Brown Field Services and Interior Design

What color is your IP Address?

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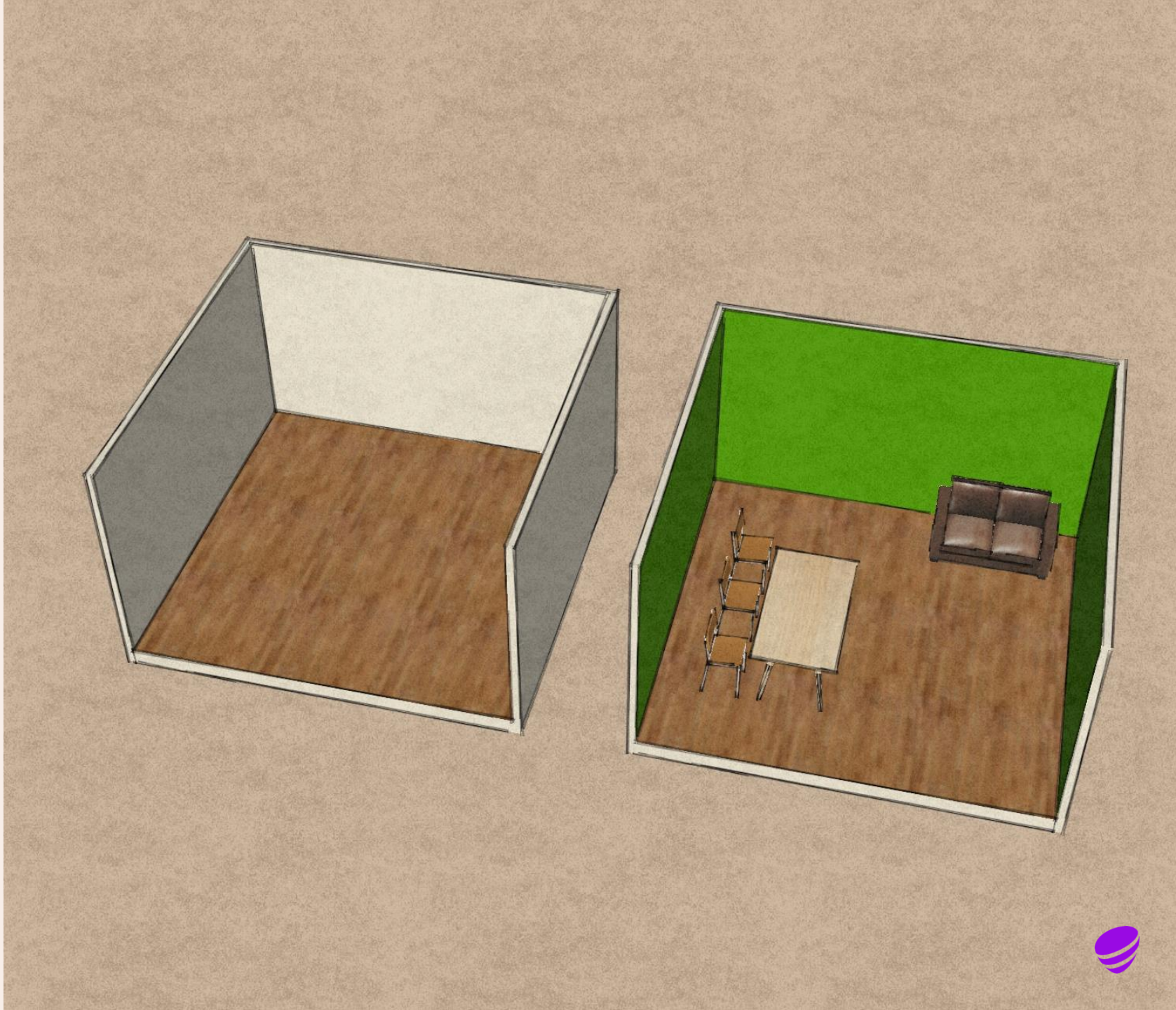
Disclaimer

Most challenges in this presentations are common to service providers.

A few are very specific to Cisco NSO's approaches.

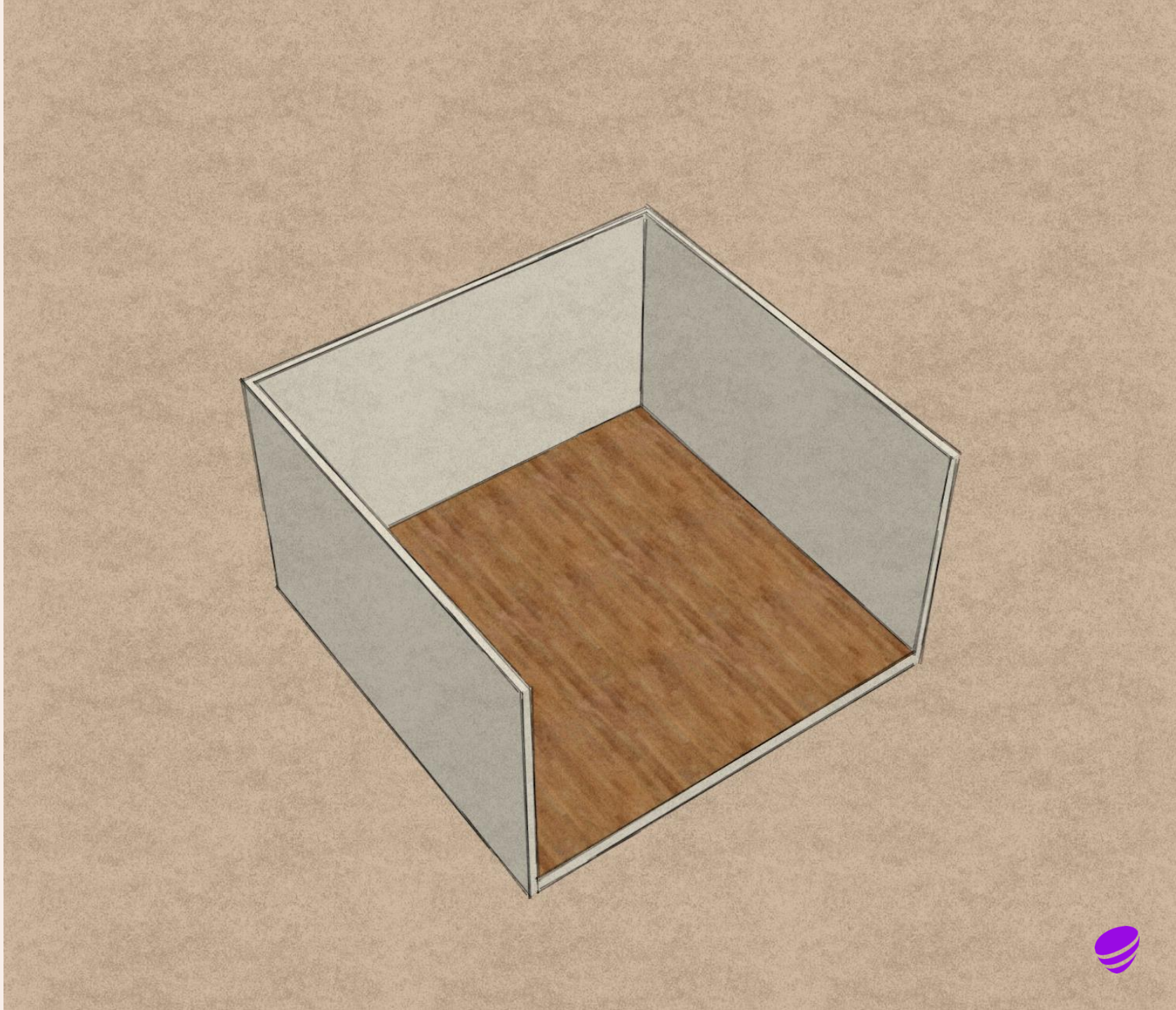
Everything should be useful generally.

Service automation and interior design



Greenfield

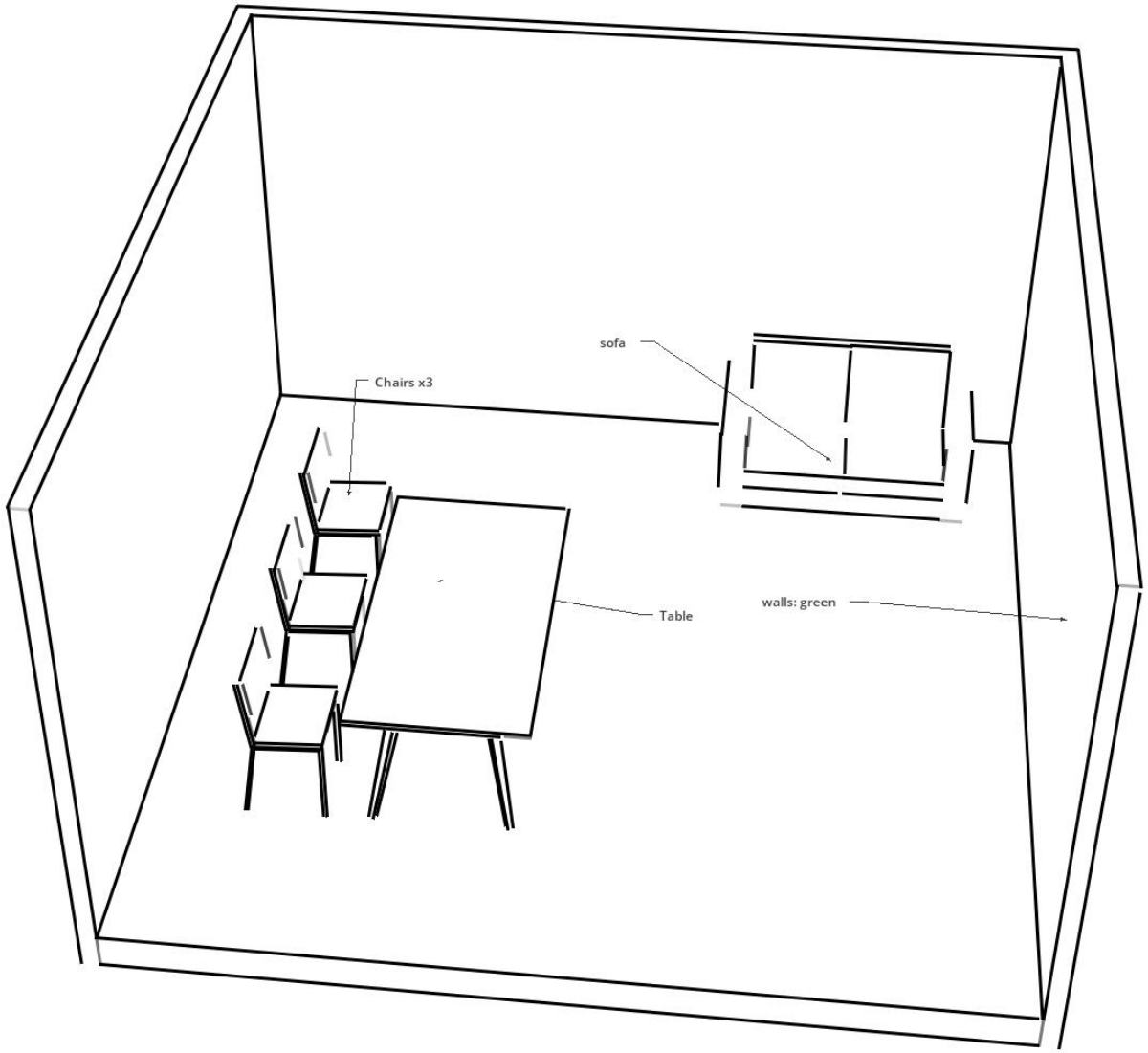
— In this scenario we start from a clean slate
— The walls in this room are unpainted, and no furniture exists



