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Conference Nov. 18 - 20

Terraform - Past, Present (0.12) and Future

Radek Simko

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Radek Simko

Software Engineer at HashiCorp
(since Jan 2017)

Terraform Contributor
(since Feb 2015)

@radeksimko

Vagrant

Packer

Terraform

Vault

Consul

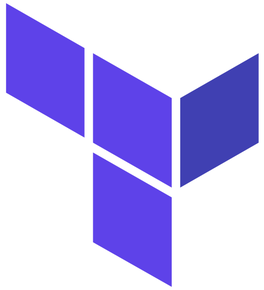
Nomad

What motivated 0.12?

Main Themes

1. Provider discovery & distribution
2. Configuration Language
3. Machine-readable output
4. Plugin SDK

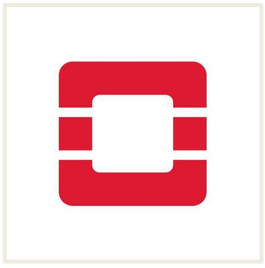
Provider Discovery & Distribution

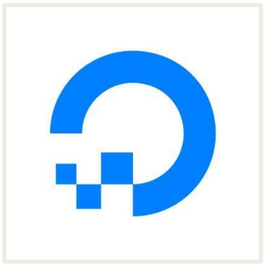



aws


Google Cloud

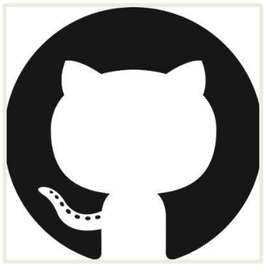

vm

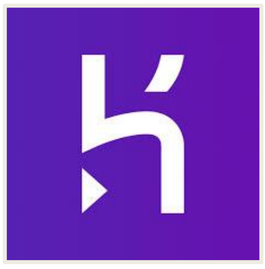





fastly


cisco





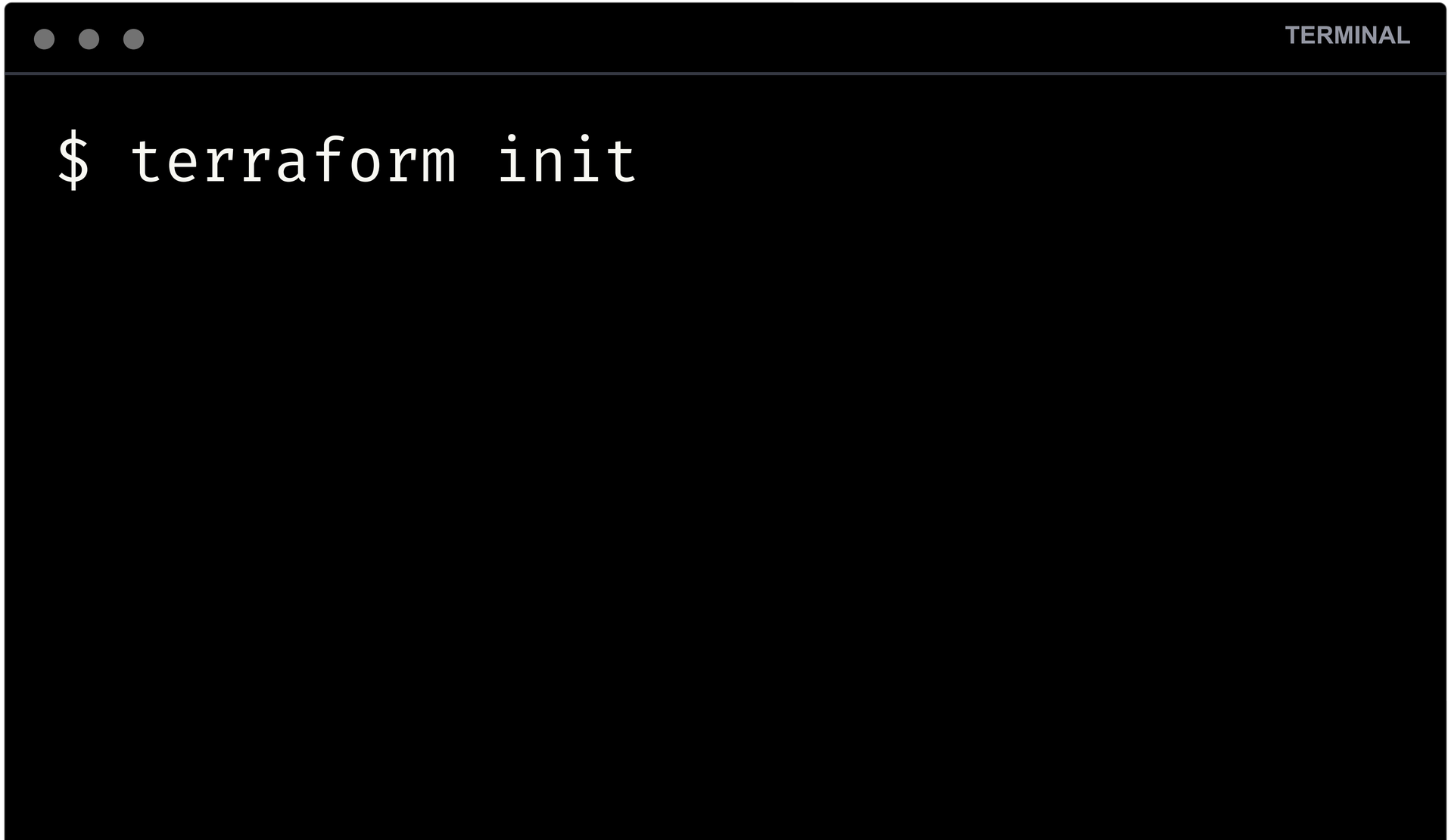

Akamai

CODE EDITOR

```
provider "aws" {
  version = ">=2.0.0"
  region  = "us-west-2"
}

data "aws_ami" "ubuntu" {
  filter {
    name   = "name"
    values = ["ubuntu/.../ubuntu-trusty-14.04-amd64-server-*"]
  }
  # …
  owners = ["099720109477"] # Canonical
}

resource "aws_instance" "example" {
  ami           = "${data.aws_ami.ubuntu.id}"
  instance_type = "t2.micro"
}
```


TERMINAL
$ terraform init

=< 0.6.0

June 2015

➔ **1 binary** per provider for each OS/arch

➔ **1 binary** for core

➔ **10-30 providers**

➔ **monorepo** w/ providers in `/builtin/...`

=< 0.6.0

June 2015

➔ **~40** binaries distributed as ZIP for each OS/arch

- core **21MB** + providers **12-36MB** each (**~600MB**)

➔ **monorepo** w/ providers in `/builtin/...`

0.7.0

August 2016

➔ “E_TOO_MANY” binaries!

➔ Big binaries

➔ Sub-optimal installation experience

0.7.0

August 2016

➔ **one** binary for each OS/arch

➔ still monorepo

0.10.0

August 2017

➔ “E_TOO_MANY_PROVIDERS”

➔ “E_TOO_MANY_CHANGES”

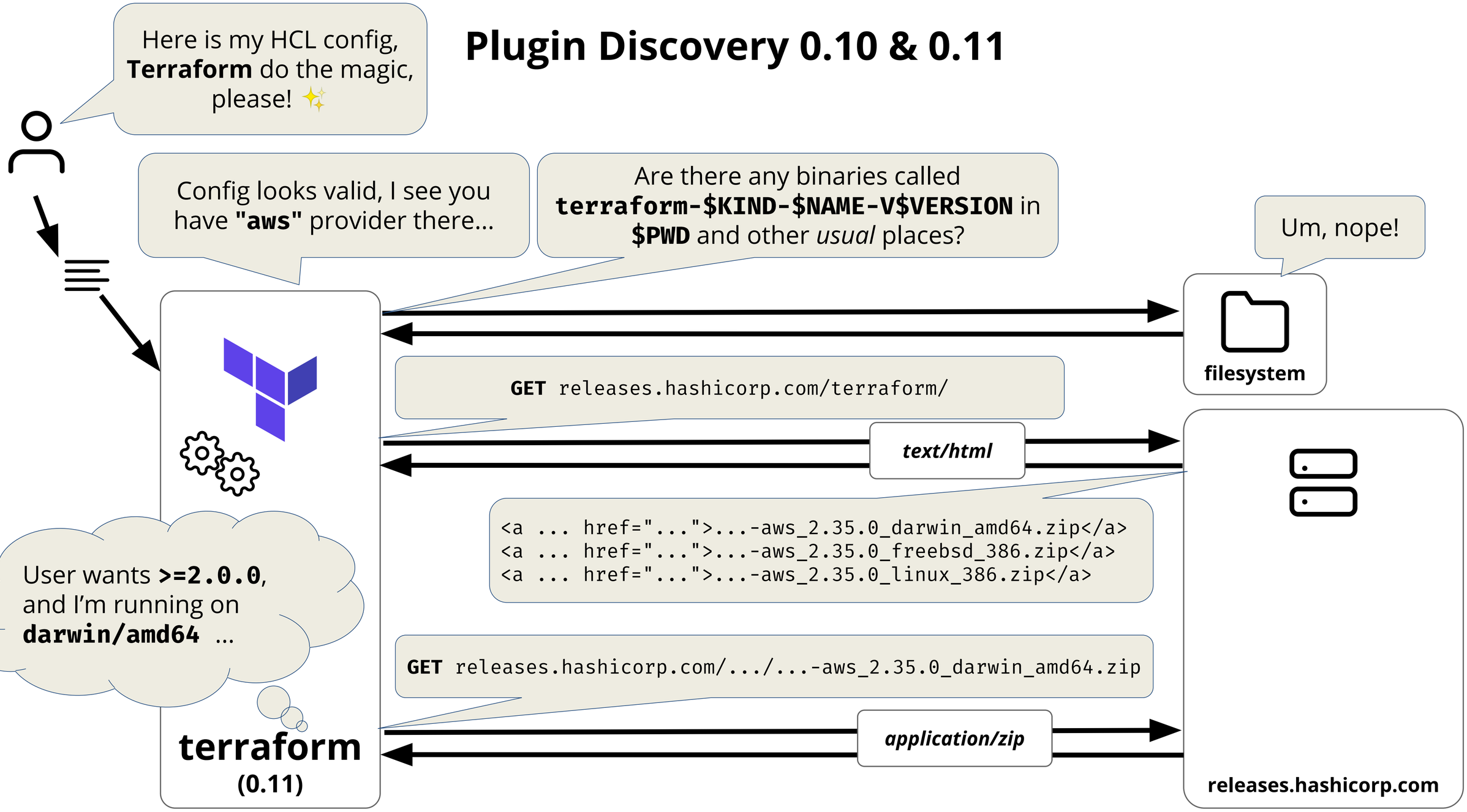
0.10.0

August 2017

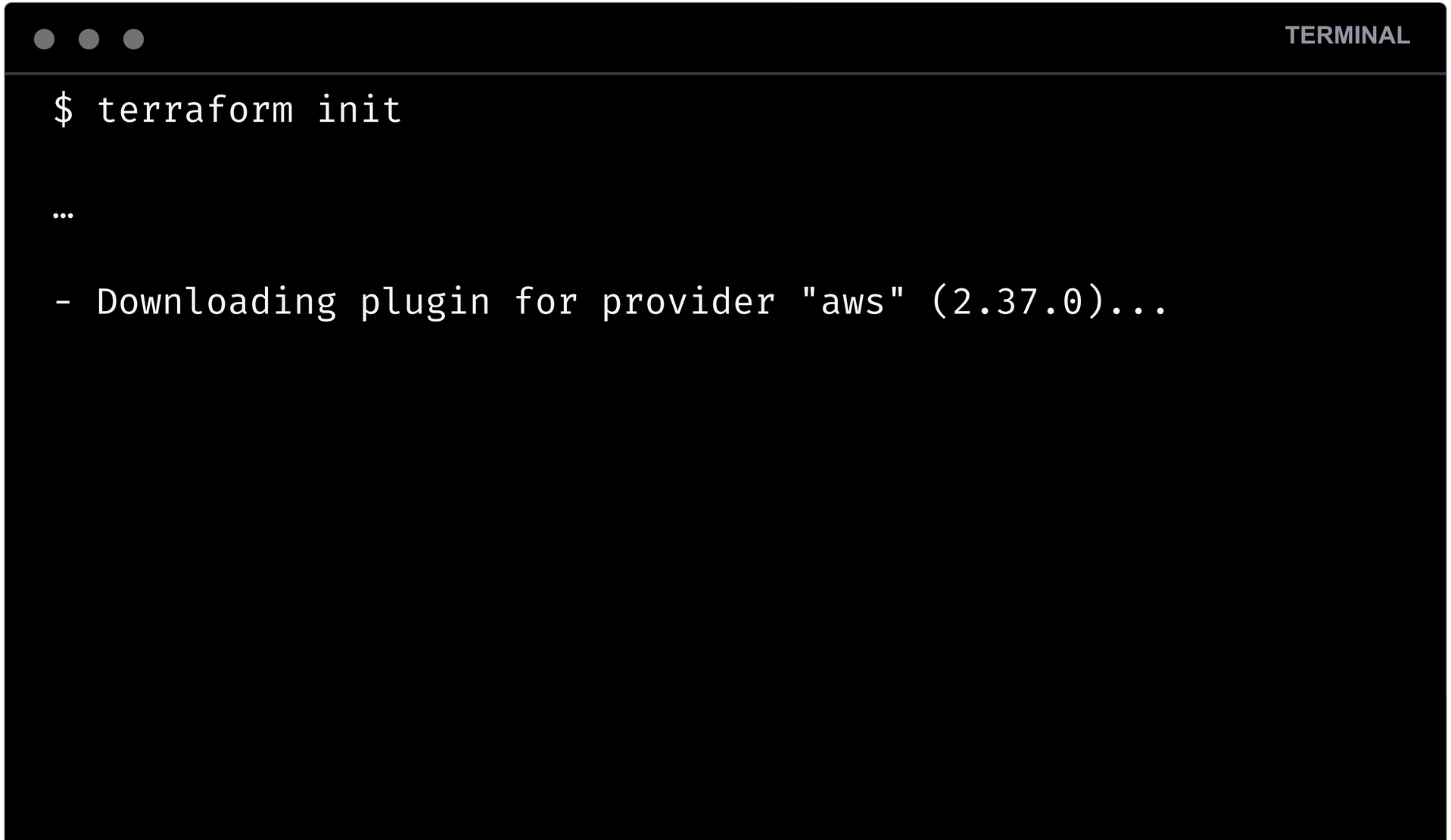
➔ **one** binary with just core

- **providers** in separate binaries **downloaded on-demand**
- **providers** versioned separately (**multi-repo**)
- provider **constraints**
- `terraform init` practically mandatory

