0/21:

```
Physical interface: et-0/0/21
Module temperature : 37 degrees C / 98 degrees F
Module voltage : 3.3290 V
Module temperature high alarm : Off
Module temperature low alarm : Off
Module temperature high warning : Off
Module temperature low warning : Off
Module voltage high alarm : Off
Module voltage low alarm : Off
```

**People**

Assignee: <someone> [Assign to me](#)

Reporter: Salt NetDev [Report issue](#)

Votes: 0 [Vote for this issue](#)

Watchers: 2 [Start watching this issue](#)

**Dates**

Created: 09/Aug/23 04:15  
Updated: 09/Aug/23 17:28  
Resolved: 09/Aug/23 17:28

**Agile**

[Find on a board](#)

**Slack**

Dedicated channel: [+ Add a new one](#)

Mentions of this issue: **none so far**

# Network Automation and AI



# What are GPU Droplets?

GPU Droplets are virtual machines powered by GPUs for AI/ML workloads.

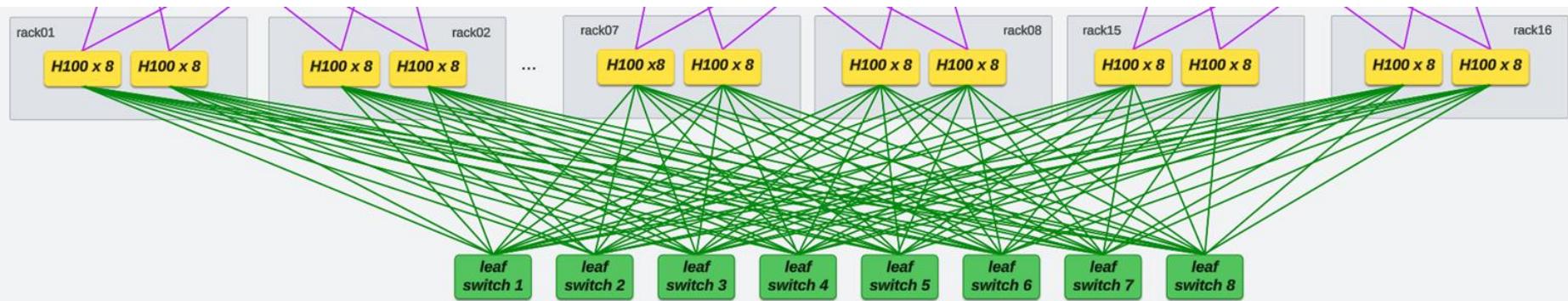
With GPU Droplets, customers can run training and inference on AI/ML models, process large data sets and complex neural networks for deep learning use cases, and serve additional use cases like high-performance computing (HPC).

GPU Droplets are powered by NVIDIA H100 and comes in 1-GPU, 8-GPU and multi-node configurations

# GPU Droplet flavours

GPU	NVIDIA H100	NVIDIA H100x8
GPUs per Droplet	1	8
GPU Memory	80 GB	640 GB
Droplet Memory	240 GB	1920 GB
Droplet vCPUs	20	160
Boot Disk	720 GiB NVMe	2 TiB NVMe
Scratch Disk	5 TiB NVMe	40 TiB NVMe
Transfer	15,000 GiB	60,000 GiB

# Nvidia H100 x 8



- Dynamic VLANs per customer, configured on the switch
- Automatic switch reconfiguration on customer action
- Impossible without network automation

# WTF (What's The Future)

# All thanks to amazing individuals

- ★ Jeremy Stretch
- ★ Zach Moody
- ★ Chip Marshall
- ★ Antoine Meillet
- ★ Marcus Butler
- ★ Stephen Beckstrand
- ★ Nancy Yang
- ★ Marcos Buzo

# Recap

- Network automation is so much more than just configuration management.
  - ◆ Automation starts before the physical network exists.
  - ◆ It's a never ending process.
  - ◆ Full automation = 0 manual intervention.
- Focus on the methodology, not the tooling.
  - ◆ Evaluate and try what's best for your business requirements.
- You can build awesome automation using open source.
  - ◆ Open source doesn't mean free.
- Be ready for the AI revolution.

The background is a vibrant blue underwater scene. In the top left, a school of small, light-blue fish swims. The bottom left features a cluster of yellow and green coral. A large, white, stylized question mark is positioned in the center. The bottom right contains more coral and a few small fish. Light rays from the surface create diagonal streaks across the slide.

# Questions?