Service

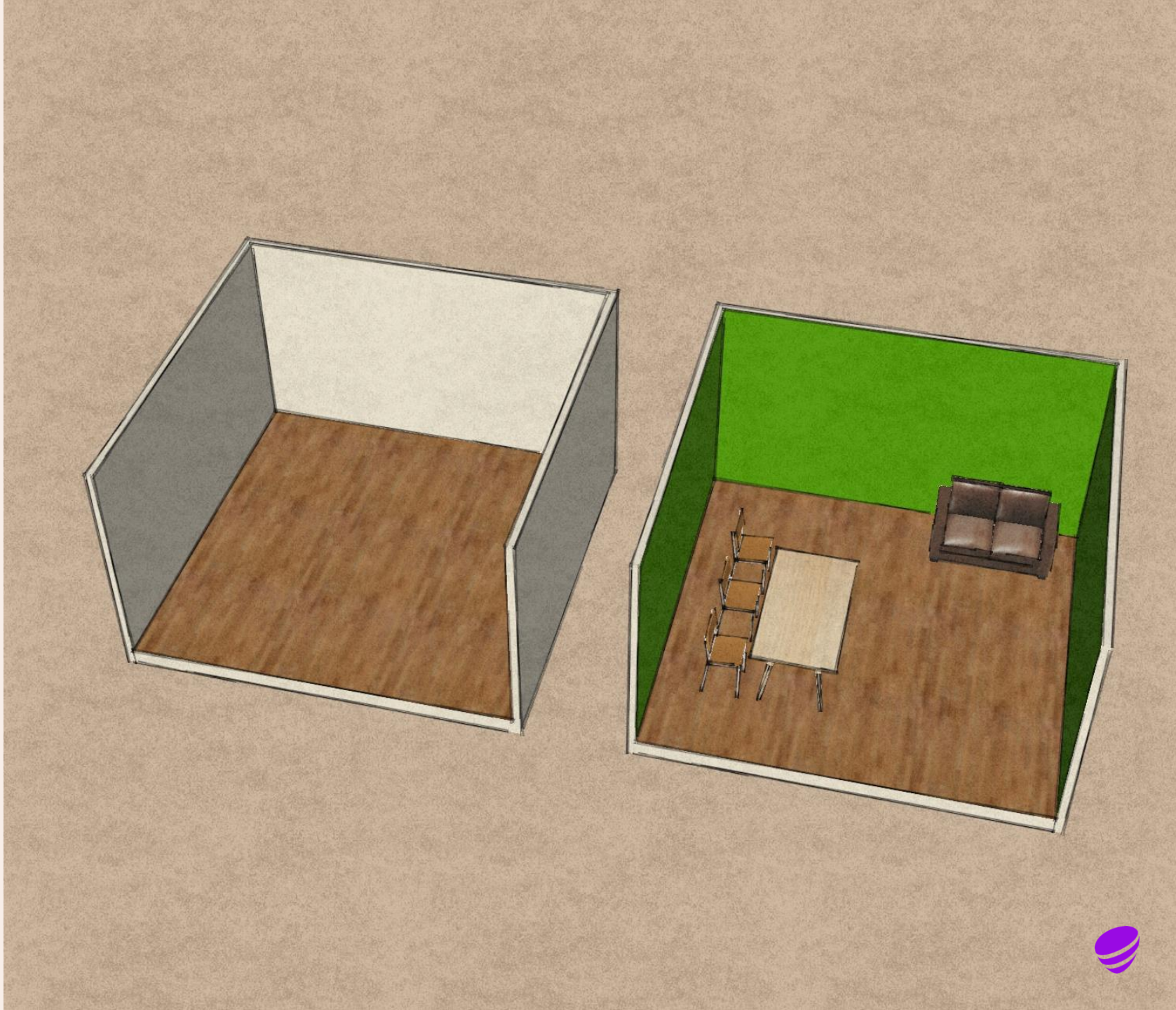
We then describe our desired state:

- Three chairs
- One table
- A sofa
- The walls should be green



What changed?

— When we’re done we can look at the steps we took to get there

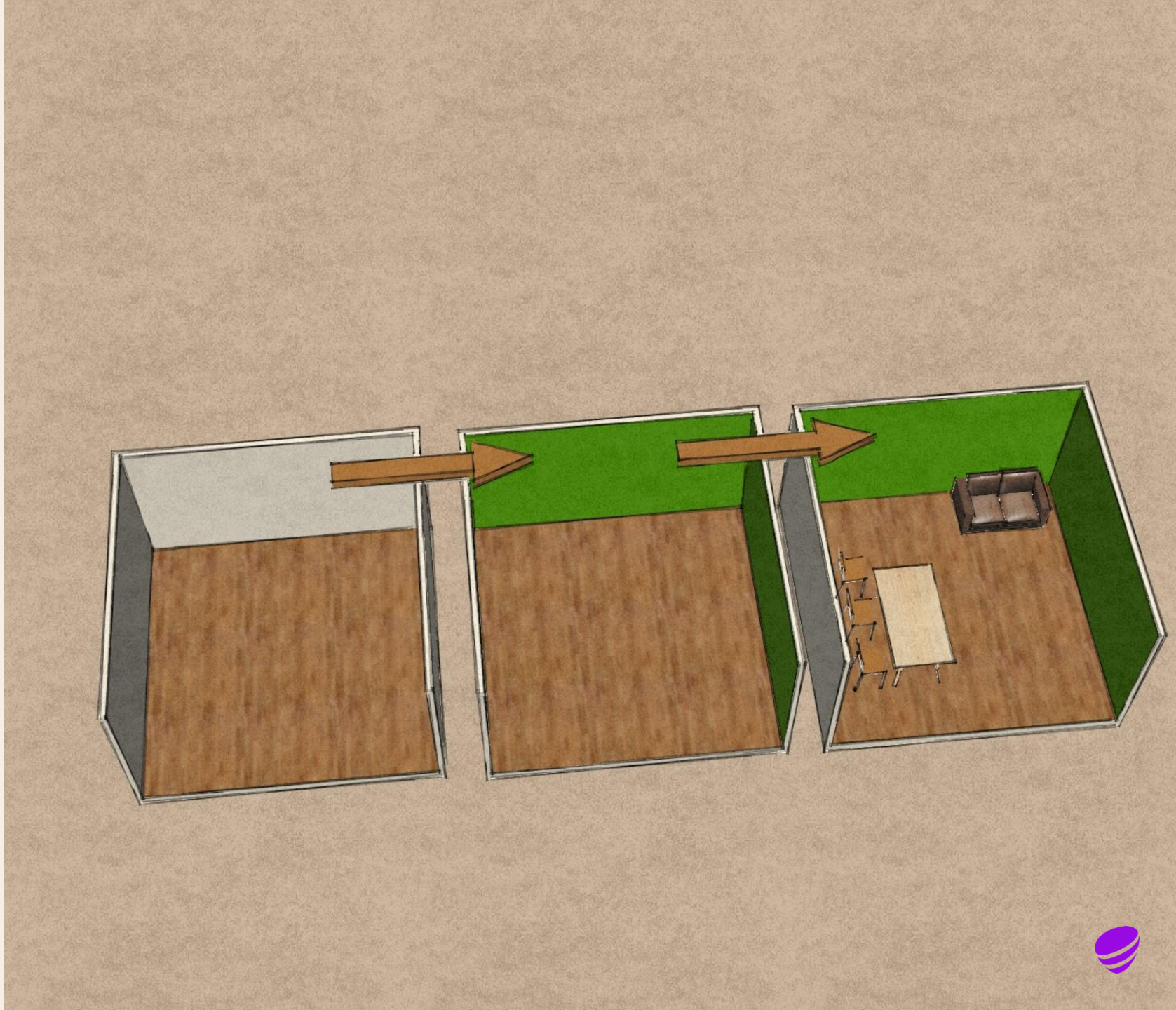


Furnishing

— The actions we took are important

— Here:

1. Paint the walls green
2. Add the furniture

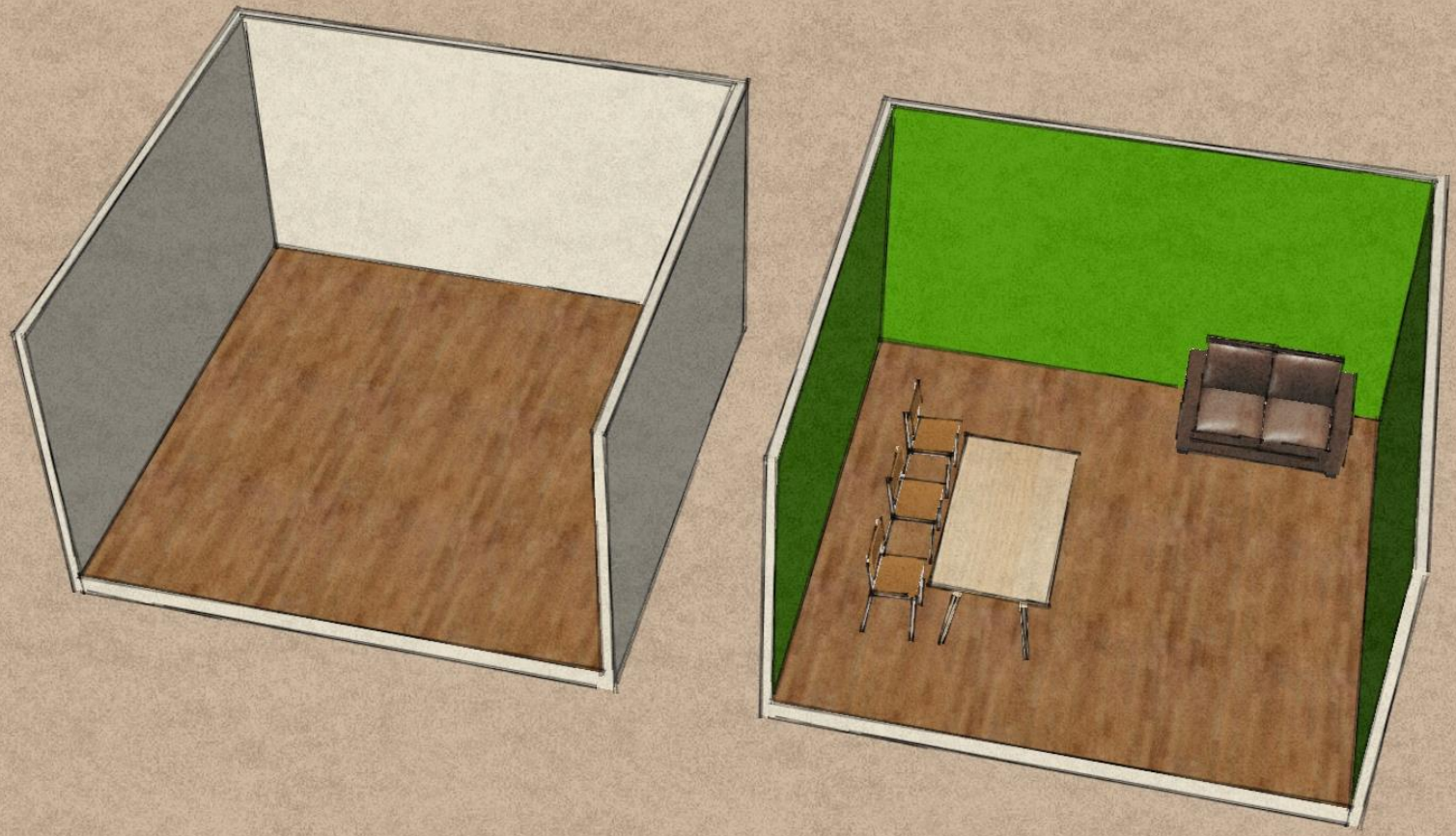


Create, modify, delete

- If we remember how to go from the empty room to the desired state, we can do the opposite too:
  1. Remove the furniture
  2. Paint the walls back to their original color
- Now we know how to add and how to remove
- Modifying the room came for free