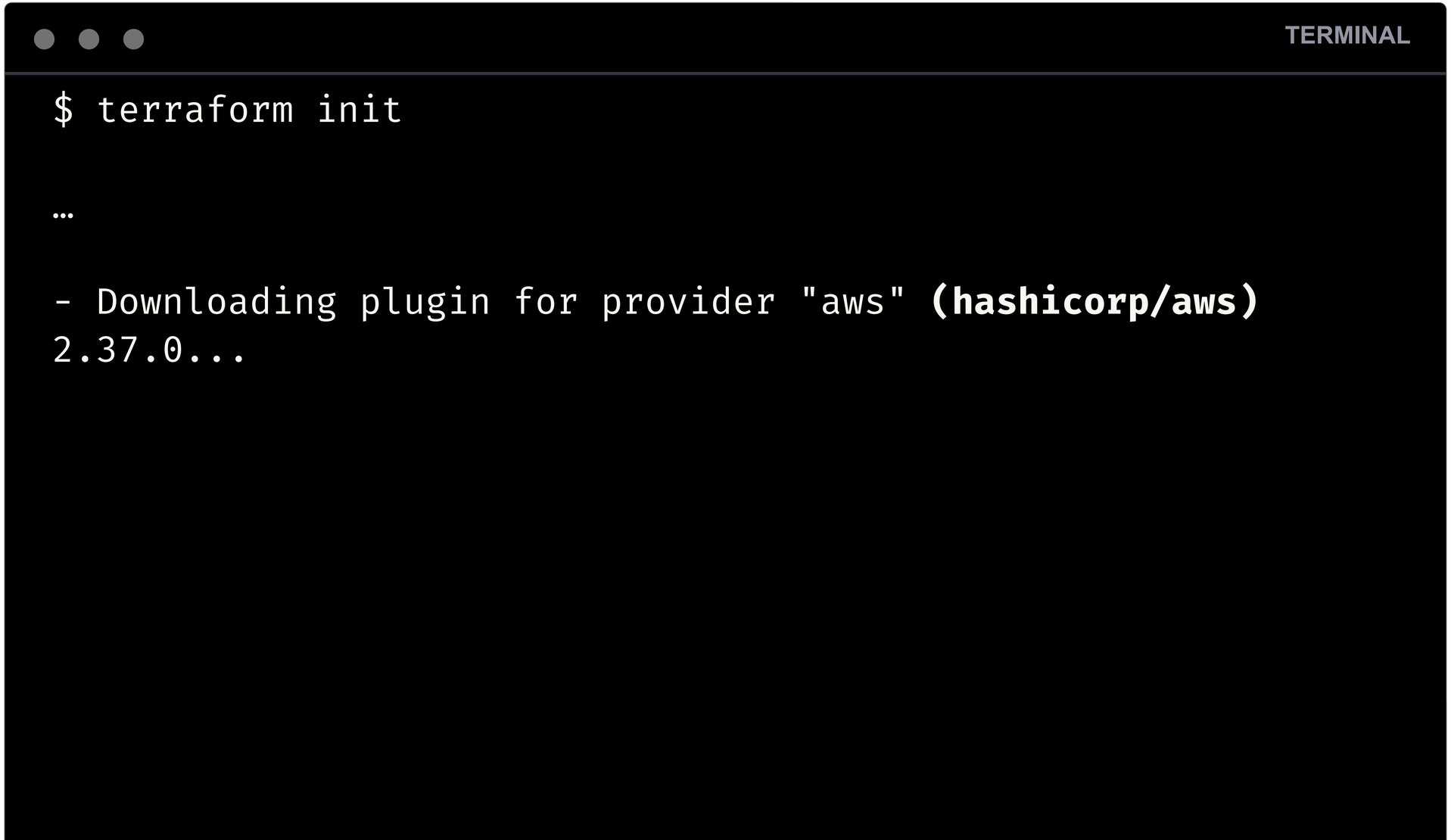
Plugin Discovery 0.10 & 0.11



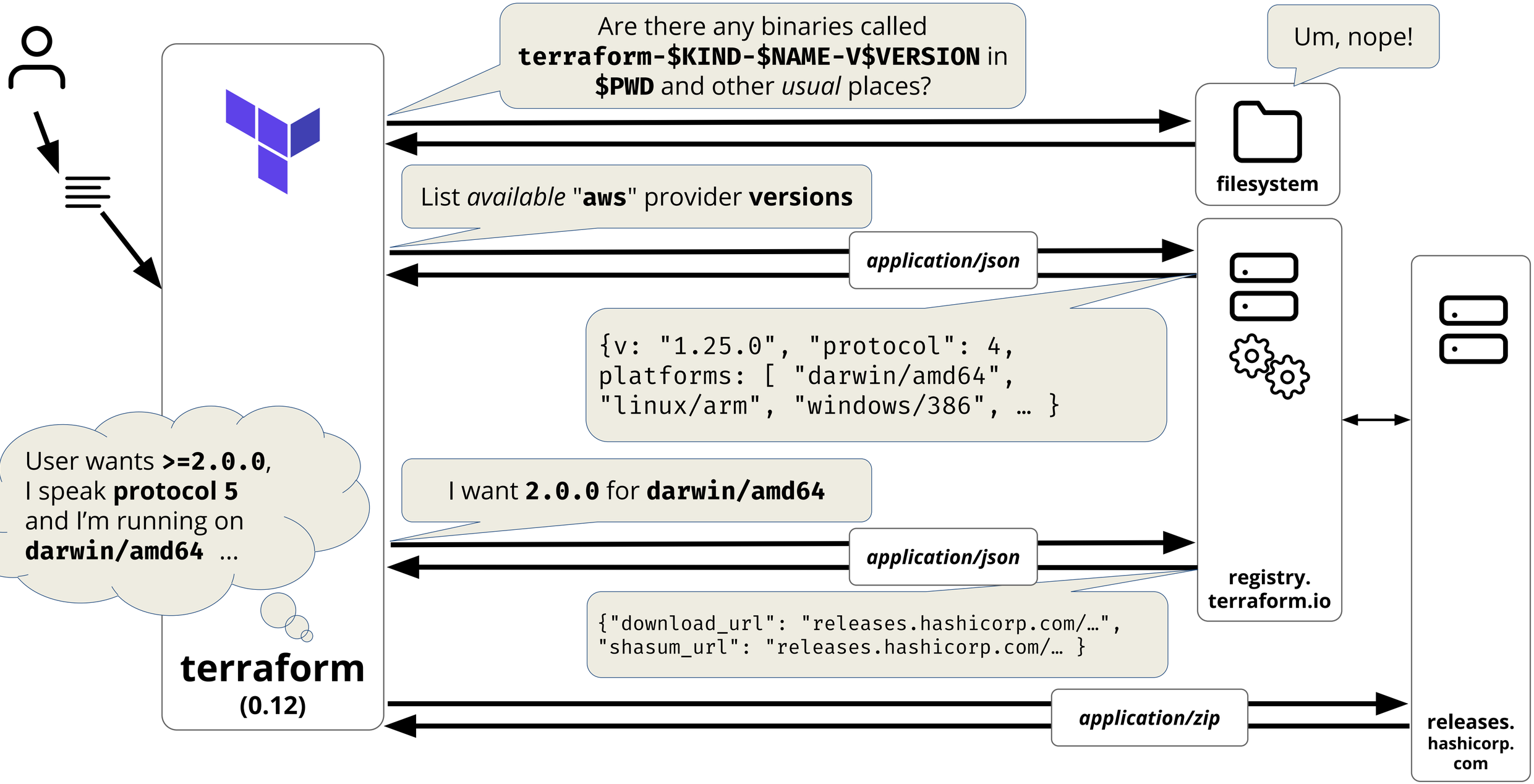
terraform init (0.10 & 0.11)



terraform init (0.12)



Plugin Discovery in 0.12.0



3rd Party Providers Today

➔ HashiCorp effectively gatekeeper

- ◆ Consistency
- ◆ Healthiness
- ◆ E2E testing

➔ “`E_TOO_MANY_PROVIDERS`”

- ◆ Not very scalable
- ◆ Providers want independence

Future: Terraform Registry

➔ Better story for 3rd party providers

- No need to be hosted on `releases.hashicorp.com`
- Discoverable via `terraform init`
- Hosted documentation

HashiCorp Terraform | Registry

Providers / hashicorp / aws / Version 2.35.0 Latest Version

aws

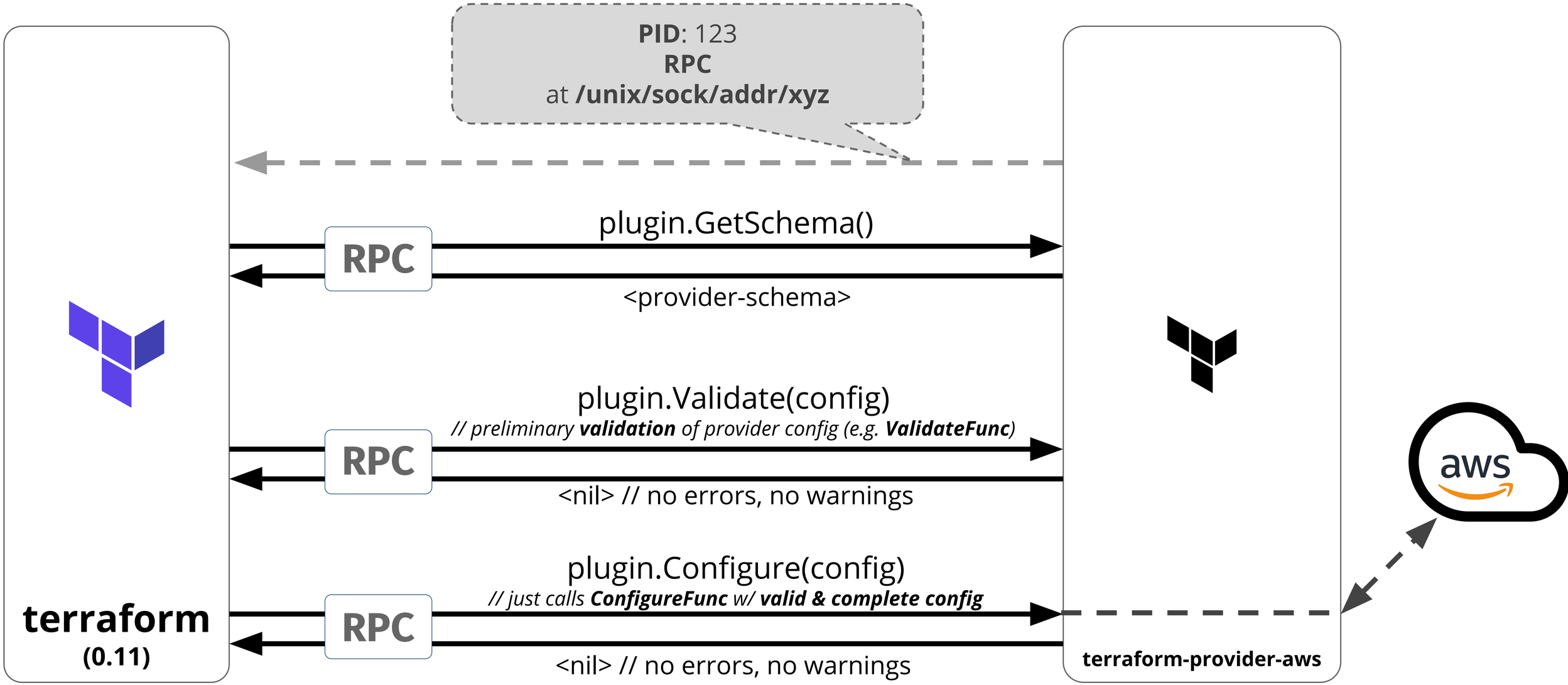
aws

Official by: HashiCorp

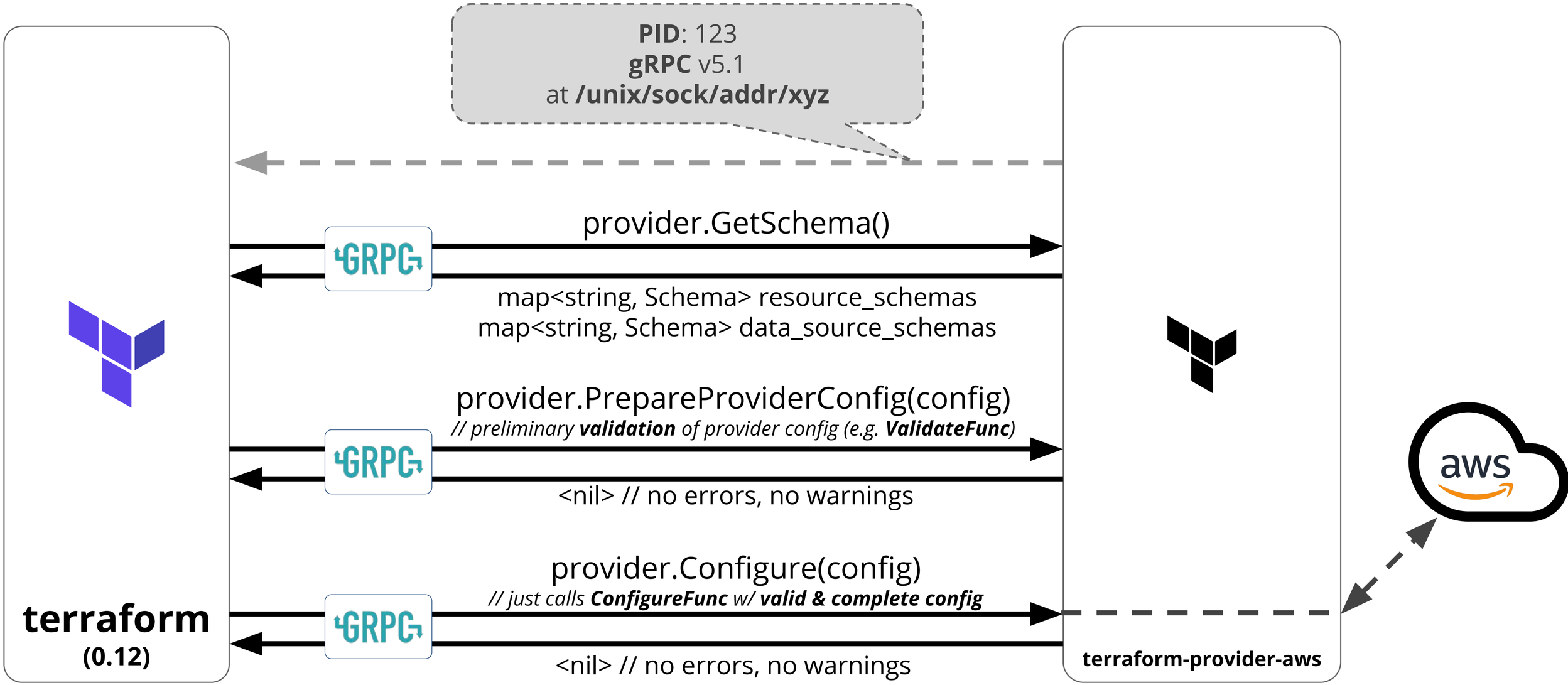
VERSION	PUBLISHED	INSTALLS	SOURCE
2.35.0	5 days ago	20819624	terraform-providers/terraform-provider-aws

Plugin Protocol

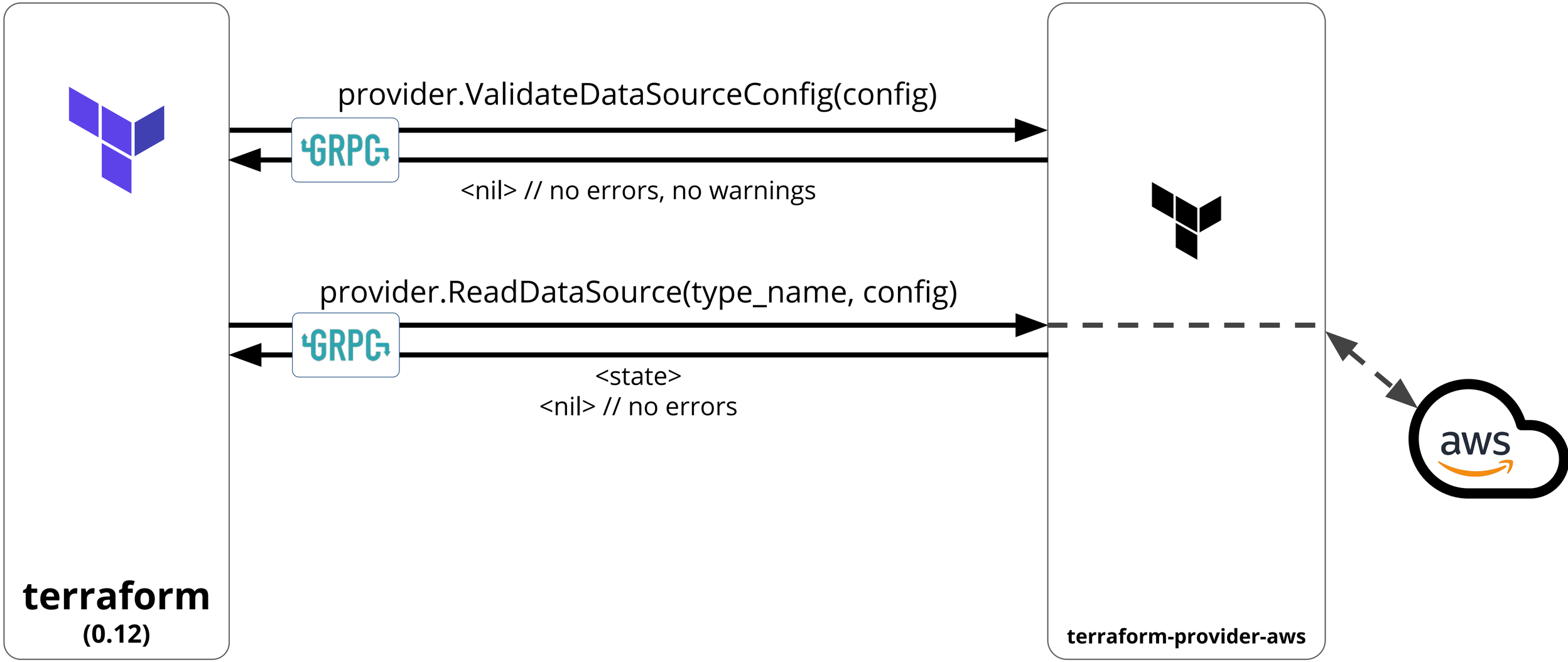
Plugin Communication (0.11) - Provider



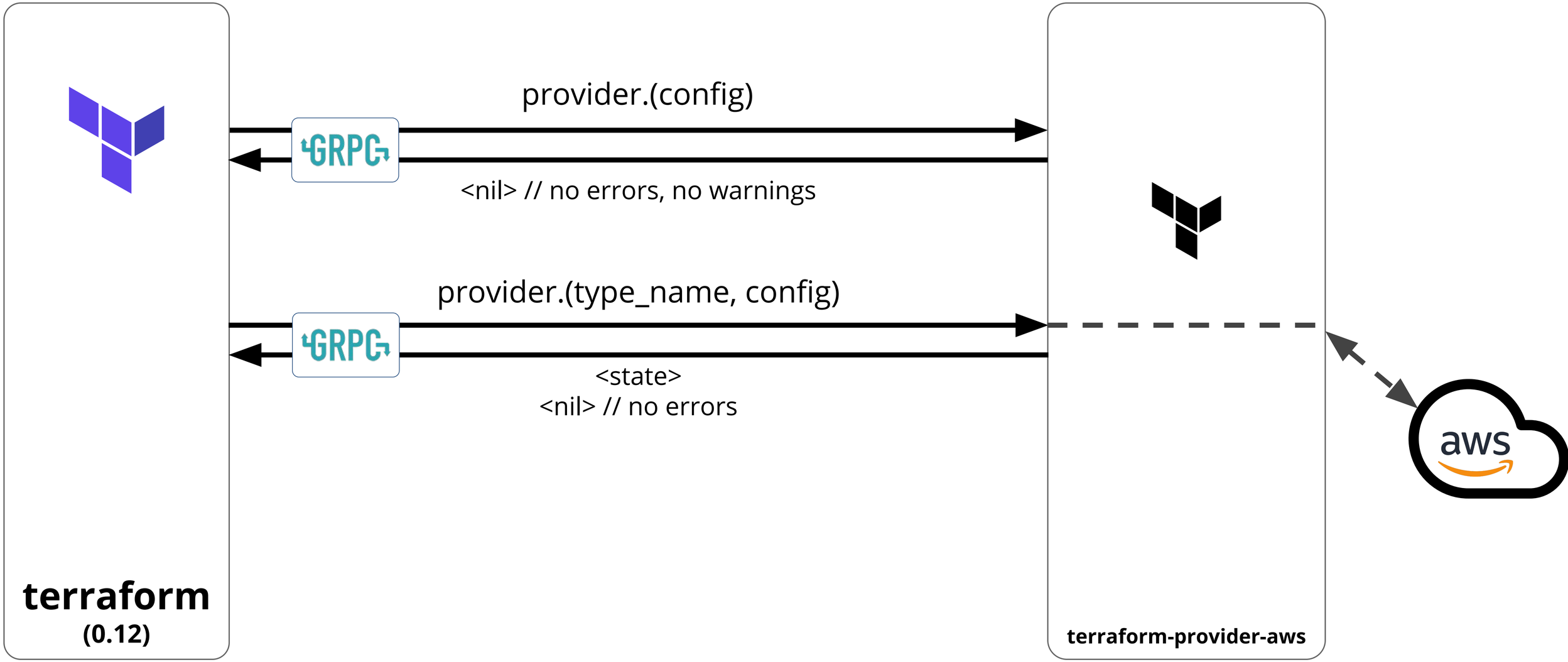
Plugin Communication 0.12 (provider)



Plugin Communication 0.12 (data source)



Plugin Communication 0.12 (resource)



Configuration Language

core: Change string list representation so we can distinguish empty, single element lists #2504

Merged **phinze** merged 4 commits into `master` from `f-string-list` on 26 Jun 2015

Conversation 14 | Commits 4 | Checks 0 | Files changed 9

phinze commented on 26 Jun 2015 — Member

This encapsulates and enhances the internal representation of lists within terraform's core.

To work around limitations of the current architecture, lists need to be "flattened" into a string as they're passed around the config interpolation.

Given a list `["foo", "bar", "baz"]`, the previous format for these strings was: `foo(special delimiter)bar(special delimiter)baz`.

This format made it impossible to distinguish between:

- `["foo"]` and `"foo"`
- `[]` and `""`
- `[""]` and `""`

Reviewers

No reviews

Assignees

No one—ass

Labels

None yet

Projects

None yet

Milestone

config: Add map() interpolation function #7832

Merged **phinze** merged 1 commit into `master` from `f-map-func` on 27 Jul 2016

Conversation 4 | Commits 1 | Checks 0 | Files changed 3

phinze commented on 27 Jul 2016 — Member

- `map(key, value, ...)` - Returns a map consisting of the key/value pairs specified as arguments. Every odd argument must be a string key, and every even argument must have the same type as the other values specified. Examples:
  - `map("hello", "world")`
  - `map("us-east", list("a", "b", "c"), "us-west", list("b", "c", "d"))`

1

core: allow non-computed data source values in "count" #11482

Merged **mitchellh** merged 5 commits into `master` from `f-computed-count` on 30 Jan 2017

Conversation 12 | Commits 5 | Checks 0 | Files changed 16

mitchellh commented on 28 Jan 2017 • edited ▾ Member

Based on #10418, but simpler due to new graphs (more LOC change due to tests).

This disables the computed value check for `count` during the validation pass. This enables partial support for #3888 or #1497: as long as the value is non-computed during the plan, complex values will work in counts.

Notably, this allows data source values to be present in counts!

The "count" value can be disabled during validation safely because we can treat it as if any field that uses `count.index` is computed for validation. We then validate a single instance (as if `count = 1`) just to make sure all required fields are set.

Revie
jb
Assig
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Label
core
enha
Proje
None

Behind the Scenes

Relevant Projects

➔ HCL1 & HIL (~ before 0.12)

➔ HCL2 & cty (~ 0.12+)

HCL1 & HIL

HashiCorp {Config, Interpolation} Language

➔ HCL for configuration, not interpolation

➔ Complex types (maps, lists, sets) stored as strings

➔ HIL as separate language for string interpolation


CODE EDITOR
provider "aws" {
version = ">=2.0.0"
region = "us-west-2"
}
data "aws_ami" "ubuntu" {
filter {
name = "name"
values = ["ubuntu/.../ubuntu-trusty-14.04-amd64-server-*"]
}
# …
owners = ["099720109477"] # Canonical
}
resource "aws_instance" "example" {
ami = "${data.aws_ami.ubuntu.id}"
instance_type = "t2.micro"
}

CODE EDITOR

```
provider "aws" {
  version = ">=2.0.0"
  region  = "us-west-2"
}

data "aws_ami" "ubuntu" {
  filter {
    name   = "name"
    values = ["ubuntu/.../ubuntu-trusty-14.04-amd64-server-*"]
  }
  # …
  owners = ["099720109477"] # Canonical
}

resource "aws_instance" "example" {
  ami           = "????????????????????????"
  instance_type = "t2.micro"
}
```

CODE EDITOR

```
provider "aws" {
  version = ">=2.0.0"
  region  = "us-west-2"
}

data "aws_ami" "ubuntu" {
  filter {
    name   = "name"
    values = ["ubuntu/.../ubuntu-trusty-14.04-amd64-server-*"]
  }
  # …
  owners = ["099720109477"] # Canonical
}

resource "aws_instance" "example" {
  ami           = "${data.aws_ami.ubuntu.id}"
  instance_type = "t2.micro"
}
```

HCL2 & cty

➔ HCL2

- ◆ Interpolation as part of the language

➔ **cty** to deal with types and operations on types

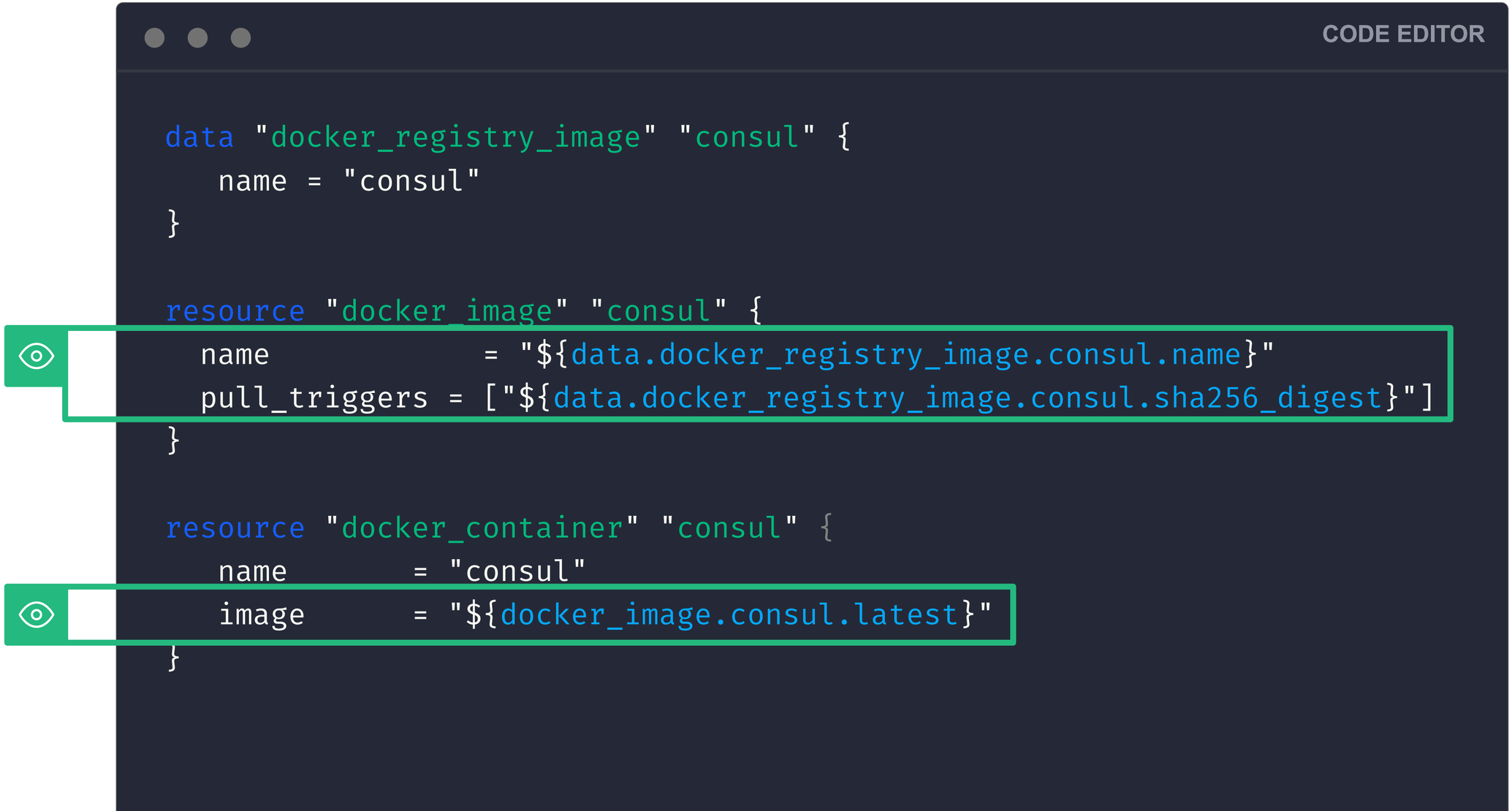
- ◆ no more string weirdness

0.12
First-Class Expressions

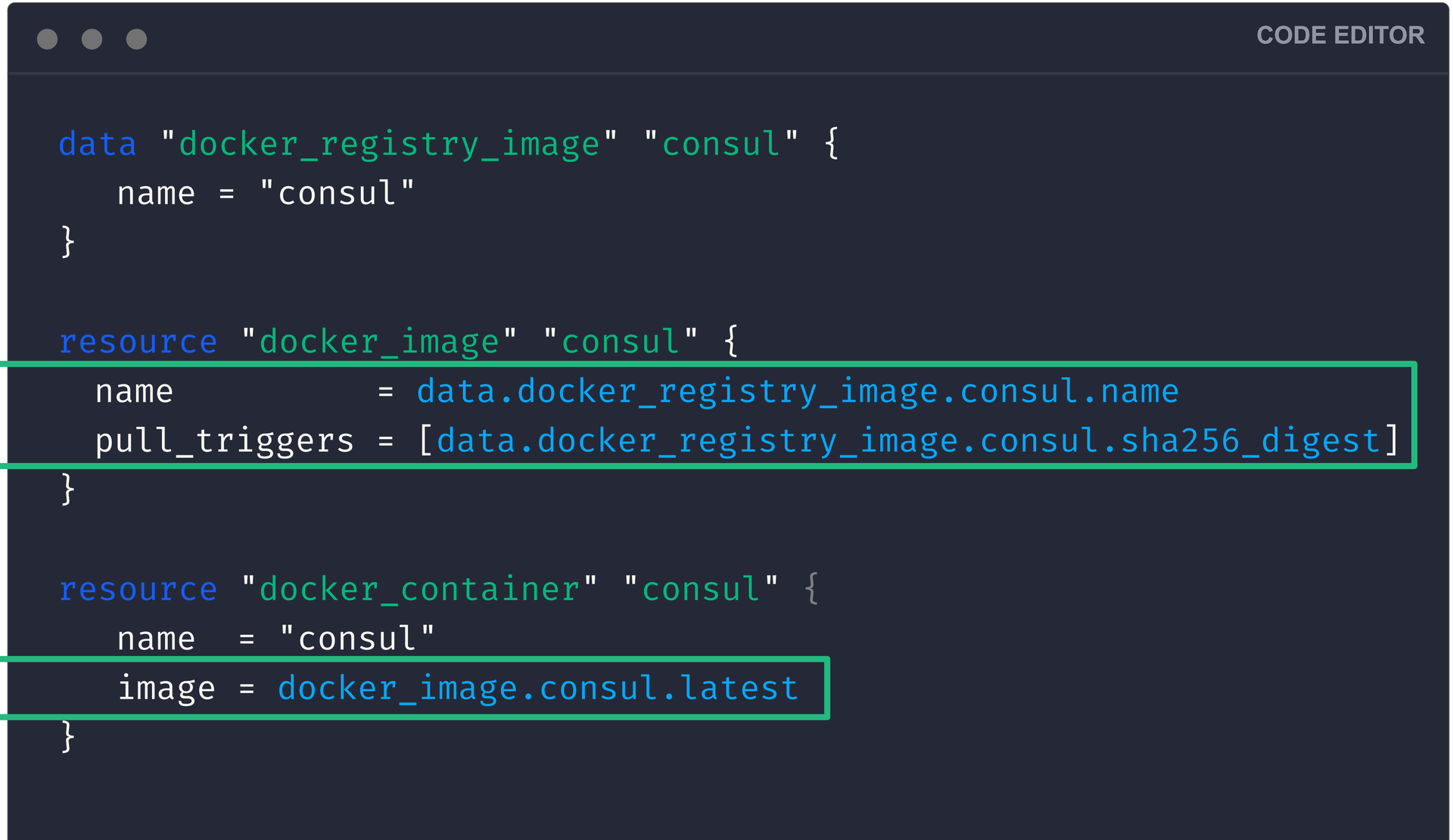
0.12: First-Class Expressions

- ➔ Expressions are native to HCL2
  - ◆ Functions and variables can be used outside of string interpolation (`"${}"`)
- ➔ Lists and maps can be used directly
  - ◆ Less `"${list("")}"`, more `[]`
  - ◆ Less `"${map("key", "val")}"`