Network automation

The act of transforming the *current* state into the *desired* state



Confused?
Let’s try again…

Service

- Service automation should be declarative
- It describes how network state should look, e.g.,
  - Bandwidth
  - IP addressing

```
{
  "service": {
    "endpoint": "214002eb-a48f-49f7-9bf2-18dddf2f7b45",
    "bandwidth": "100m",
    "ip-addresses": [
      {
        "family": 6,
        "address": "2001:db8:f00::/56",
      },
      {
        "family": 4,
        "address": "192.0.2.1/30"
      }
    ]
  }
}
```

“Furnishing”

— To get the **network** to the desired state, a number of steps will be taken

— We find the end-point and then:

1. Add the ipv6 address
2. Add the ipv4 address
3. Add the QoS policy

```
interface GigabitEthernet0/0/1/0
  ipv6 address 2001:db8:f00::/56
!
 interface GigabitEthernet0/0/1/0
   ipv4 address 192.0.2.1/30
 !
    interface GigabitEthernet0/0/1/0
      service-policy input CUSTOMER_100M
      service-policy output CUSTOMER_100M
    !
```

Create, modify, delete

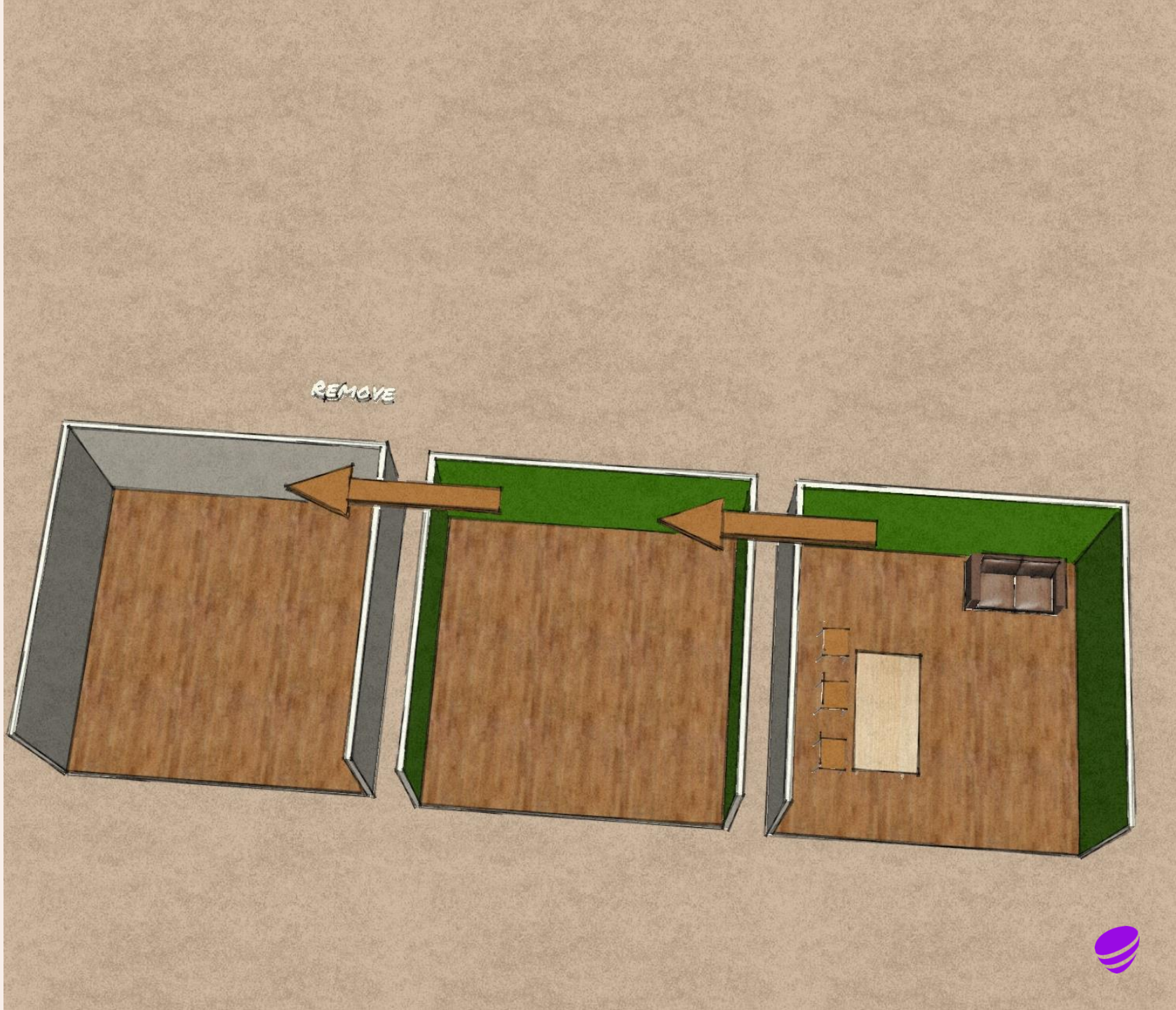
- If we record how to go from the **interface** as it was to the desired state, we can do the opposite too:
  1. Remove the addresses
  2. Remove the service policy
- If we modify the service, we just have to reverse your steps, and start over

```
  interface GigabitEthernet0/0/1/0
+    ipv6 address 2001:db8:f00::/56
+    ipv4 address 192.0.2.1/30
+    service-policy input CUSTOMER_100M
+    service-policy output CUSTOMER_100M
  !
```

```
interface GigabitEthernet0/0/1/0
  no ipv6 address 2001:db8:f00::/56
  no ipv4 address 192.0.2.1/30
  no service-policy input CUSTOMER_100M
  no service-policy output CUSTOMER_100M
!
```

Network automation

When removing a service the *desired* state should be the state *prior* to activating the service