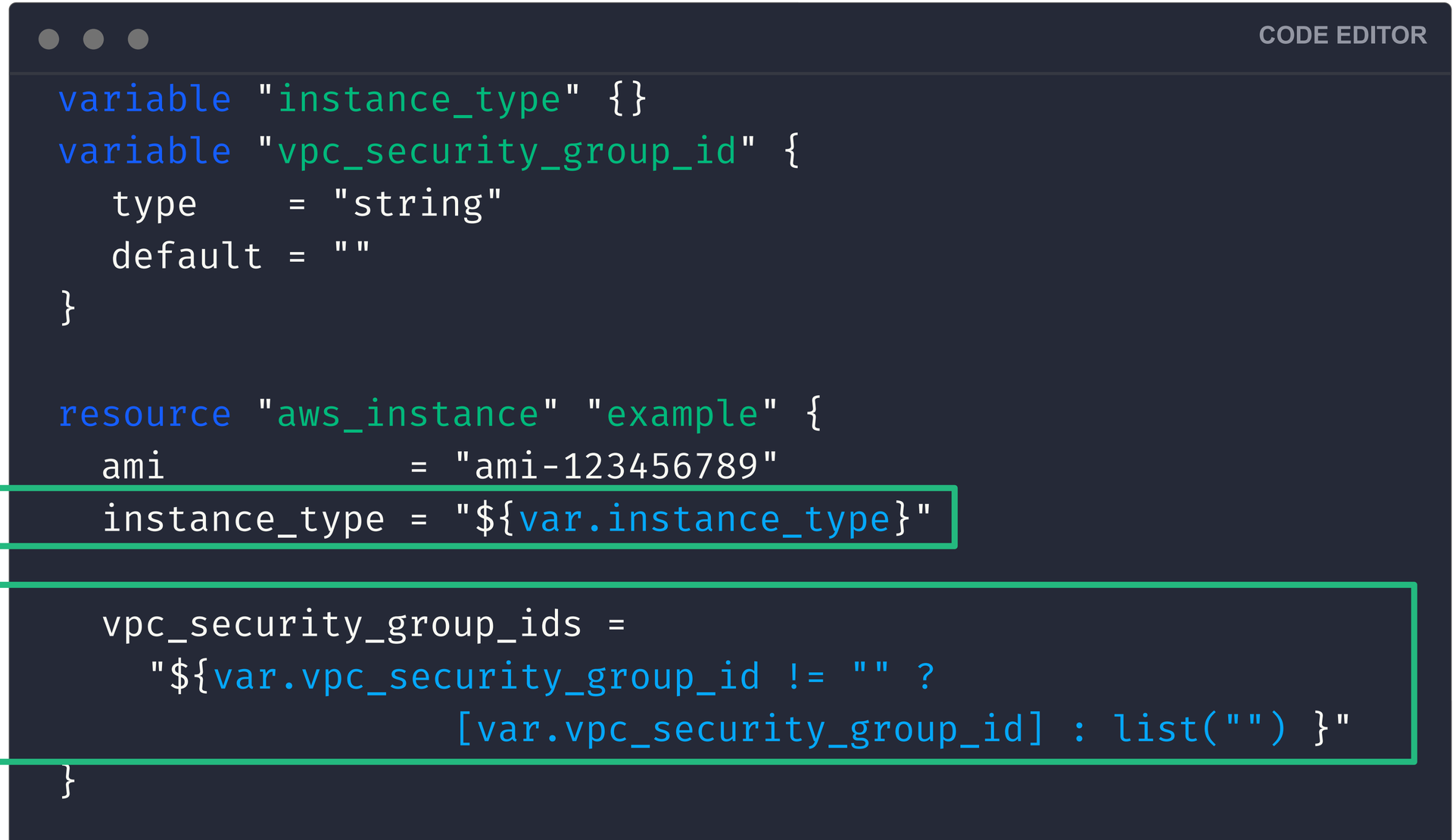
Terraform 0.11



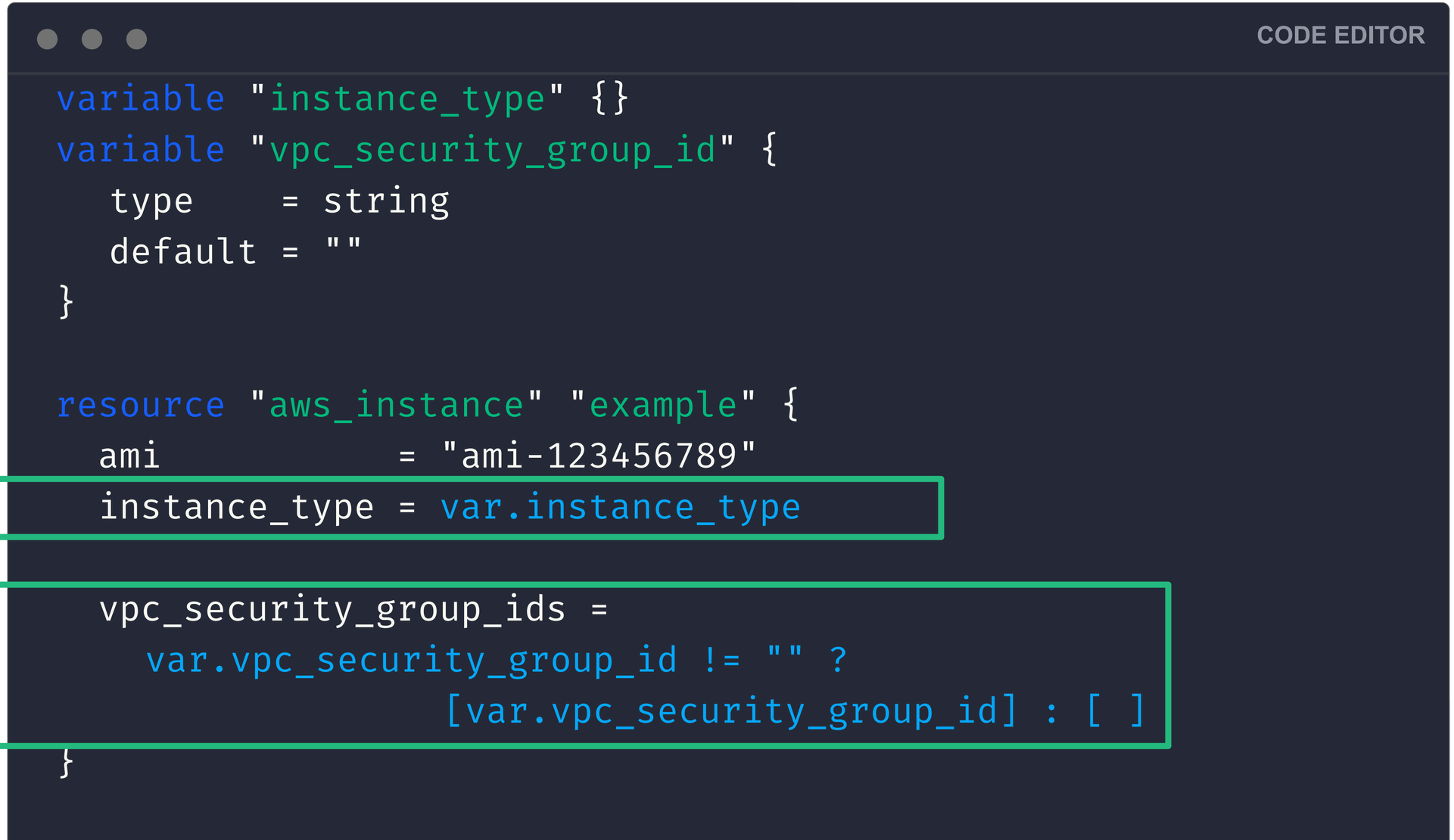
Terraform 0.12



Terraform 0.11



Terraform 0.12

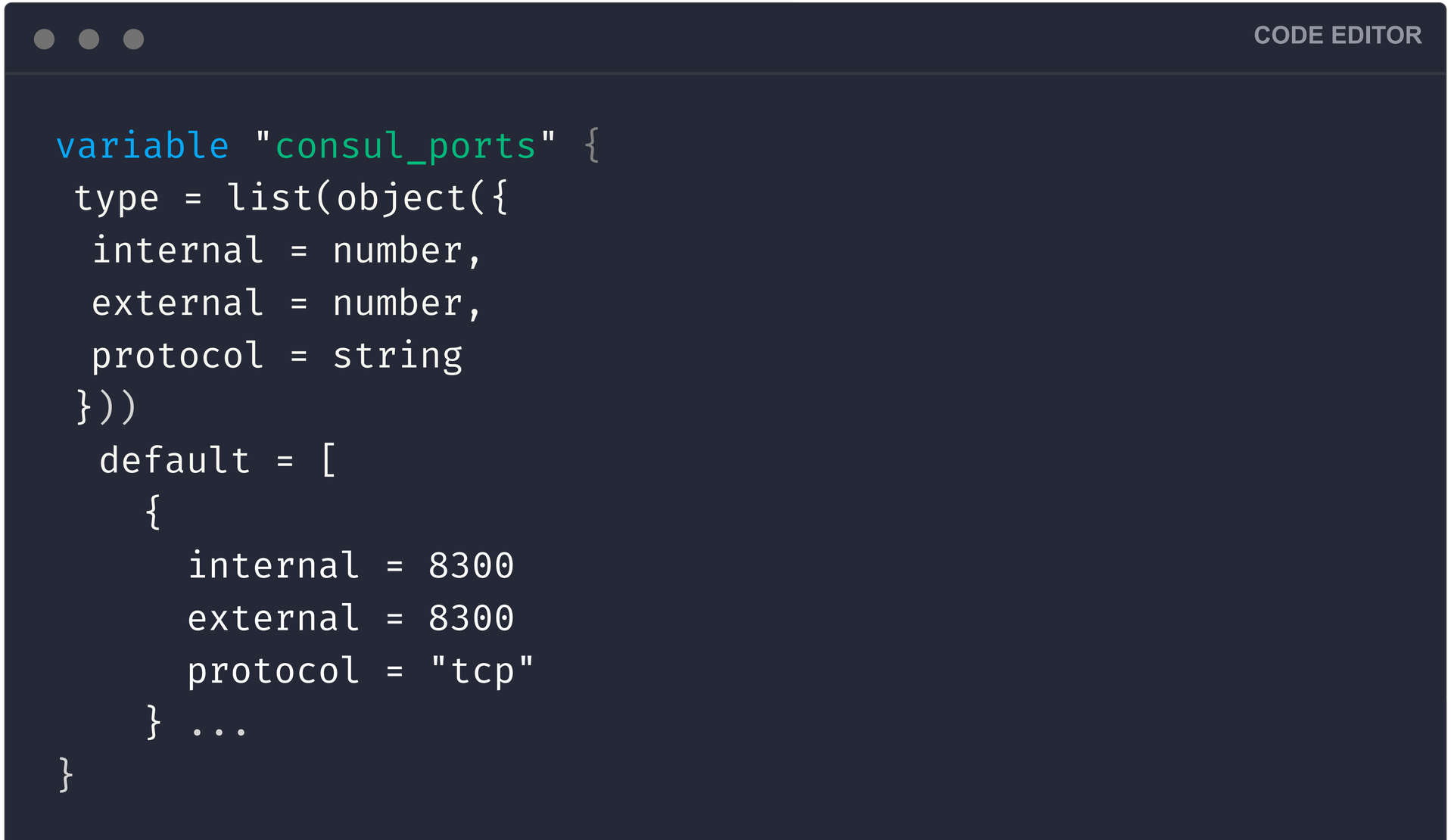


0.12
Rich Value Types

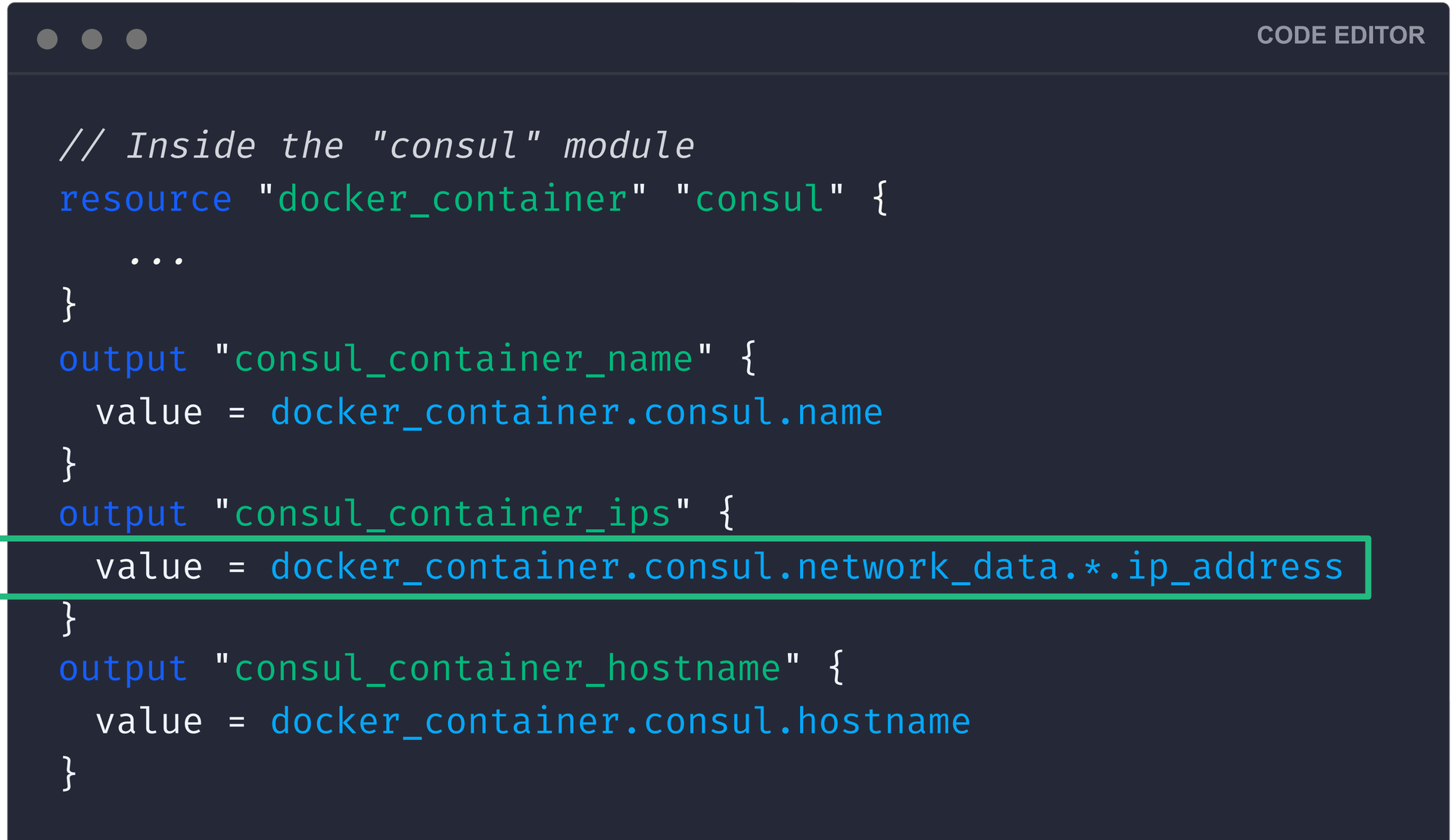
0.12: Rich Value Types

- ➔ Complex Values
  - ◆ **Complex objects** can be passed to child **modules** as **inputs**, and returned to parent **modules** as **outputs**.
- ➔ **Resources** and **Modules** can be used as **Values**
  - ◆ Entire resources and modules can be used as object values within configuration, including returning them as outputs and passing them as input variables.

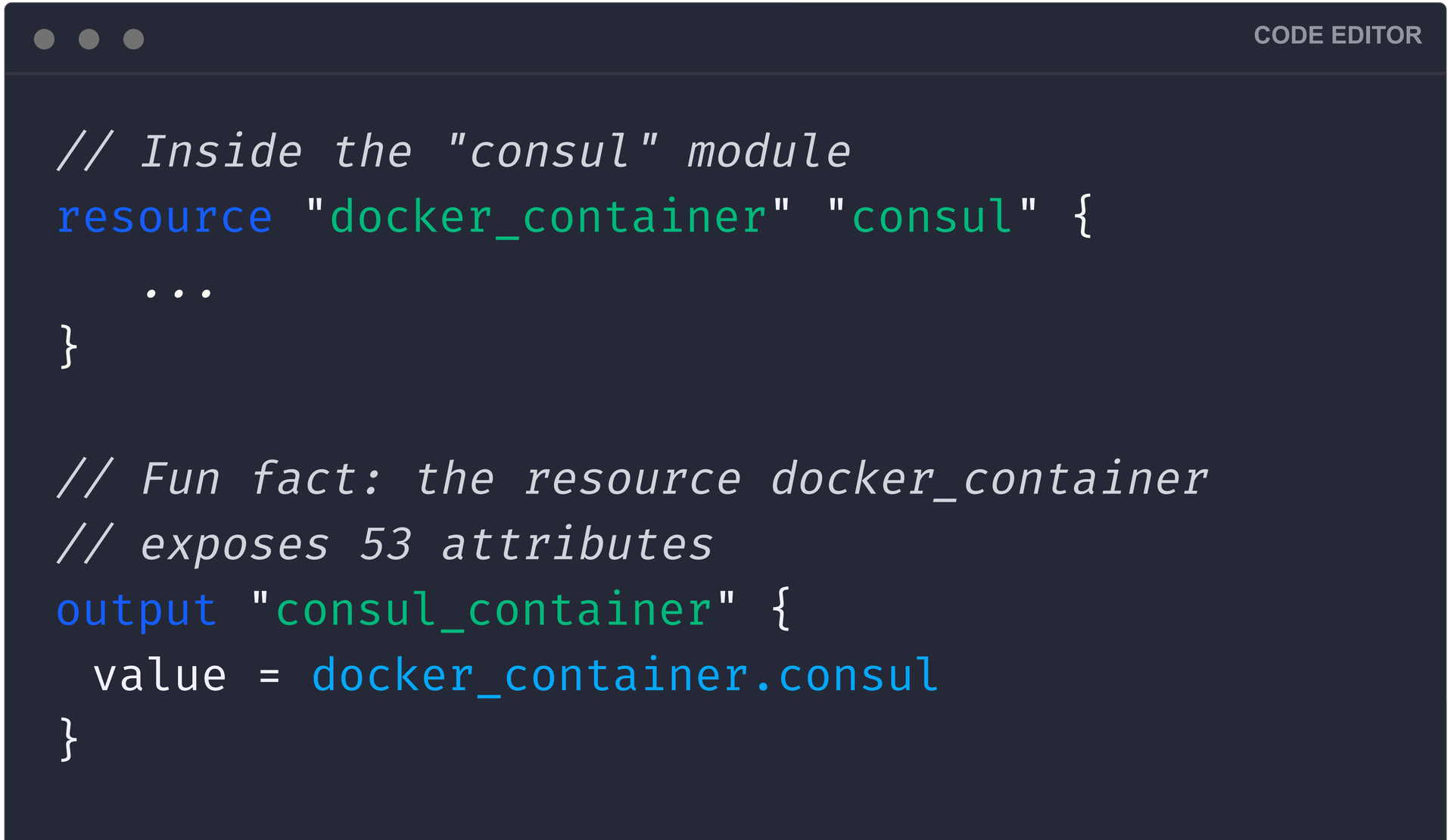
Terraform 0.12



Terraform 0.12

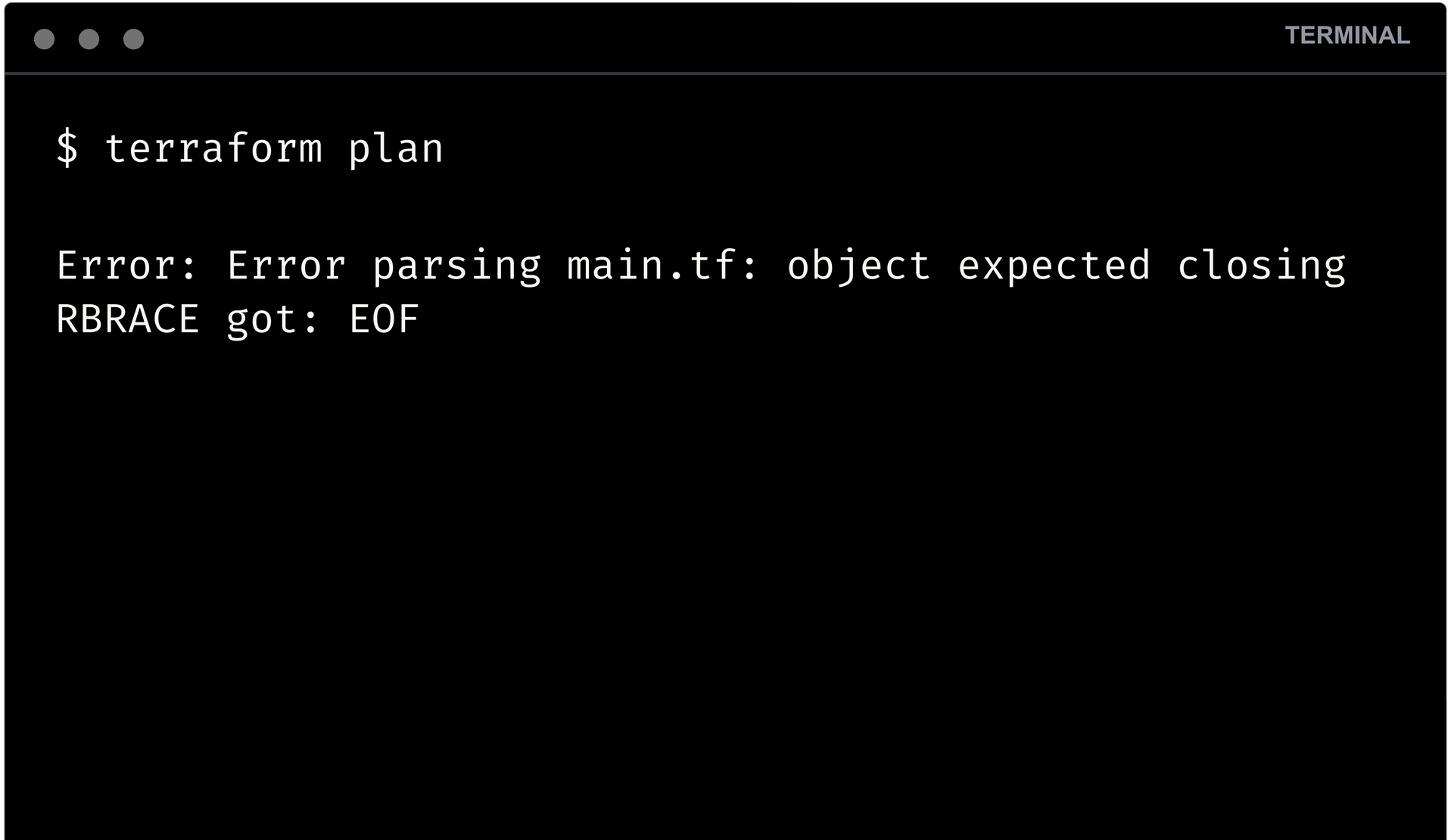


Terraform 0.12

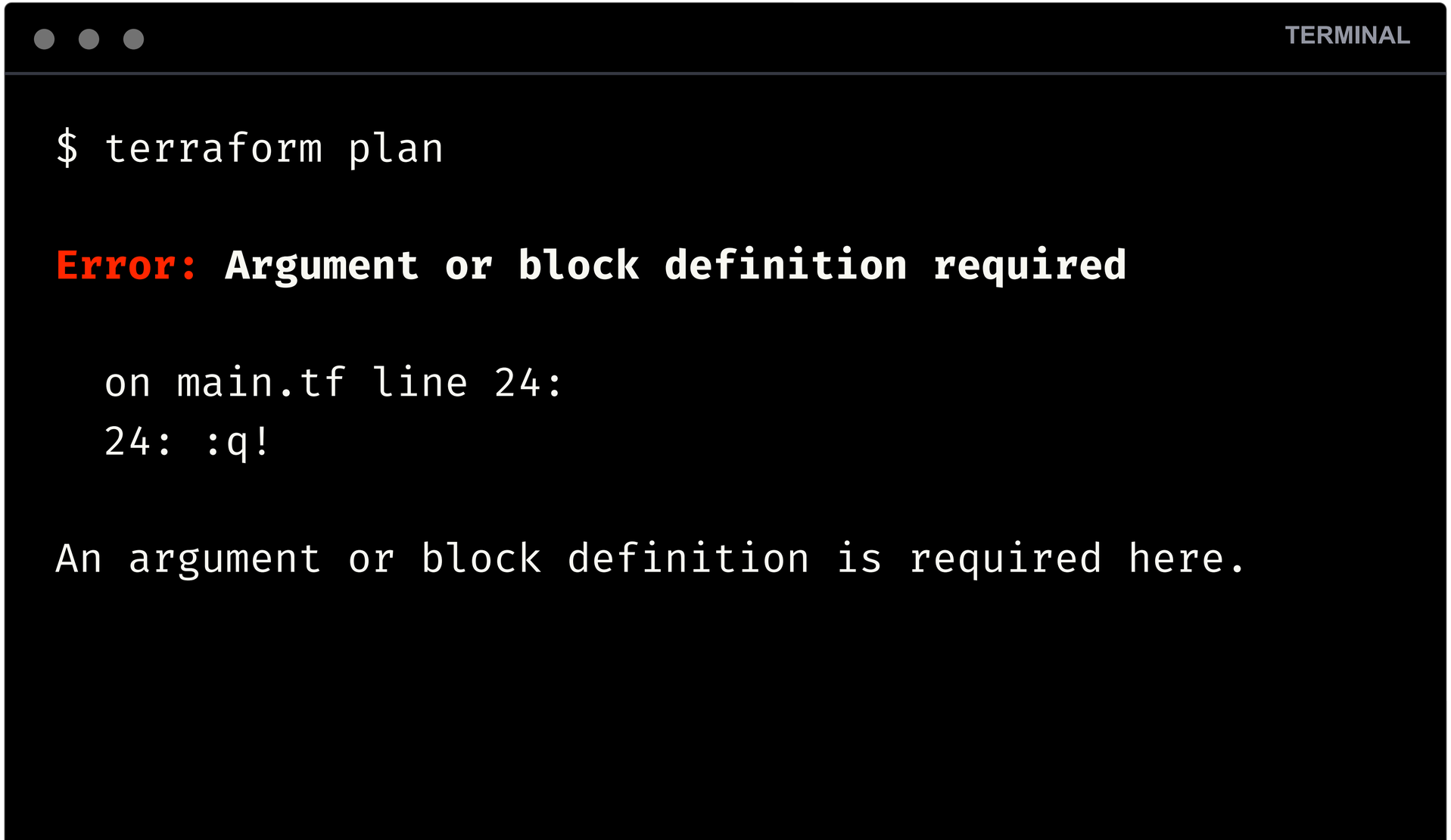


0.12
Improved Error Messages

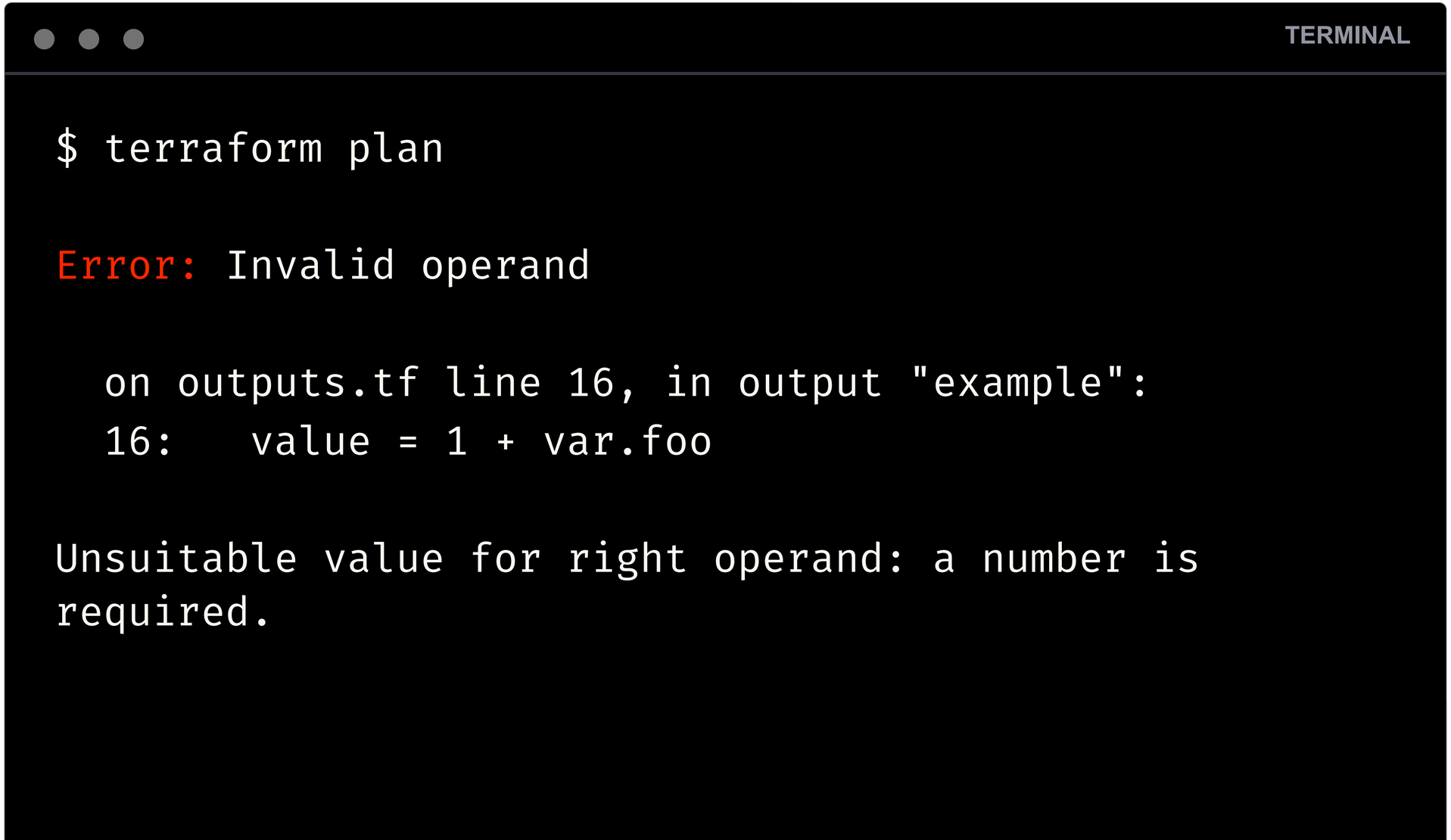
Terraform 0.11



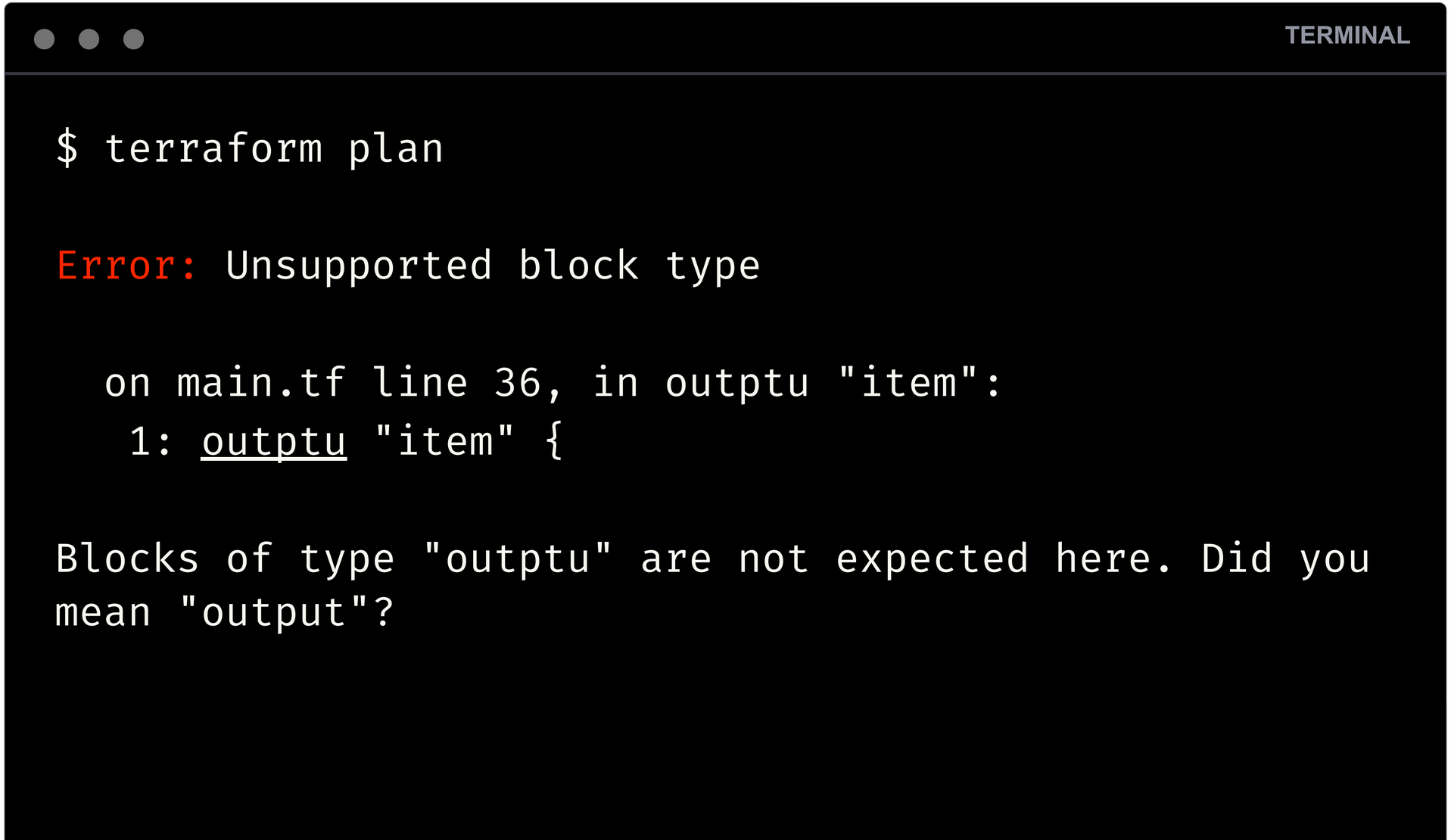
Terraform 0.12



Terraform 0.12



Terraform 0.12