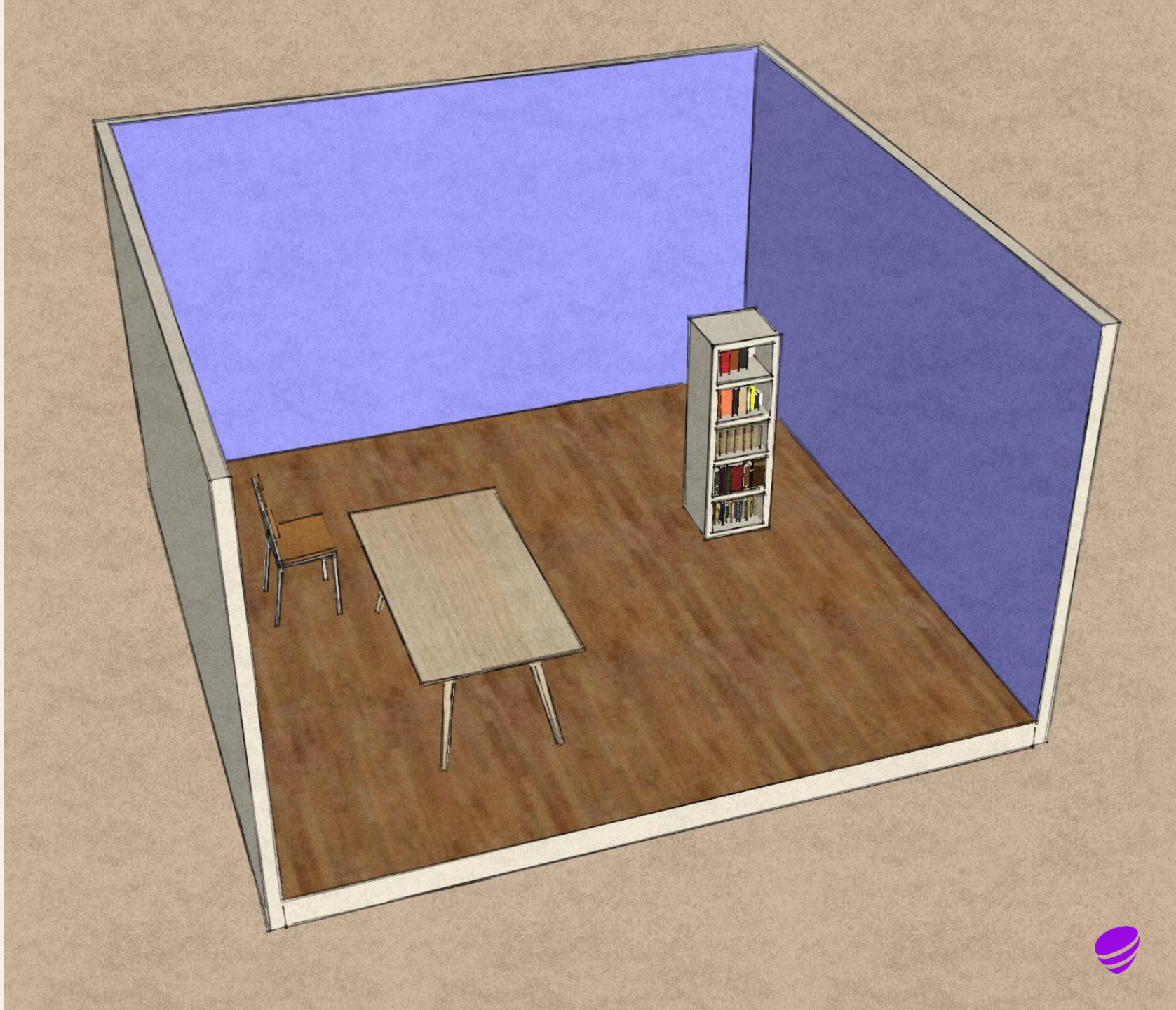


It’s never that simple…

Brown field scenarios

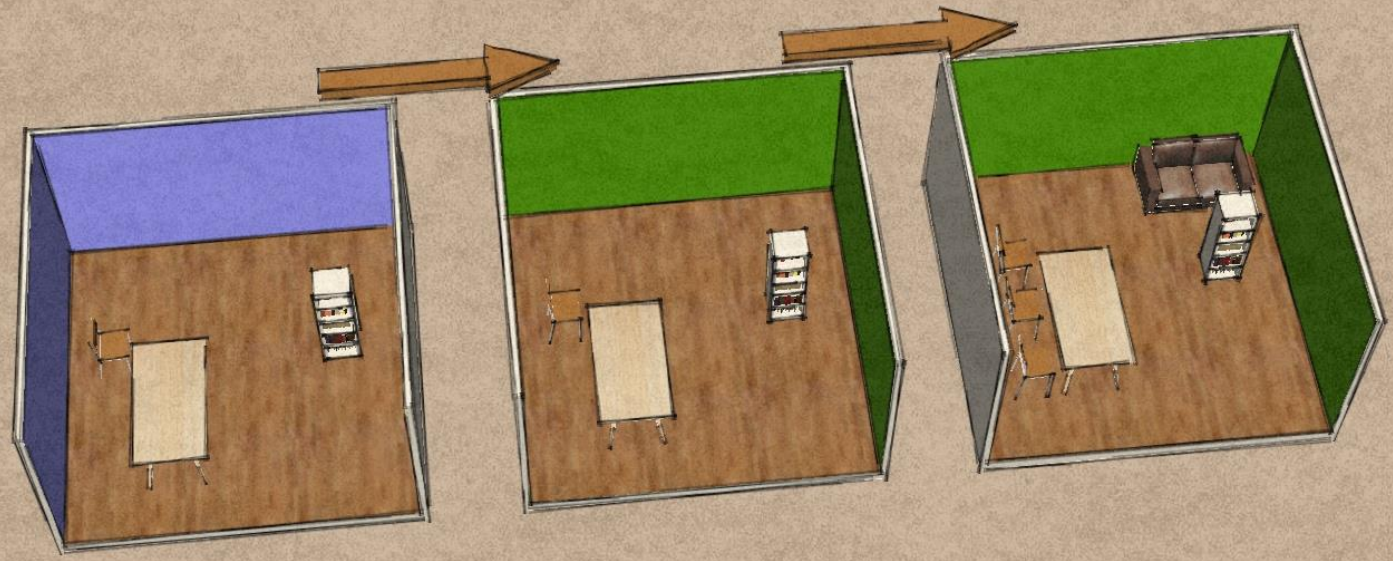
Brown field

- What if instead of an empty room, there is already something in it?
- The walls could have a different color
- Some furniture is already there
- Some of it may be expected, some not
  - like the bookcase



Reaching the intended state

- Our orchestrator should apply the desired state on top of the room as we found it
- The walls will be re-painted to green
- the missing two chairs will be added
- The sofa will be added
- But the bookcase will remain untouched

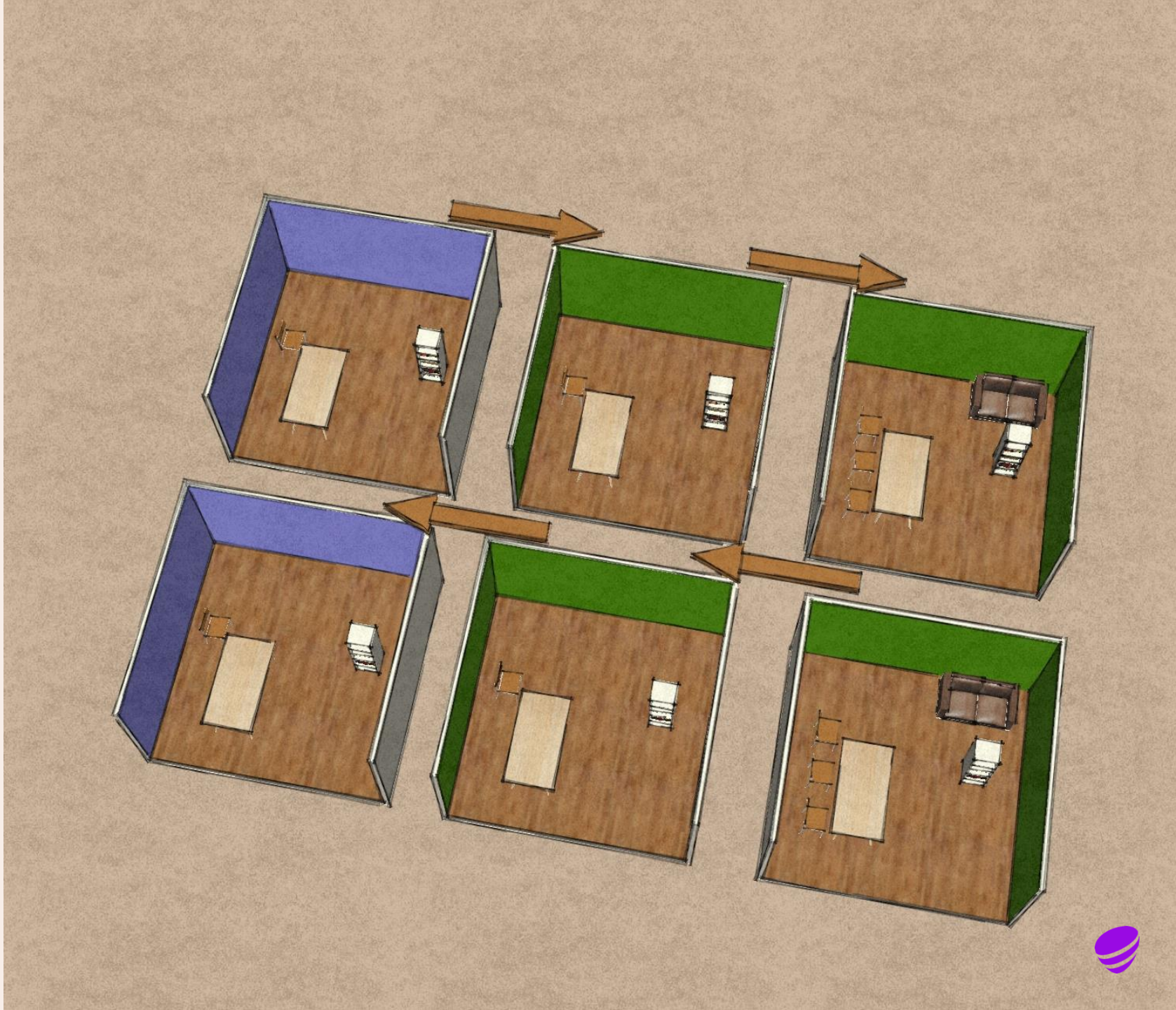


Removal

— When moving out, we should restore the room to its original state

— Including the old paint and the furniture that was already there

— Just like renting an appartment

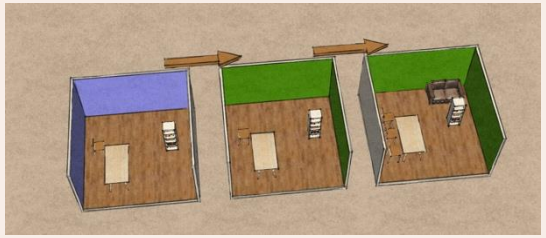


How does that apply to network automation?

The brownfield network

— Most networks are full of customer services created in the past
— These could have been made by hand or with some other tools we don’t use anymore
— Just like our rooms have furniture, our network devices has configuration already
— Just adding **no** in front of all our commands is no longer good enough
— Our documentation may help us

Reaching the intended state



- Our orchestrator should apply the **desired** state on top of the **current** state
- For example:
  - The IPv6 address will be changed to the right one
  - the missing IPv4 address will be added
  - But the mtu will remain untouched

```
interface GigabitEthernet0/0/1/0
  mtu 9216
  ipv6 address 2001:db8:ba0:1234::/64
  service-policy input CUSTOMER_100M
  service-policy output CUSTOMER_100M
!
```

```
interface GigabitEthernet0/0/1/0
  mtu 9216
  ipv6 address 2001:db8:f00::/56
  ipv4 address 192.0.2.1/30
  service-policy input CUSTOMER_100M
  service-policy output CUSTOMER_100M

!
```

Service Diff

- We still only record what changed in the network state
- What wasn't changed during creation, will not be touched during deletion

```
  interface GigabitEthernet0/0/1/0
-     ipv6 address 2001:db8:ba0:1234::/64
+     ipv6 address 2001:db8:f00::/56
+     ipv4 address 192.0.2.1/30
!
```

Unexpected and expected existing states

Expected/safe

- Default configuration on interfaces
- Automatic configuration done by the platform

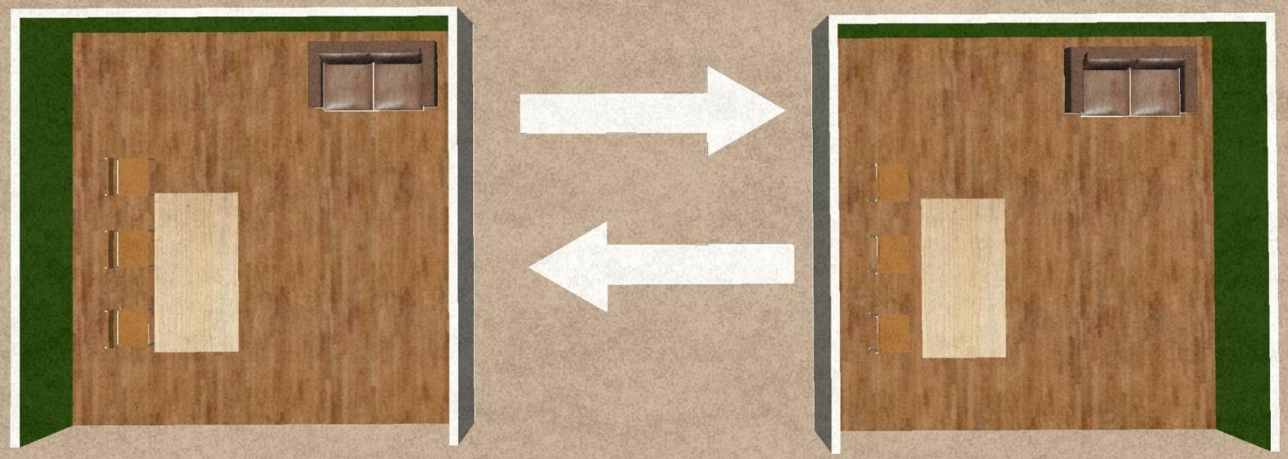
```
interface GigabitEthernet0/0/1/0
  description UNUSED_INTERFACE
  mac address-group PROTECT in
  no ip address
  shutdown
!
```

Unexpected/unsafe

- Wrong interface recorded in documentation
- Old configuration not entirely removed
- Overwriting an undocumented service

What if it was right from the start?