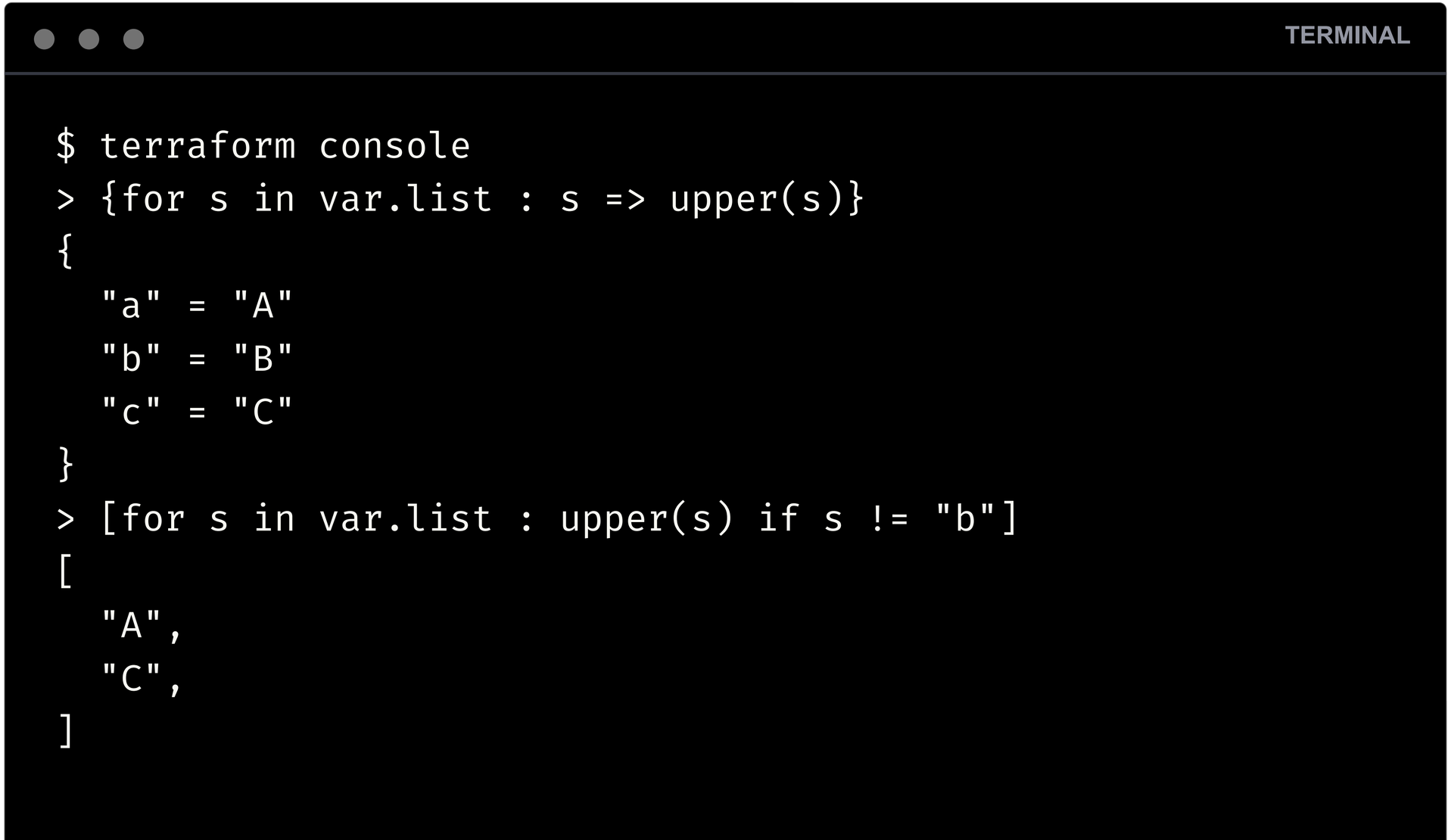


0.12
For Expressions

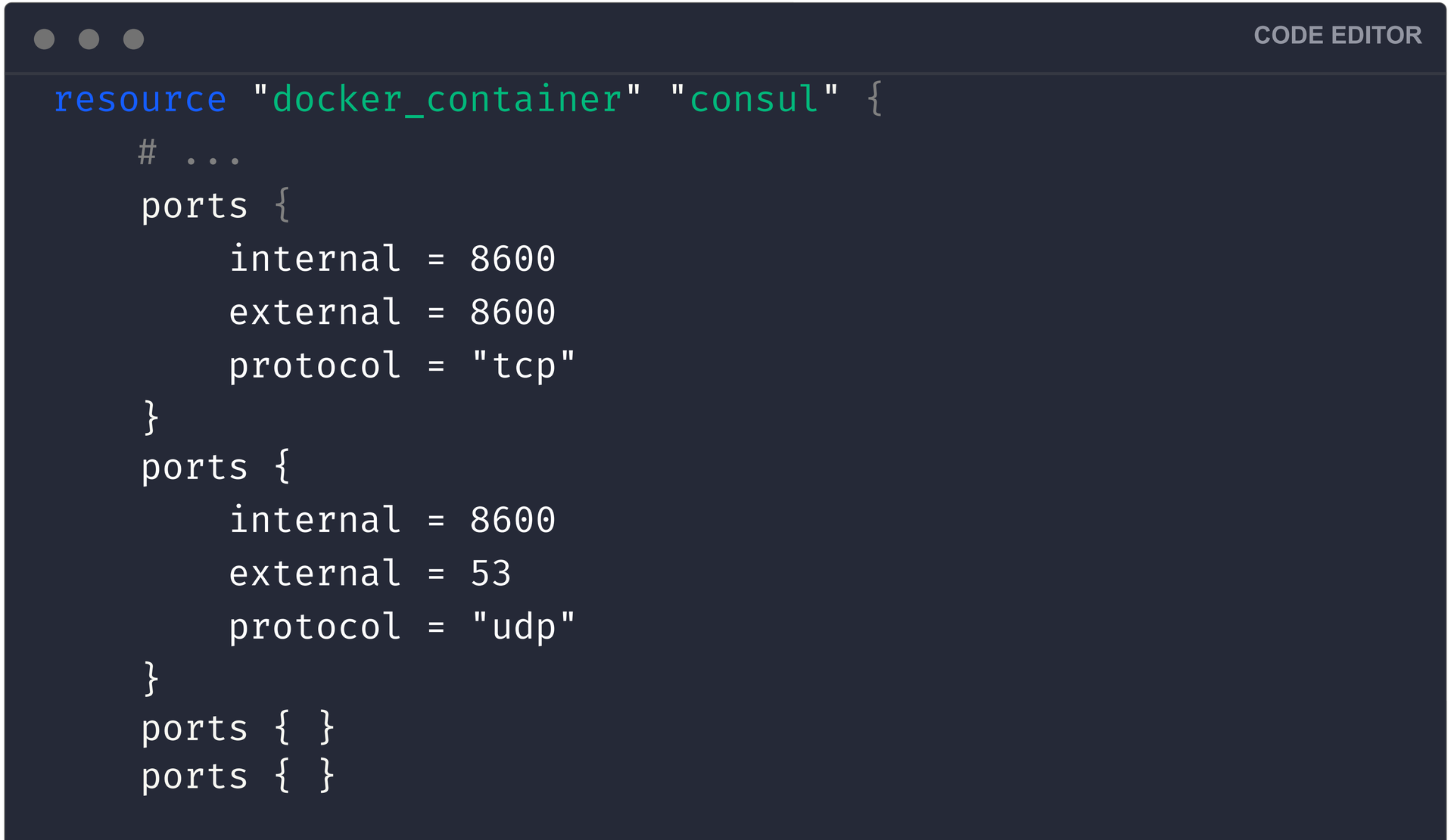
0.12: For Expressions

- ➔ `for`
  - ◆ Used for **list** and **map** transformation
- ➔ `for_each`
  - ◆ Iterate over **sets** or **maps**
- ➔ `dynamic`
  - ◆ Used with "**for_each**" to dynamically construct a collection of nested blocks

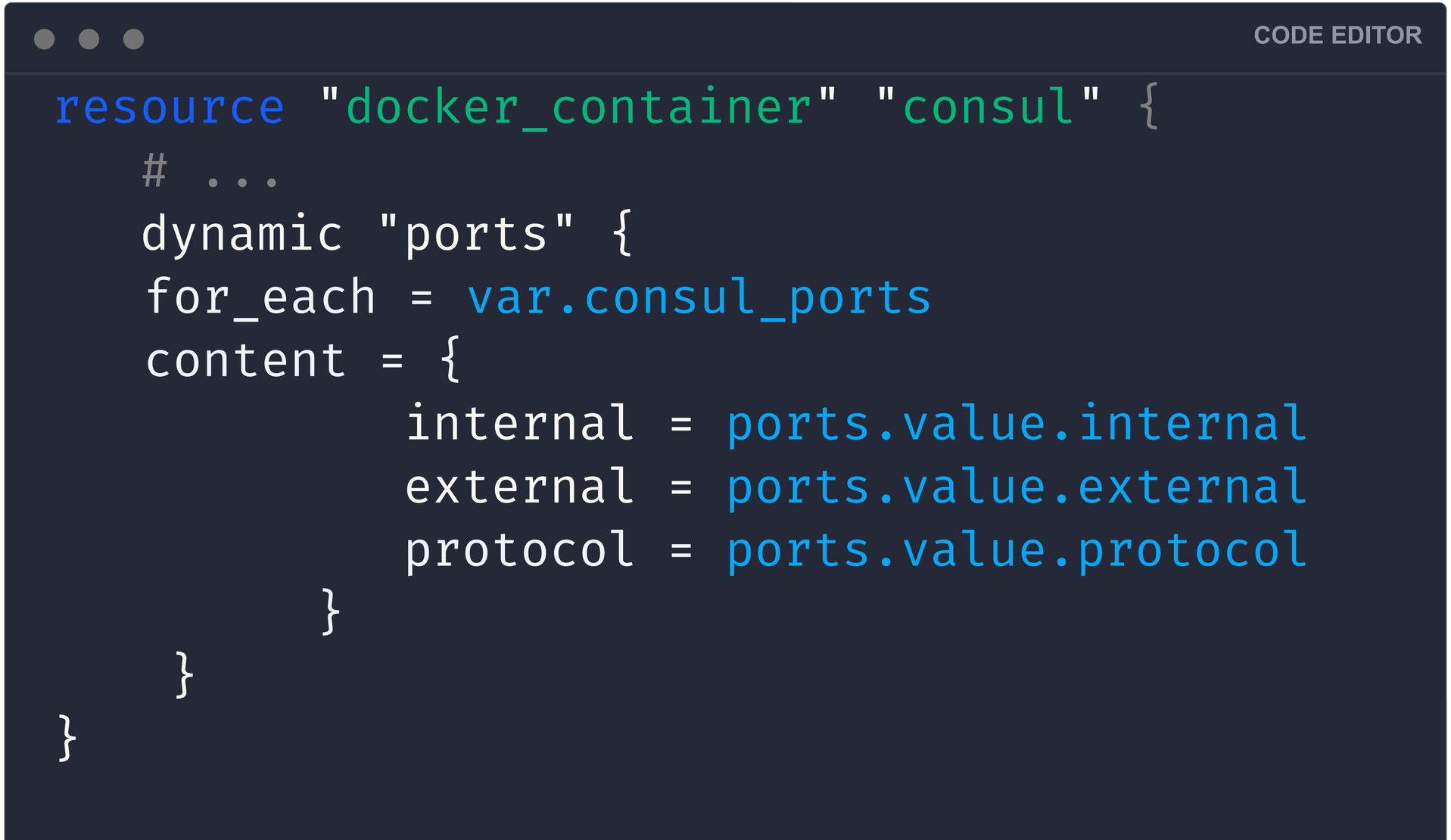
0.12: for expression



0.12: Nested Block



0.12: Dynamic Nested Block



Machine-Readable Output

Machine-readable output

1. `terraform show -json`
2. `terraform-config-inspect`
3. `terraform providers schema -json`

terraform show

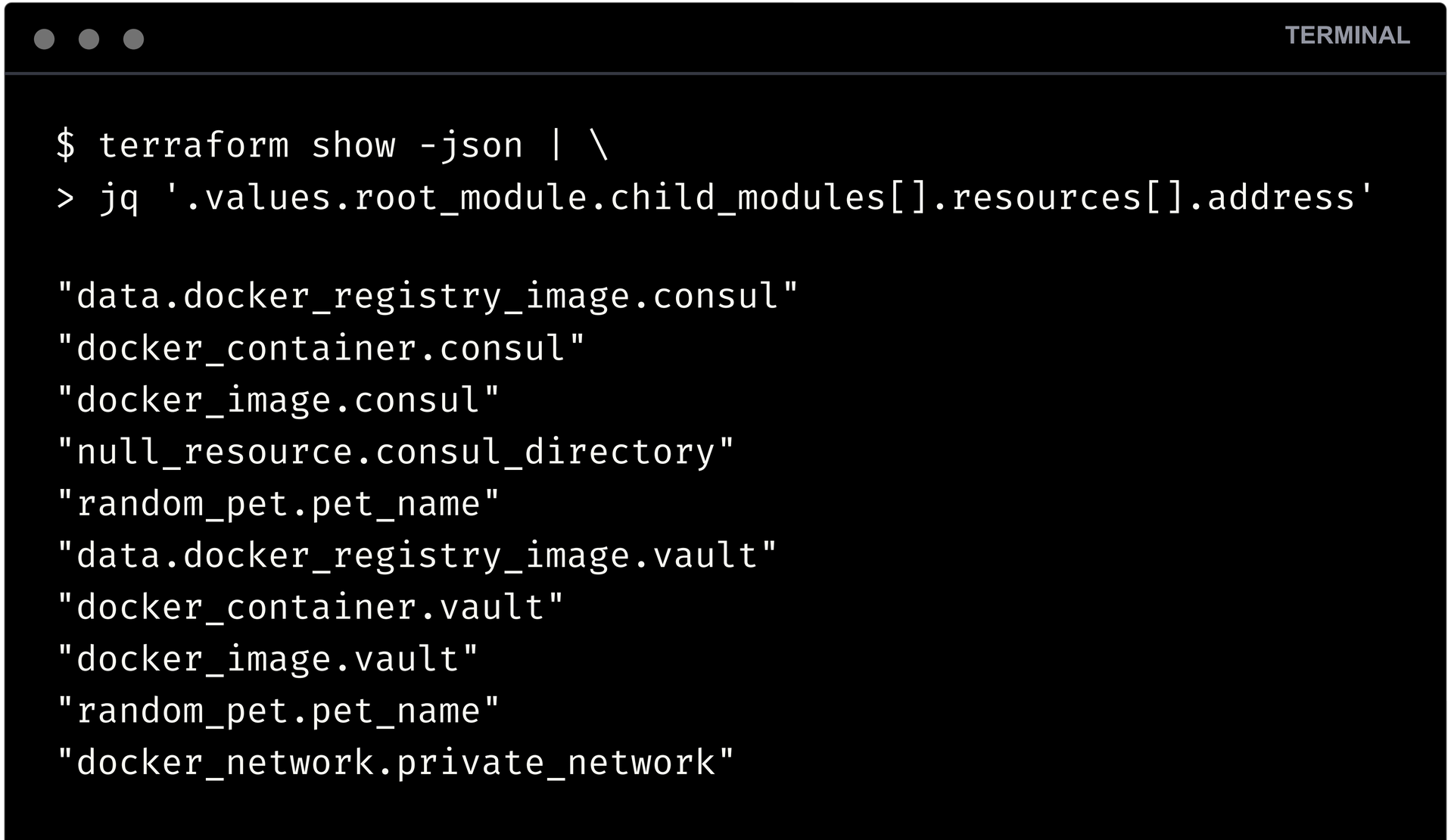
TERMINAL

```
$ terraform show

# module.consul_container.data.docker_registry_image.consul:
data "docker_registry_image" "consul" {
    id            = "sha256:e70c788854dd6e8ee0aa3d4c3a6a8c717ce74ed3c18b1665d983bf7e5fff5486"
    name          = "consul"
    sha256_digest = "sha256:e70c788854dd6e8ee0aa3d4c3a6a8c717ce74ed3c18b1665d983bf7e5fff5486"
}

# module.consul_container.docker_container.consul:
resource "docker_container" "consul" {
    attach           = false
    env              = [
        "CONSUL_HTTP_TOKEN=supersecure",
    ]
    gateway          = "172.23.0.1"
    hostname         = "consul"
    id               = "ce9a2197e65de5cf9174389f4209ac5e331f482e708a7edf71474aef747bf922"
    image            = "sha256:f136343b75e00664a7aa4c477a6d1e7b40a9708610fb6e483e884e0cce691599"
    ip_address       = "172.23.0.2"
    ip_prefix_length = 16
    log_driver       = "json-file"
    logs             = false
    must_run         = true
    name             = "consul-noted-pig"
    network_data     = [
        {
            gateway          = "172.23.0.1"
            ip_address       = "172.23.0.2"
            ip_prefix_length = 16
            network_name     = "ministack"
        },
```

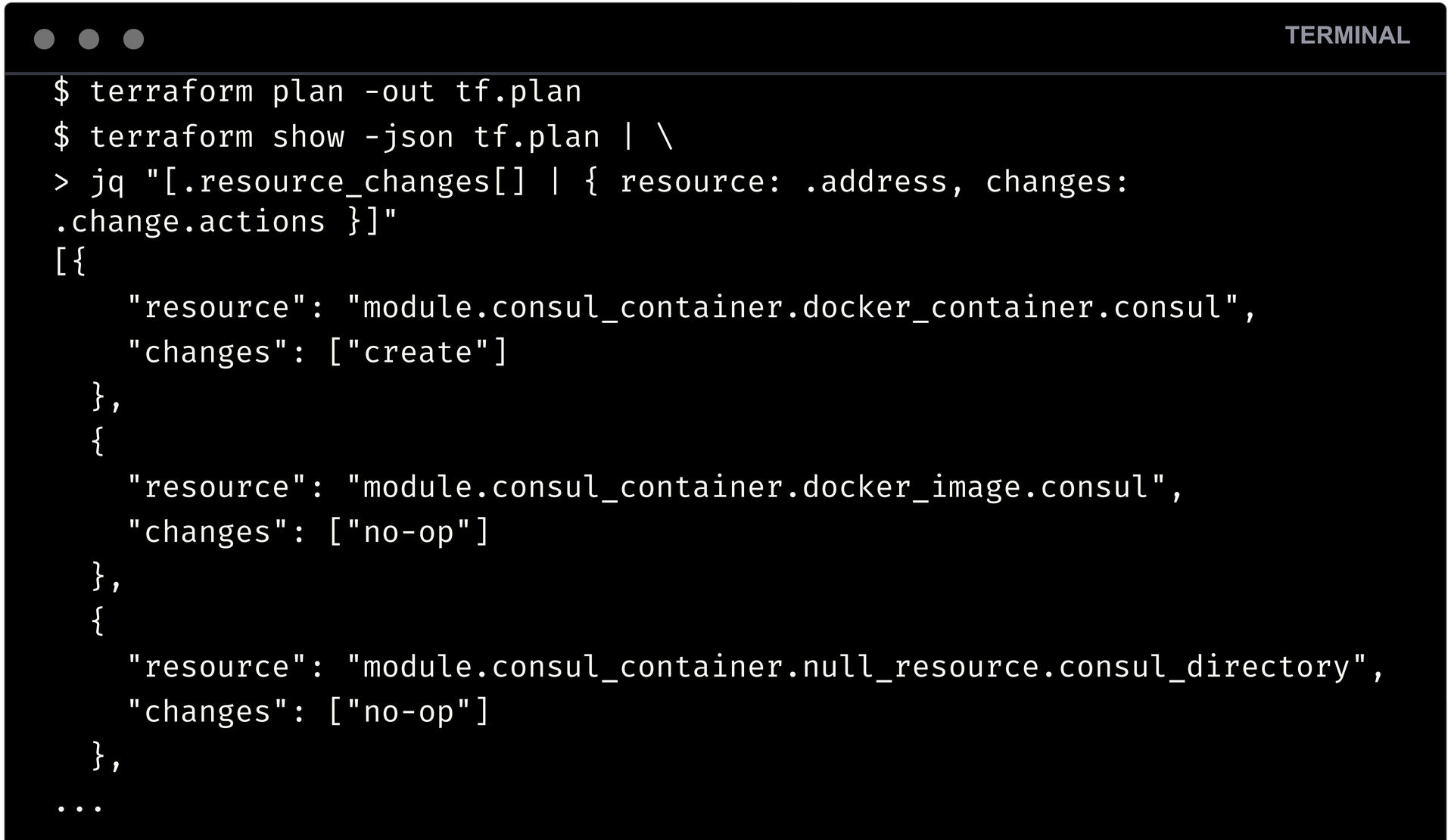
TERMINAL

```
$ terraform show -json | jq
{
  "format_version": "0.1",
  "terraform_version": "0.12.1",
  "values": {
    "root_module": {
      "child_modules": [
        {
          "resources": [
            {
              "address": "data.docker_registry_image.consul",
              "mode": "data",
              "type": "docker_registry_image",
              "name": "consul",
              "provider_name": "docker",
              "schema_version": 0,
              "values": {
                "id": "sha256:e70c788854dd6e8ee0aa3d4c3a6a8c717ce74ed3c18b1665d983bf7e5fff5486",
                "name": "consul",
                "sha256_digest":
"sha256:e70c788854dd6e8ee0aa3d4c3a6a8c717ce74ed3c18b1665d983bf7e5fff5486"
              }
            },
            {
              "address": "docker_container.consul",
              "mode": "managed",
              "type": "docker_container",
              "name": "consul",
              "provider_name": "docker",
              "schema_version": 1,
              "values": {
```