- When the automation is run, it has nothing to do
- Once the service is deleted, there are no steps to reverse
- This means that the service is removed, but the result of the service is still in the network
- We thought we removed the service, but it is actually still there!

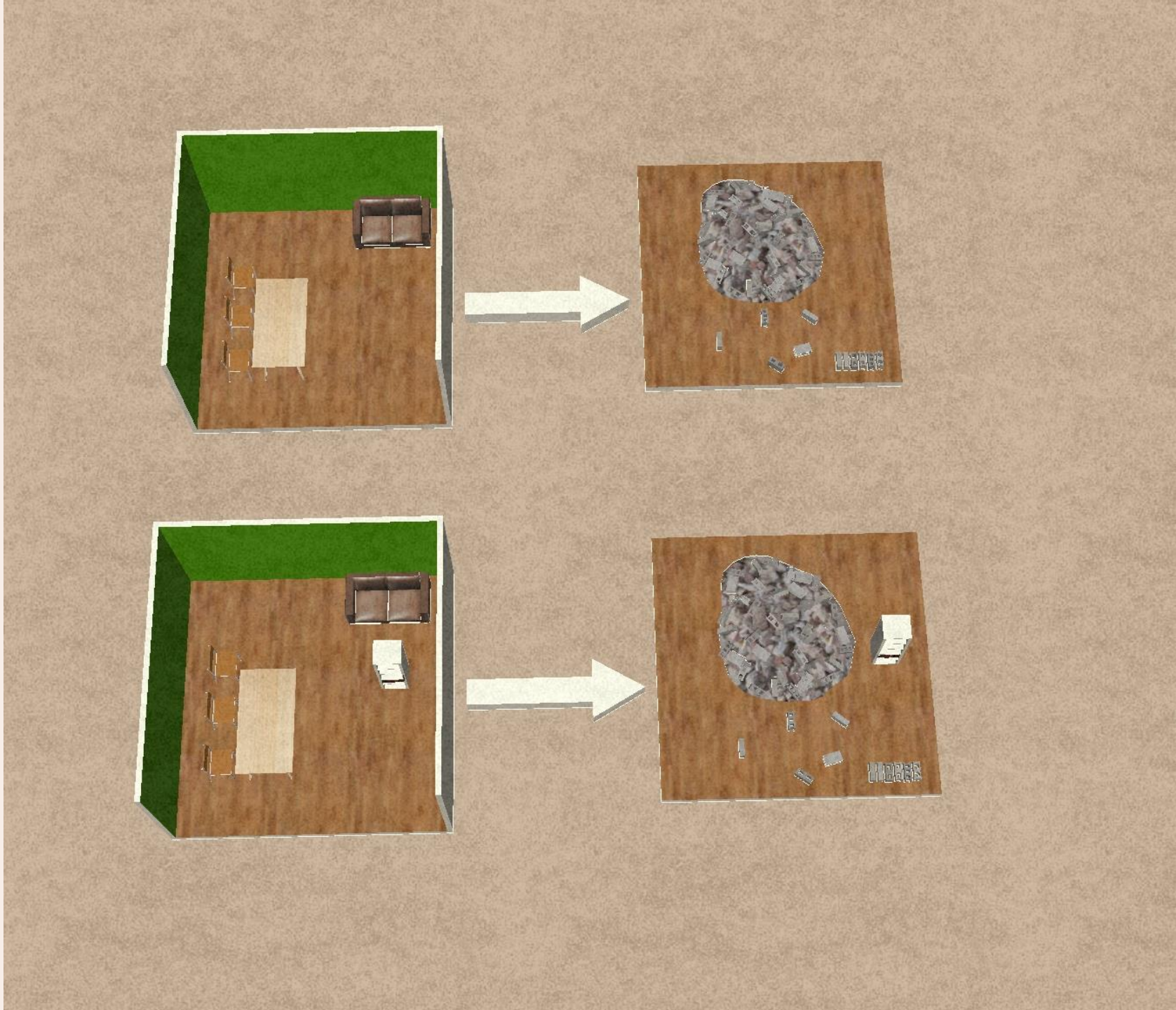


Ownership

— If the sofa was there before, we need to take over the ownership
— If there’s an unexpected item, we need to remove it

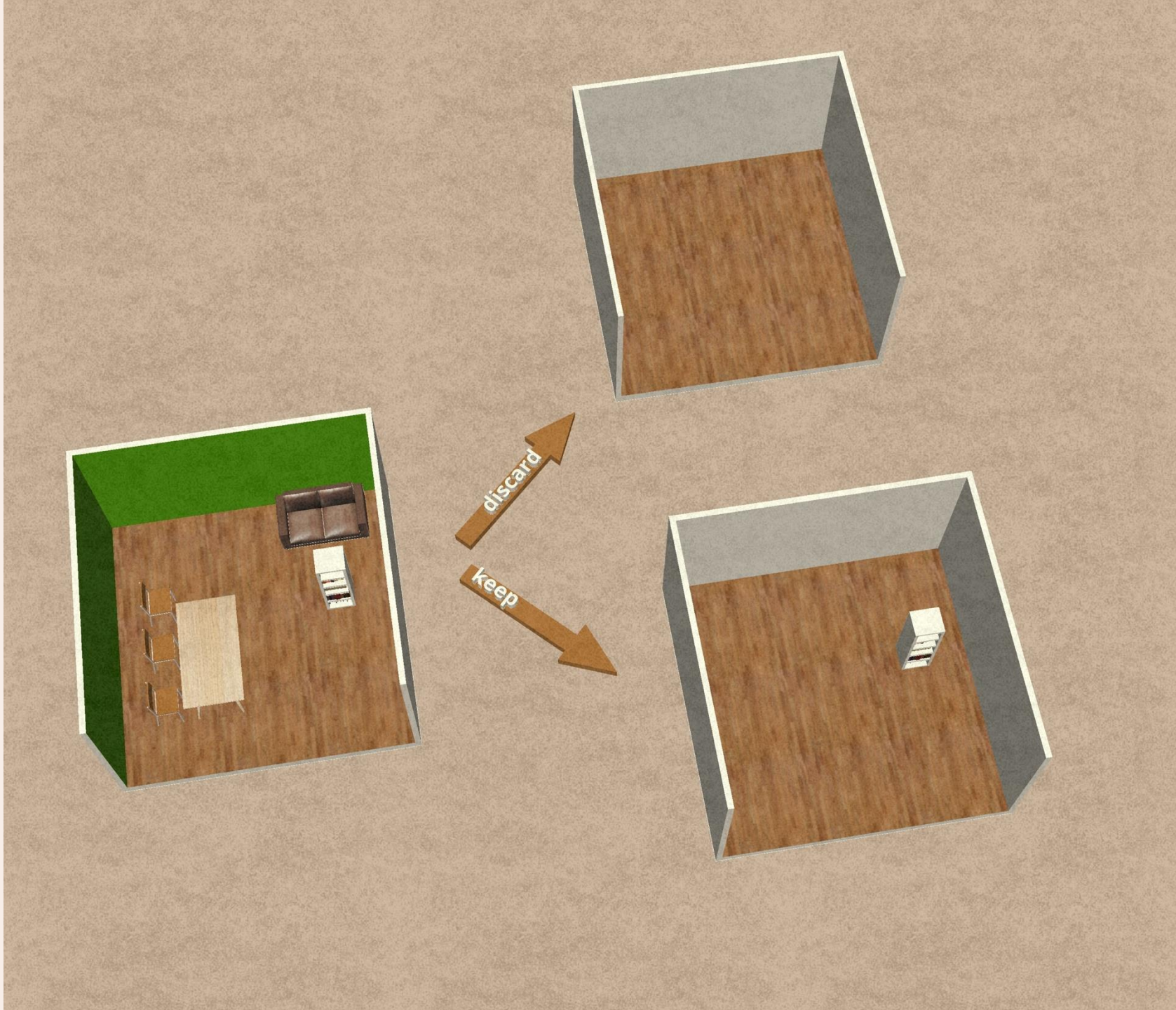
Ownership

— You shouldn’t take over too much
— We don’t want to tear down the whole room if there are still things inside it



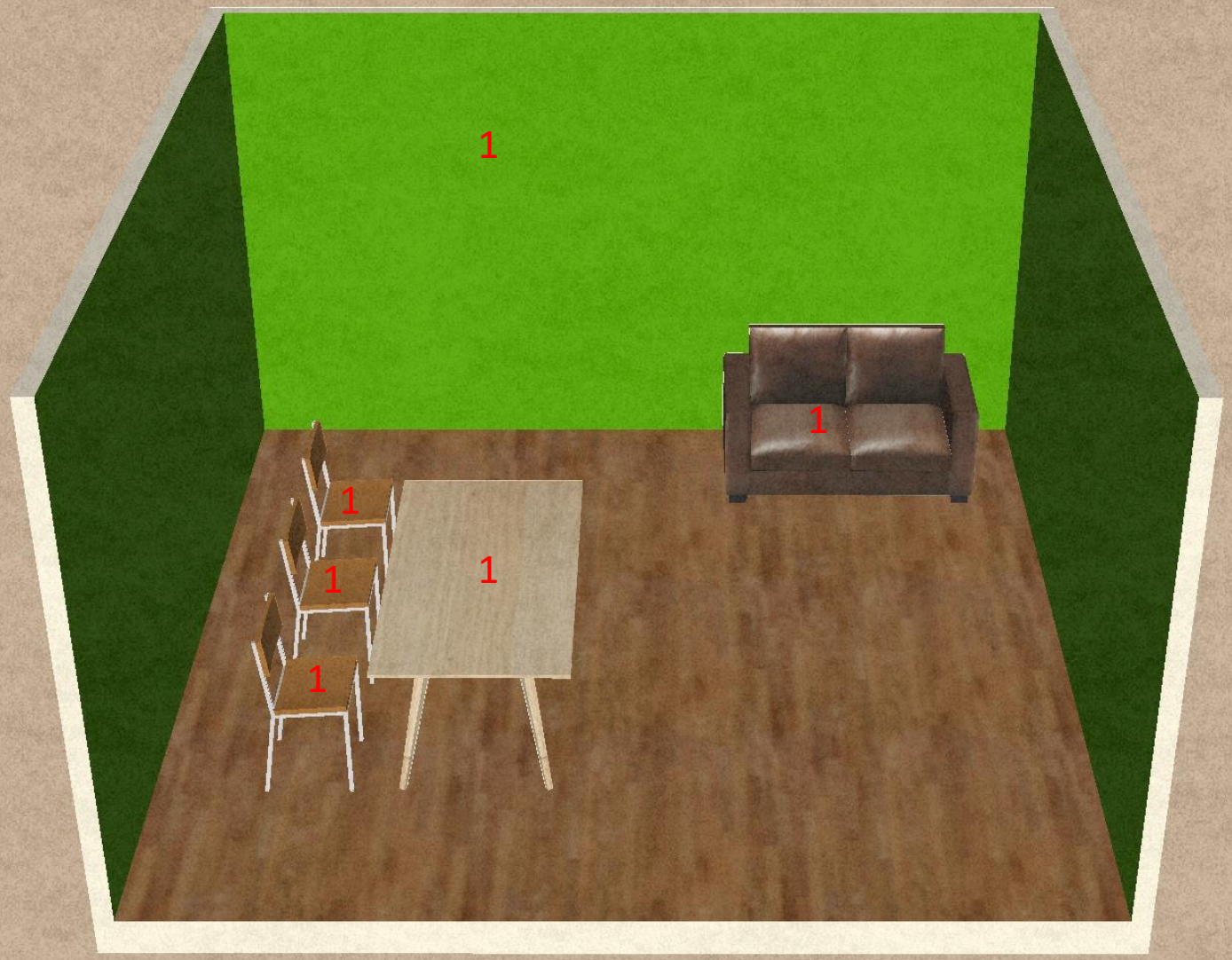
What about the bookcase?

— You need to choose what to do with the elements that are not part of your service
— Keep or remove?
— The bookcase is easy
— In reality it might be more complicated



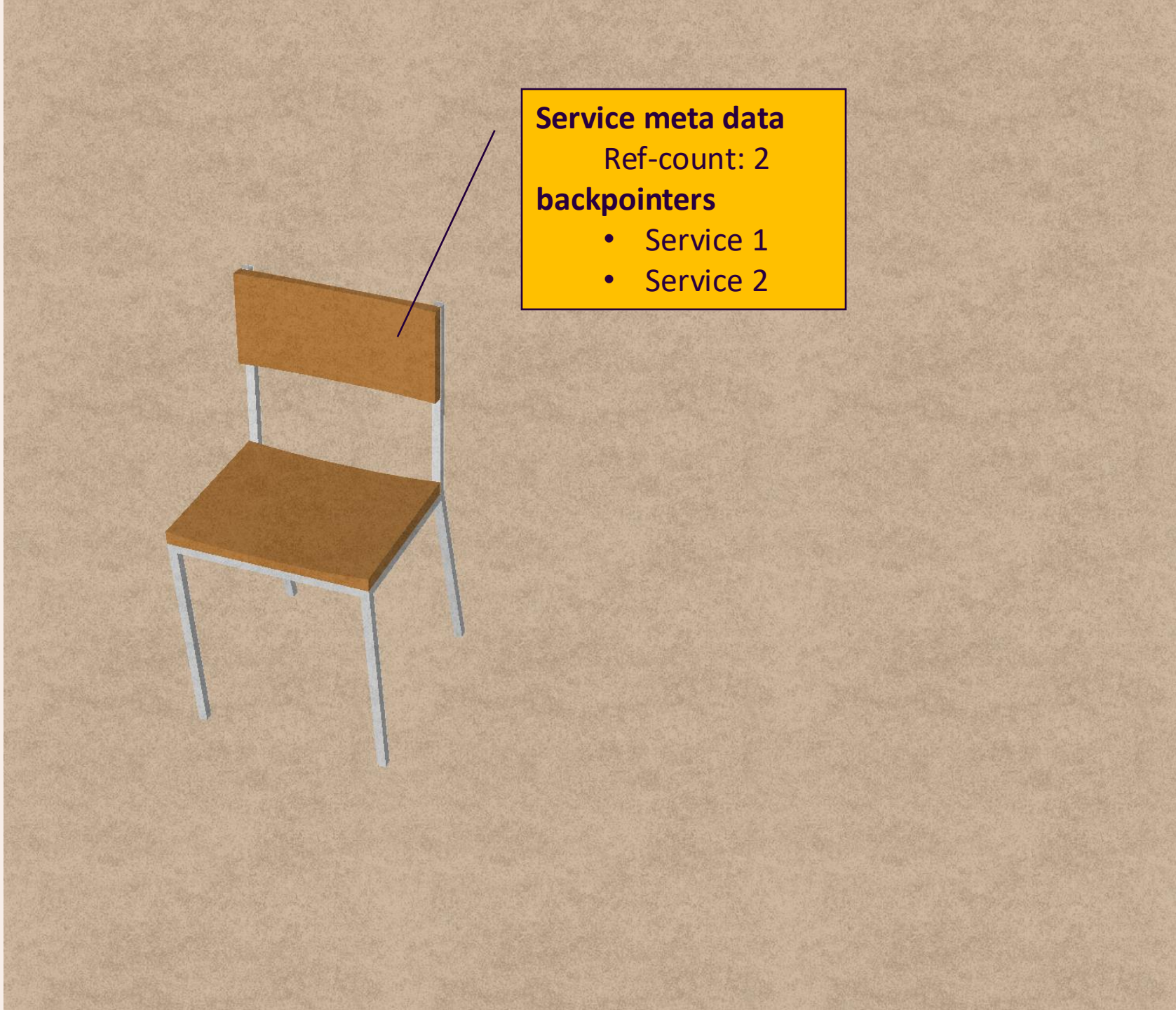
Claiming ownership

- We also need to track who has a claim to each item
- Each item our service created from scratch is owned by **1**
- If a service wants to add something that is already there, it adds **1** to the counter
- An item should be removed if nobody owns it anymore



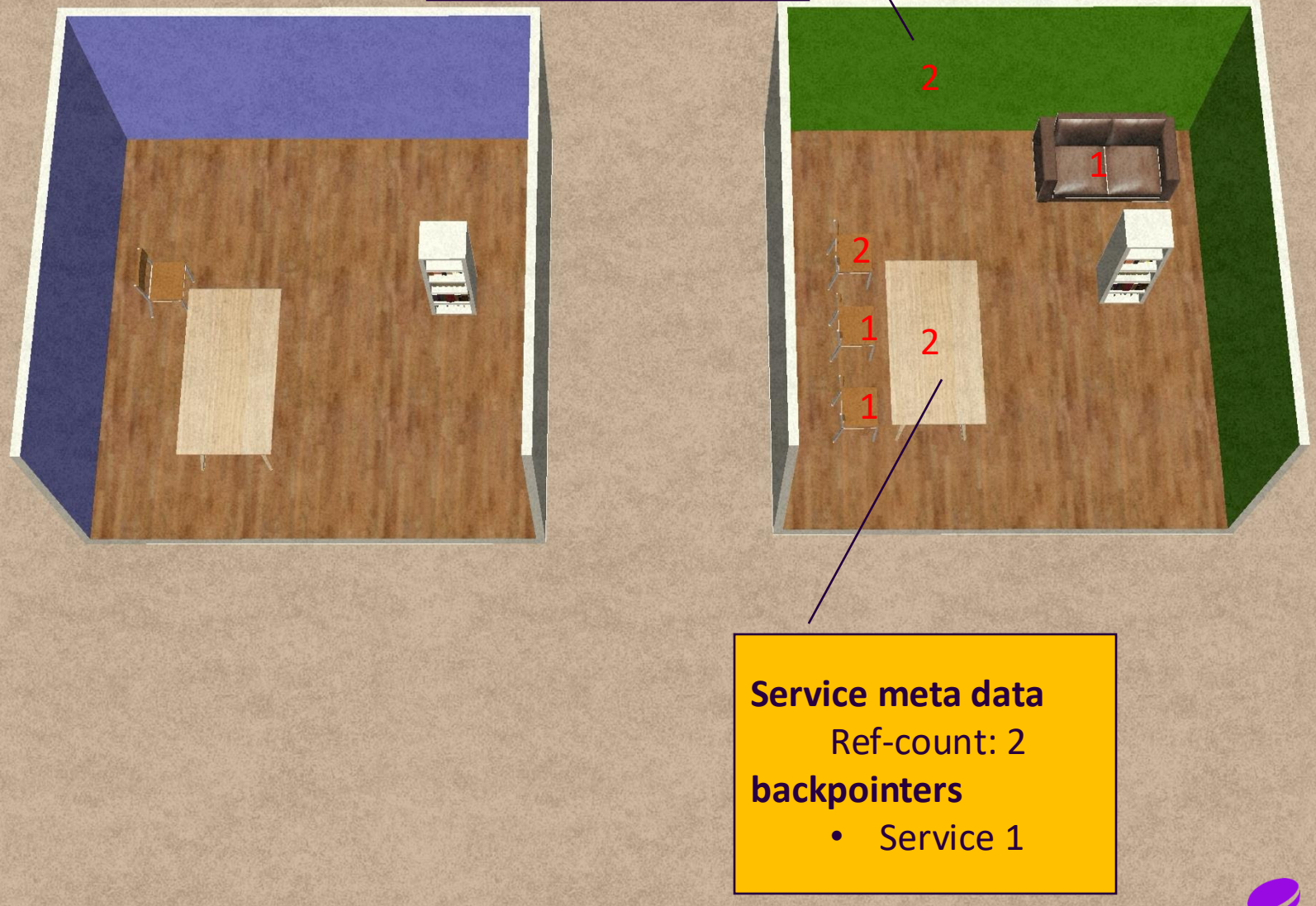
Backpointers

— Ownership should be public
— Each claim to an item should come with an identifier
— Each service leaves its address on each item
— This allows us to tie the ref-count to the actual services



Brownfield

- If something already exists, it will get a ref-count but no backpointer
- The bookshelf is not part of the service, so it will have no ref-count
- Original values of items changed should also be recorded
- In NSO: “re-deploy re-concile”