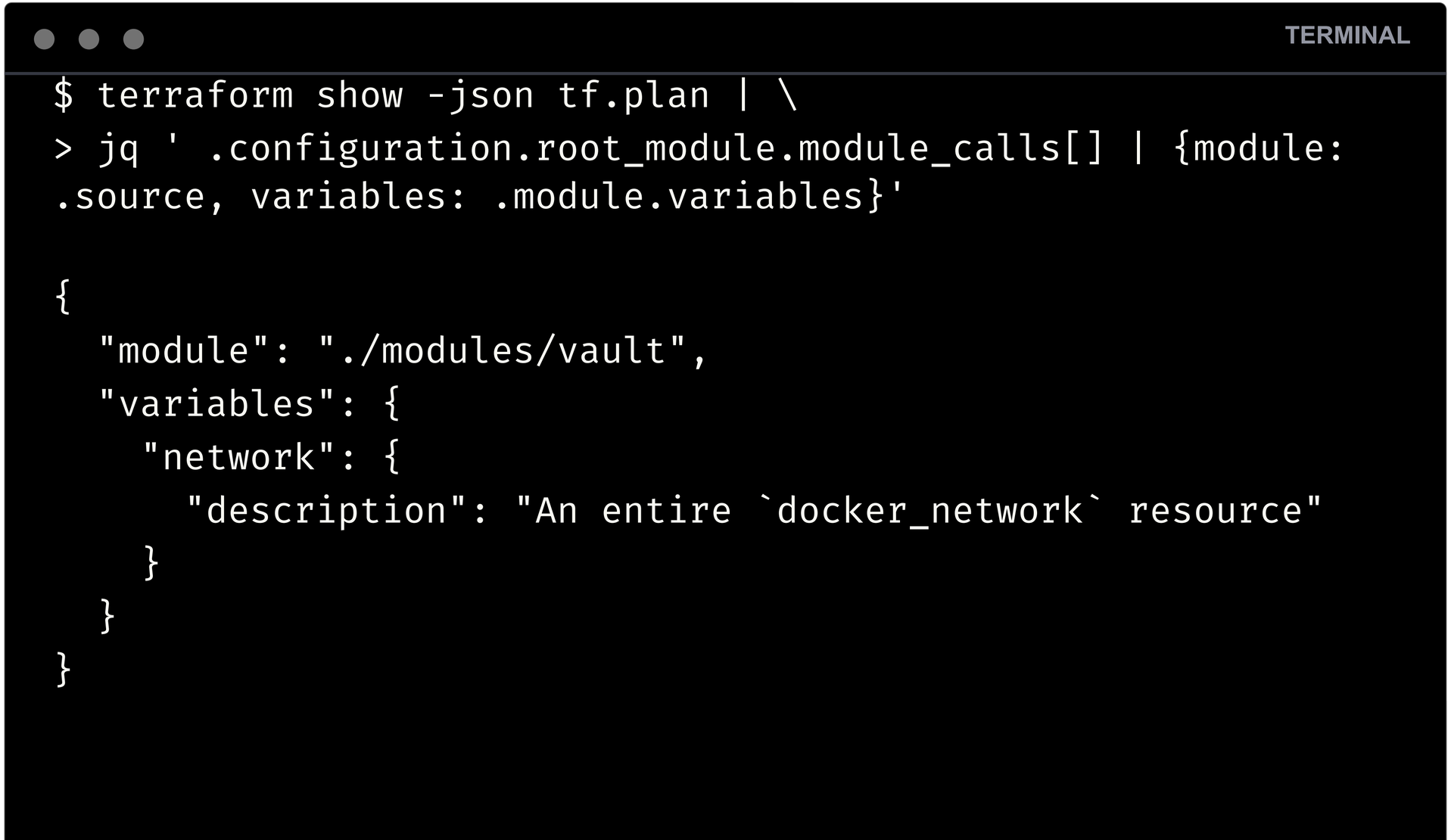
Machine-Readable Output: state



Machine-Readable Output: plan

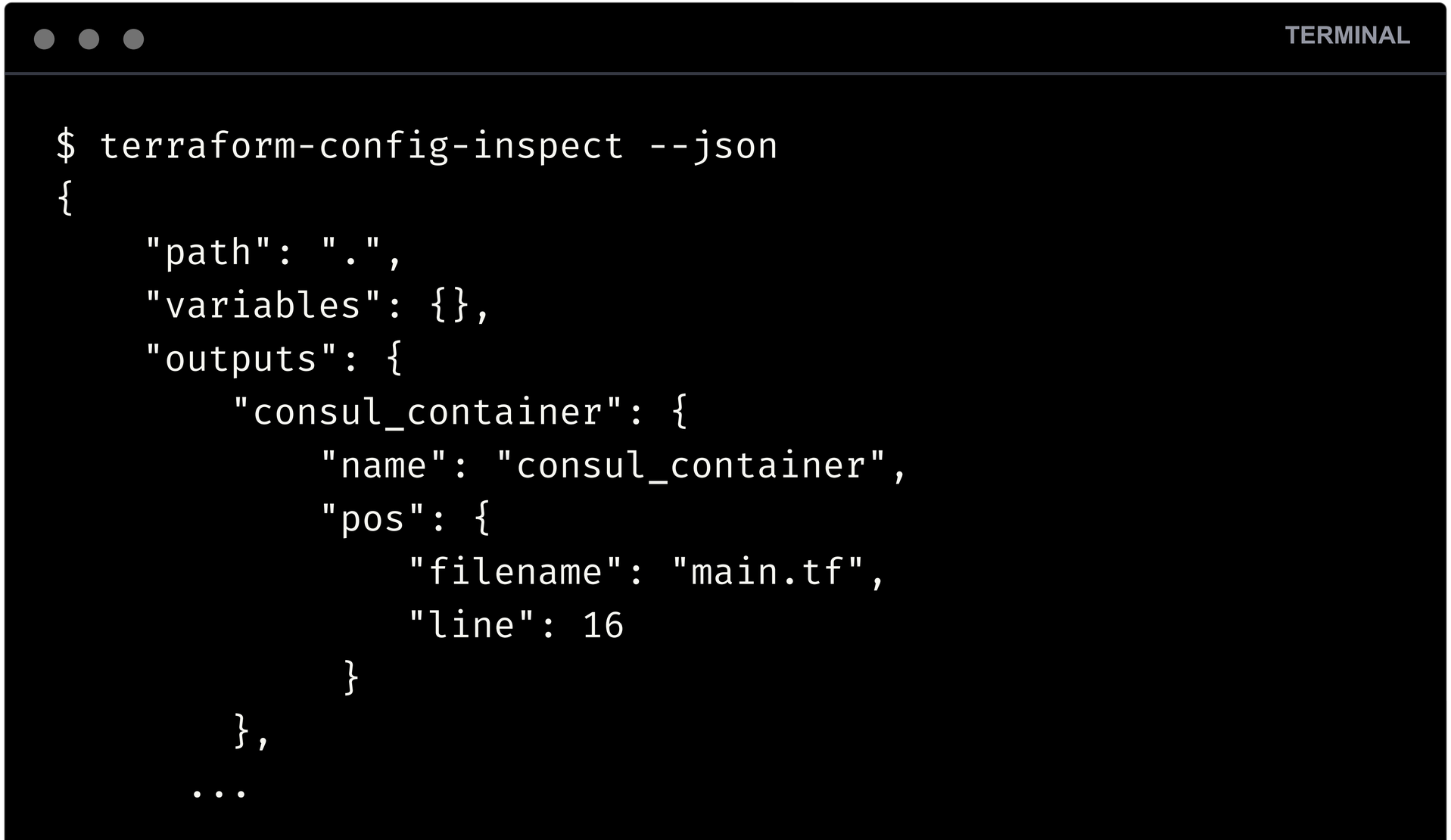


Machine-Readable Output: plan (config)



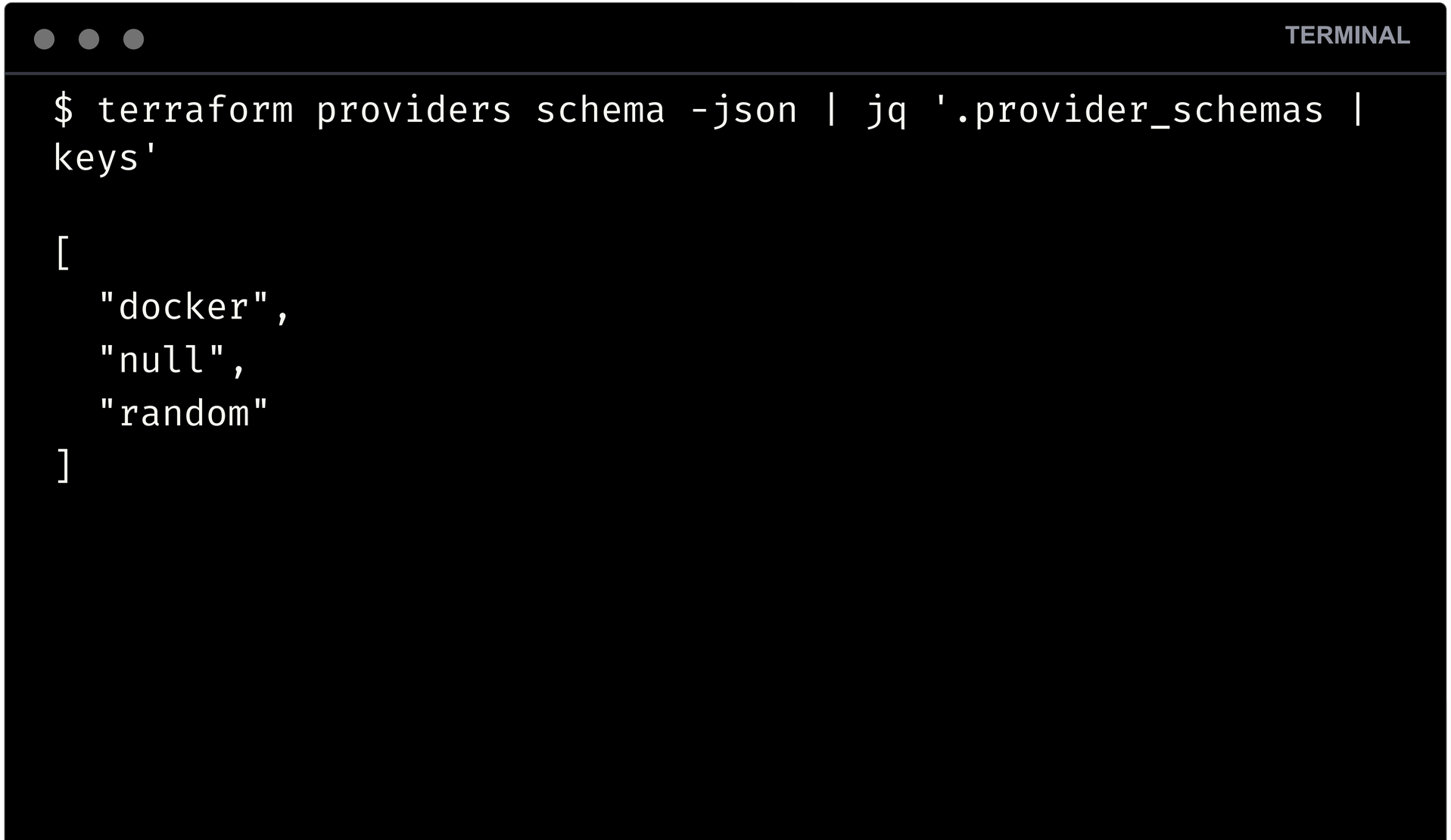
terraform-config-inspect

terraform-config-inspect



terraform providers schema

Machine-Readable Output: schemas

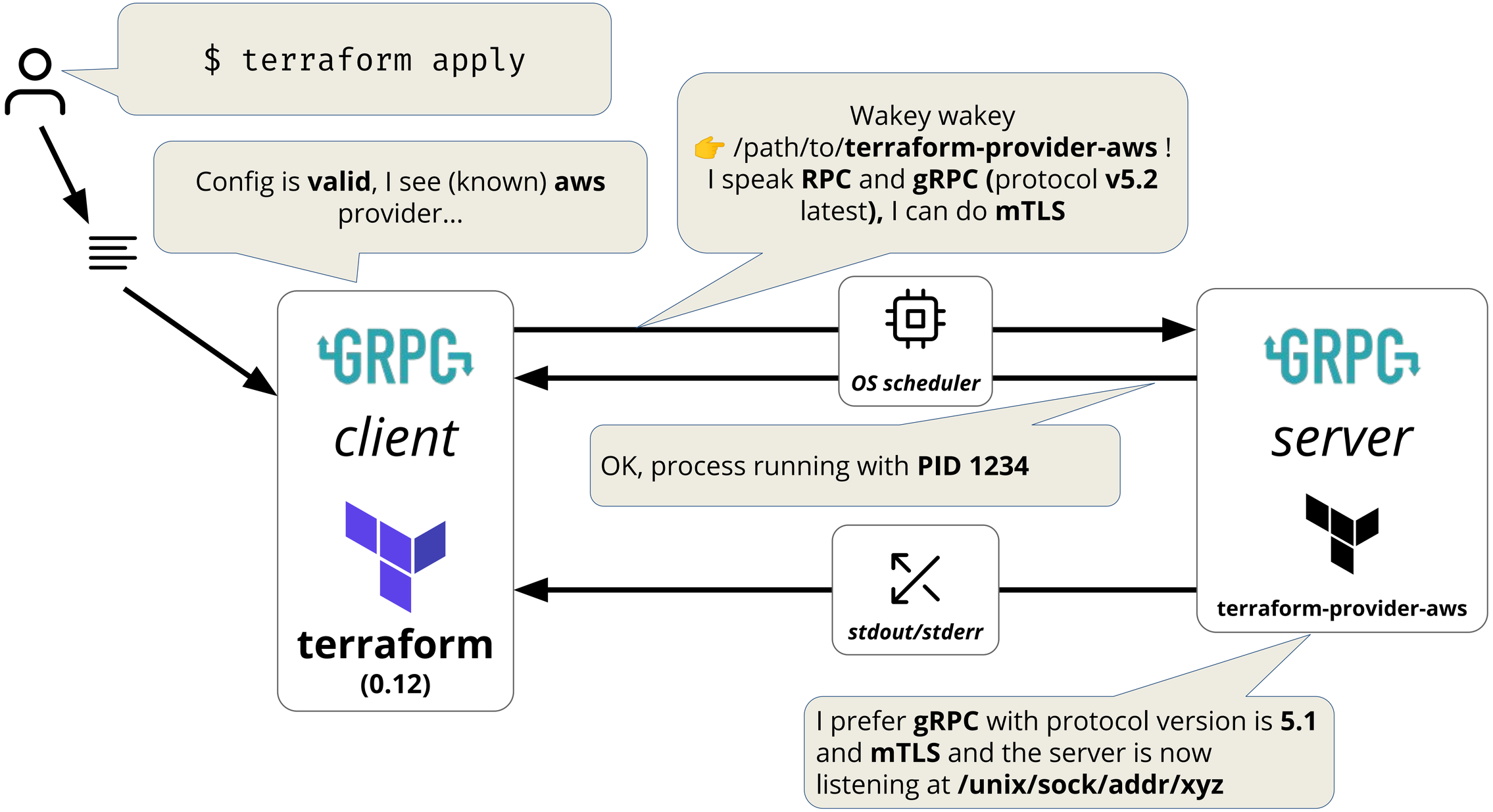


TERMINAL

```
terraform providers schema -json | jq \
> '.provider_schemas["docker"].resource_schemas["docker_container"].block | \
> .attributes, .block_types.attributes'
...
  "network_alias": {
    "type": [
      "set",
      "string"
    ],
    "description": "Set an alias for the container in all specified networks",
    "optional": true
  },
  "network_data": {
    "type": [
      "list",
      [
        "object",
        {
          "gateway": "string",
          "ip_address": "string",
          "ip_prefix_length": "number",
          "network_name": "string"
        }
      ]
    ],
```

Plugin SDK

Launching plugin (after discovery)



What is Plugin SDK?

➔ Hides implementation details, such as

- ◆ gRPC itself
- ◆ Protocol built on gRPC
- ◆ Low-level operations

➔ Allows providers to talk in high-level primitives

- ◆ Resource’s and data source’s schemas
- ◆ CRUD

SDK “<1.0.0”

Before it was called SDK

➔ Loosely coupled packages inside Terraform’s `/helper/...` namespace

➔ Versioned alongside Terraform core

➔ Made providers depend on Terraform core

➔ Allowed providers to be *“too creative”*

SDK 1.0.0

Released in September 2019

- ➔ More strictly separated namespace
  - ◆ Prevent import of non-SDK packages
- ➔ As compatible w/ `<1.0.0` as possible
- ➔ Migration tool available for convenience
- ➔ Versioned separately from core

SDK 1.0.0

➔ Dedicated **team**

- Radek Simko (me)
- Katy Moe
- Alex Pilon

➔ Dedicated GitHub **repository**

- `github.com/hashicorp/terraform-plugin-sdk`

Future: SDK

➔ Coming Soon:

- ◆ Deprecating 0.11 (protocol 4) support

➔ May come later:

- ◆ Provisioners
  - under providers
- ◆ Backends under providers

Thank You

@radeksimko

www.terraform.io
www.hashicorp.com

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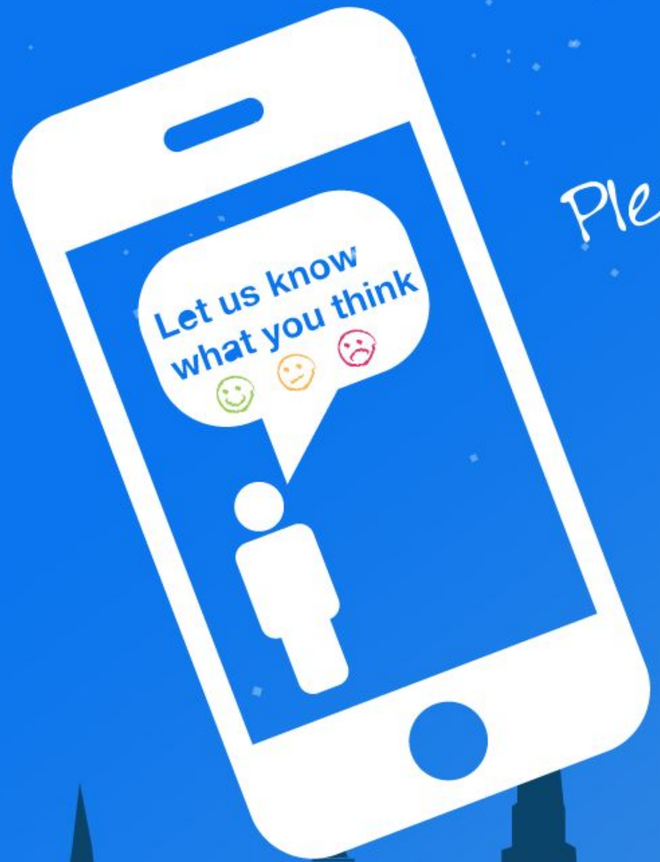

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