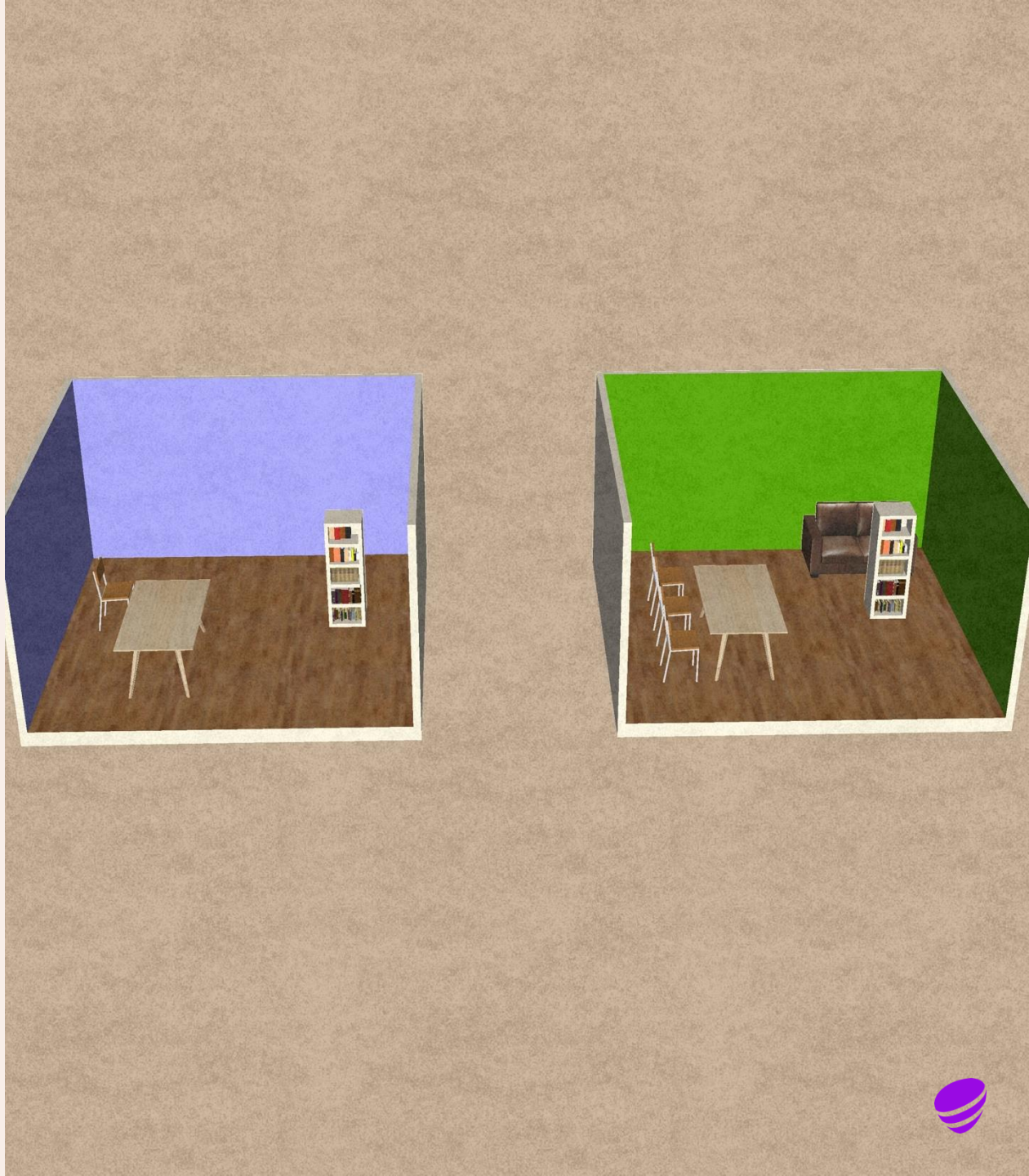


Reconciliation

Let’s settle the differences

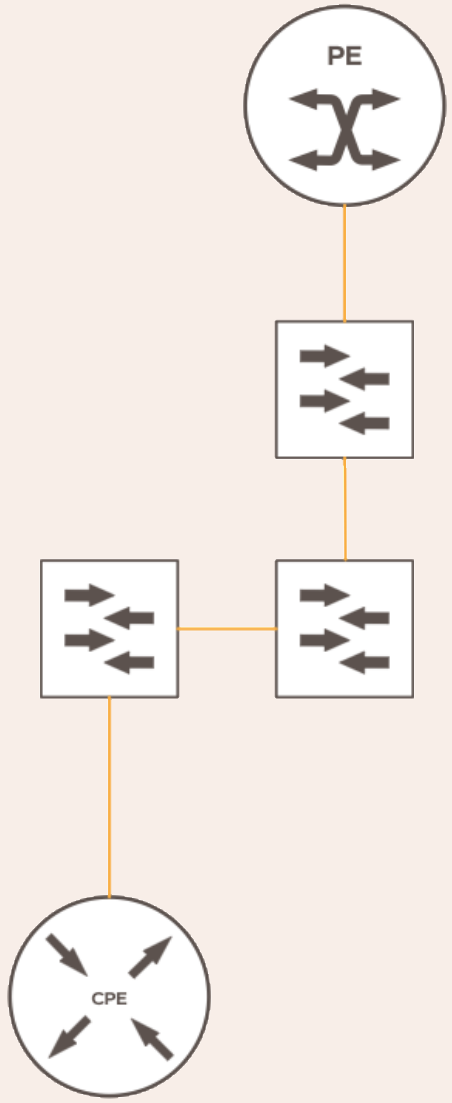
Who is right?

- Was the wall actually supposed to be blue?
- How many chairs did the customer actually want?
- Did the customer actually order a book case but we didn’t support that in our standard product?
- This requires some insight in to the customer order



Who is right? (with proper examples)

- Was the ~~wall~~ vlan actually supposed to be ~~blue~~ 101?
- How many ~~chairs~~ megabit/s did the customer actually want?
- Did the customer actually order ~~a book case~~ OSPF but we didn't support that in NSO or our standard product?



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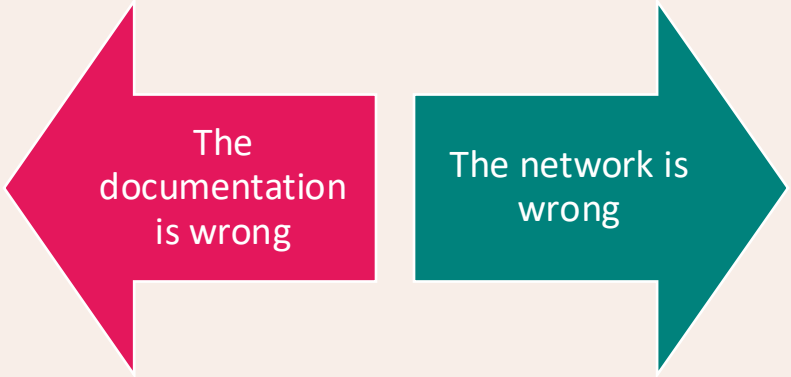
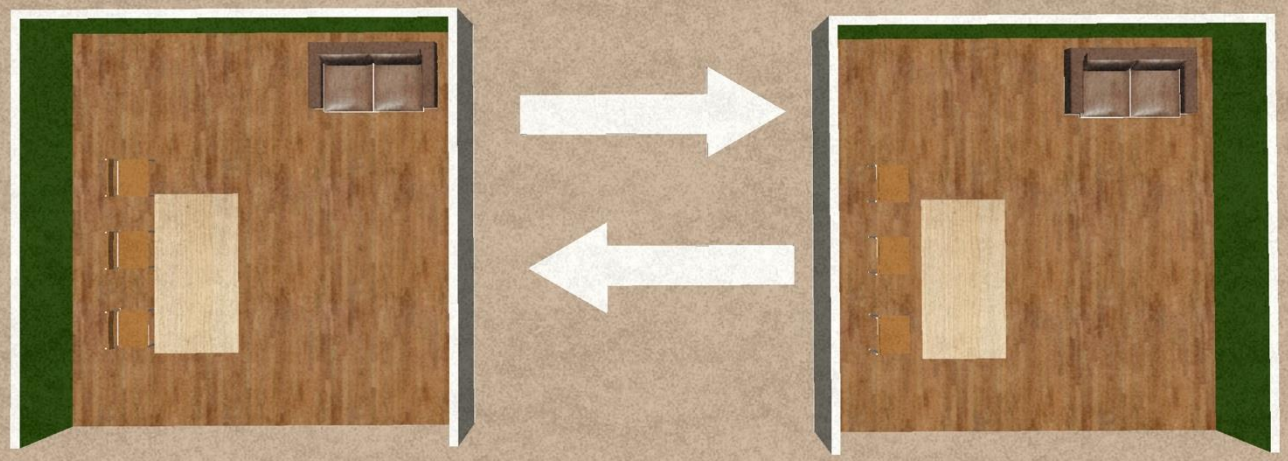


Challenge at scale

— Some of the original states might have been correct
— Some are obviously incorrect
— But it may be hard to tell without knowing
— There may be thousands of services to analyze

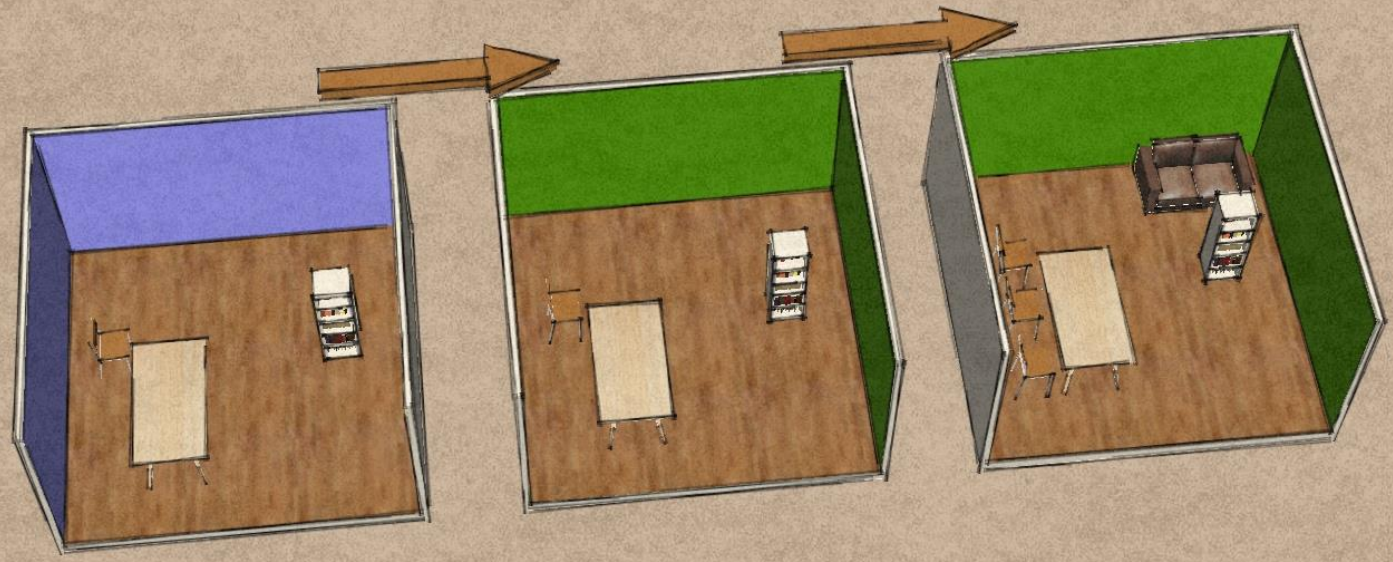
Service analysis

— We expect all existing services to be correct
— We expect the current state to match the desired state



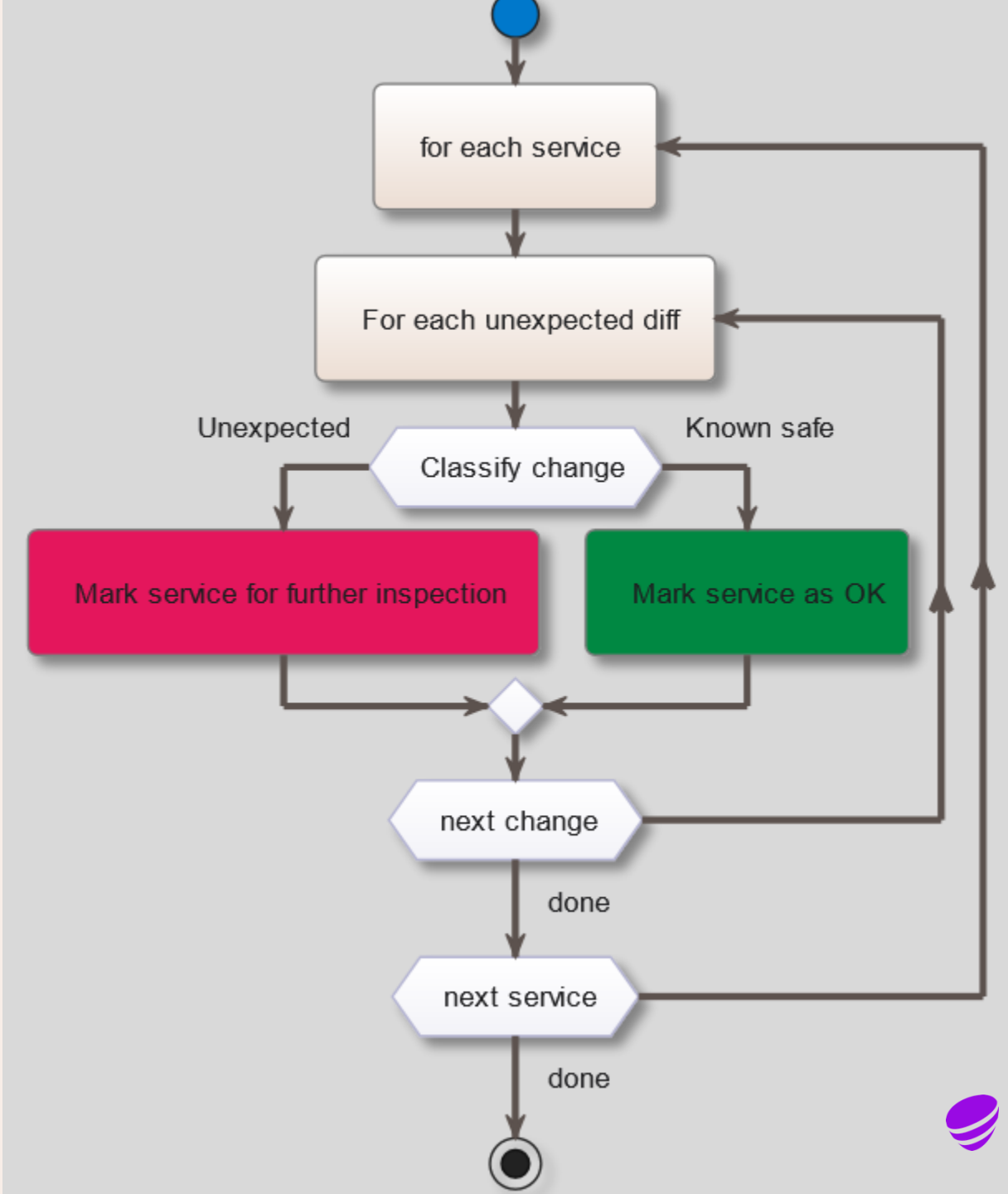
Service analysis

— If this is true, nothing will be done
— If it is not, the actions tell us about a deviation



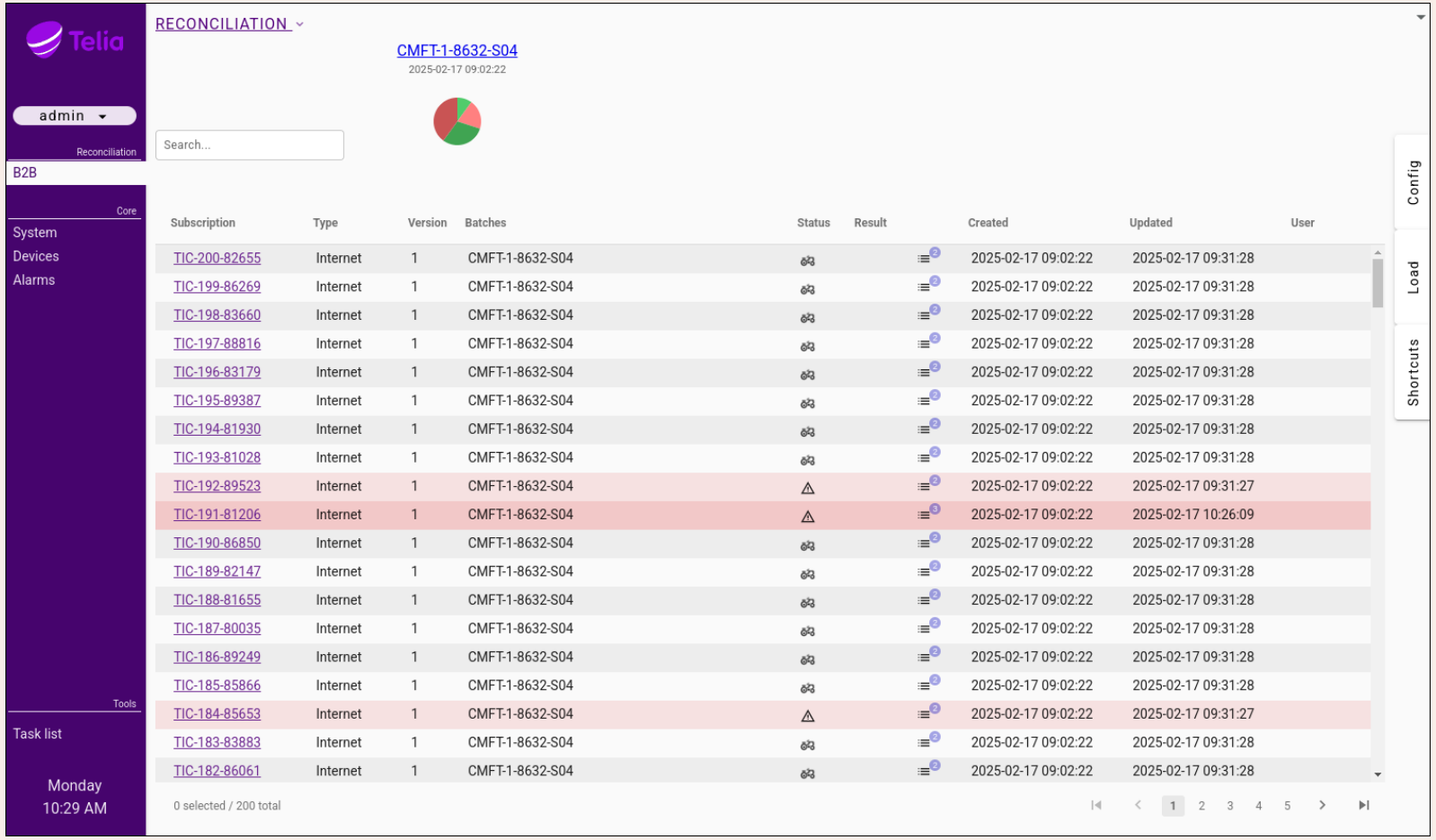
How do we solve it?

- We can do this at scale
- We can use ”commit dry-run” or work with virtual routers
- Any deviation should be analyzed and categorized
- Some changes might be safe and unimportant
- Other changes might indicate something larger



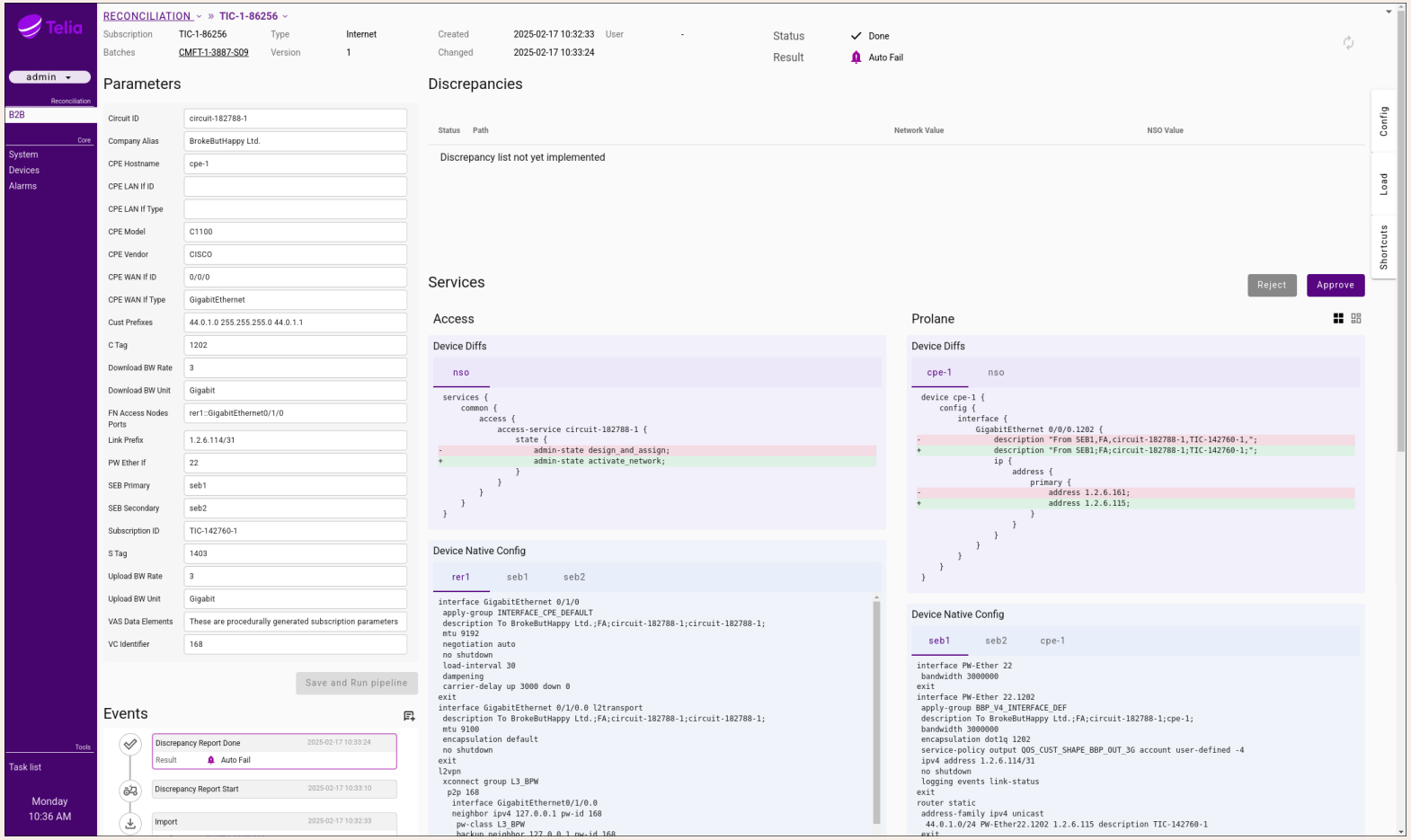
Making it user friendly

- Our first version was a python script that wrote text files
- Now we are building a tool to make it easy
- Here we can process large batches of services on top of a production copy
- The services with differences can be processed



Processing a service

- The operators can drill down on individual services
- They can adjust the service parameters to match
- Or approve or reject the service as it is



Summary

- The key challenges to brown field automation concerns
  - Reconciliation of differences
  - Ownership of configuration
- If your services own too little, they won’t clean up after themselves
- If your services own too much, they can cause major outages

Summary

— You should analyze if existing services match what is currently in the network
— This can be done with dry-run simulations
— Deviations should be analyzed carefully
— Use your network delivery engineers. They are experts in this field.

Thank you!

Questions?