

P4

 **OpenRAN**
BRASIL

Workshop Técnico

Meta 3 - P4

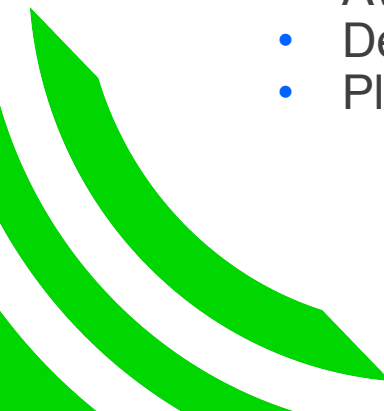
Ariel G. De Castro

P4

Domínio P4

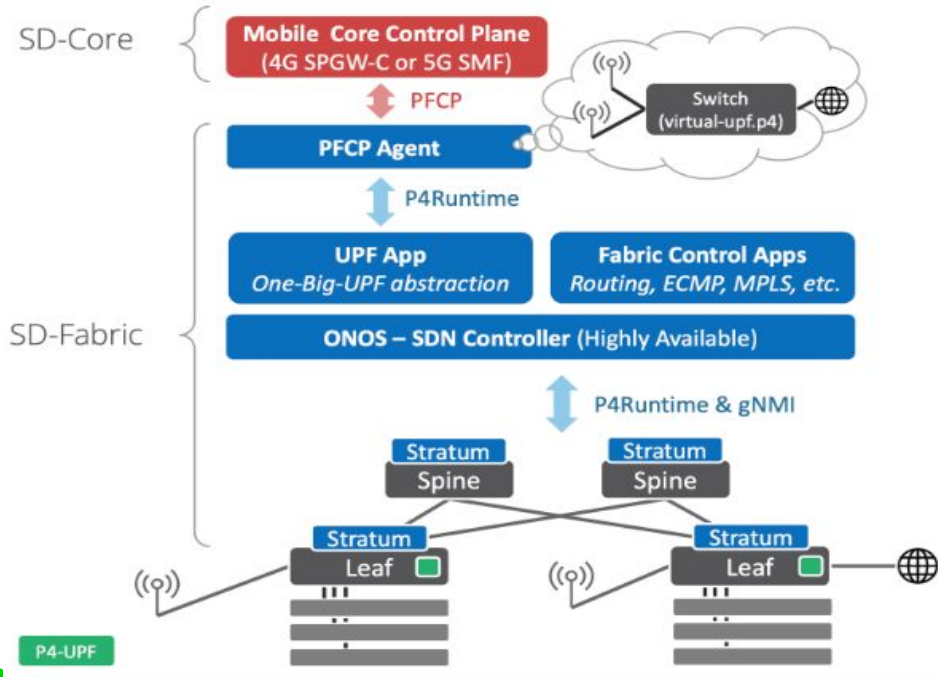


- SD-Fabric
 - SD-Fabric: uma plataforma programável P4
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SD-Fabric

P4 SD-Fabric: uma plataforma programável P4

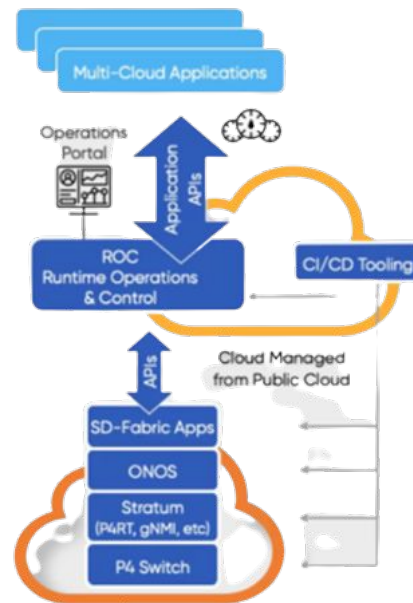


Stratum

P4 Stratum: Visão Geral



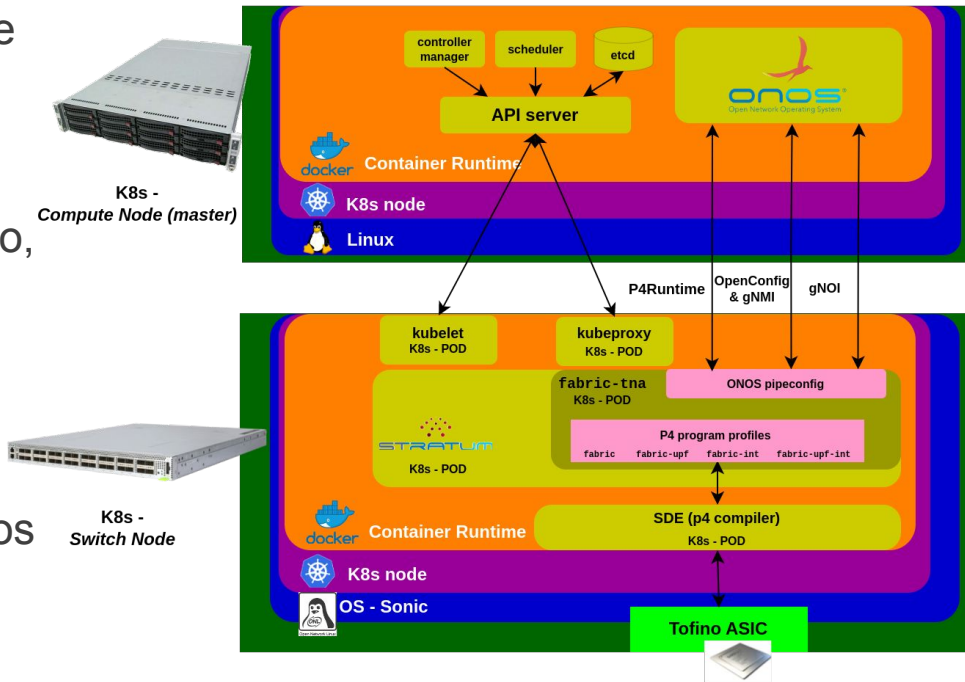
- Stratum é um **sistema operacional** de switches silicon-independent e **código aberto** para SDN
- **Distribuição aberta** e mínima production-ready para **switches whitebox**
- Stratum expõe um **conjunto de interfaces SDN** de última geração, incluindo P4Runtime e OpenConfig



P4 Stratum: Fabric-TNA



- **fabric-tna** é um **programa P4** que realiza o plano de dados do SD-Fabric
- **fabric-tna** é baseado na Tofino Native Architecture (TNA), portanto, pode ser usado para programar qualquer switch baseado no **Intel Tofino ASIC**
- O **programa P4** foi projetado especificamente para ser executado em **switches** habilitados para **Stratum** controlados pelo controlador ONOS SDN



Desenvolvimento

P4 Avanços: SD-Fabric config (Antes)



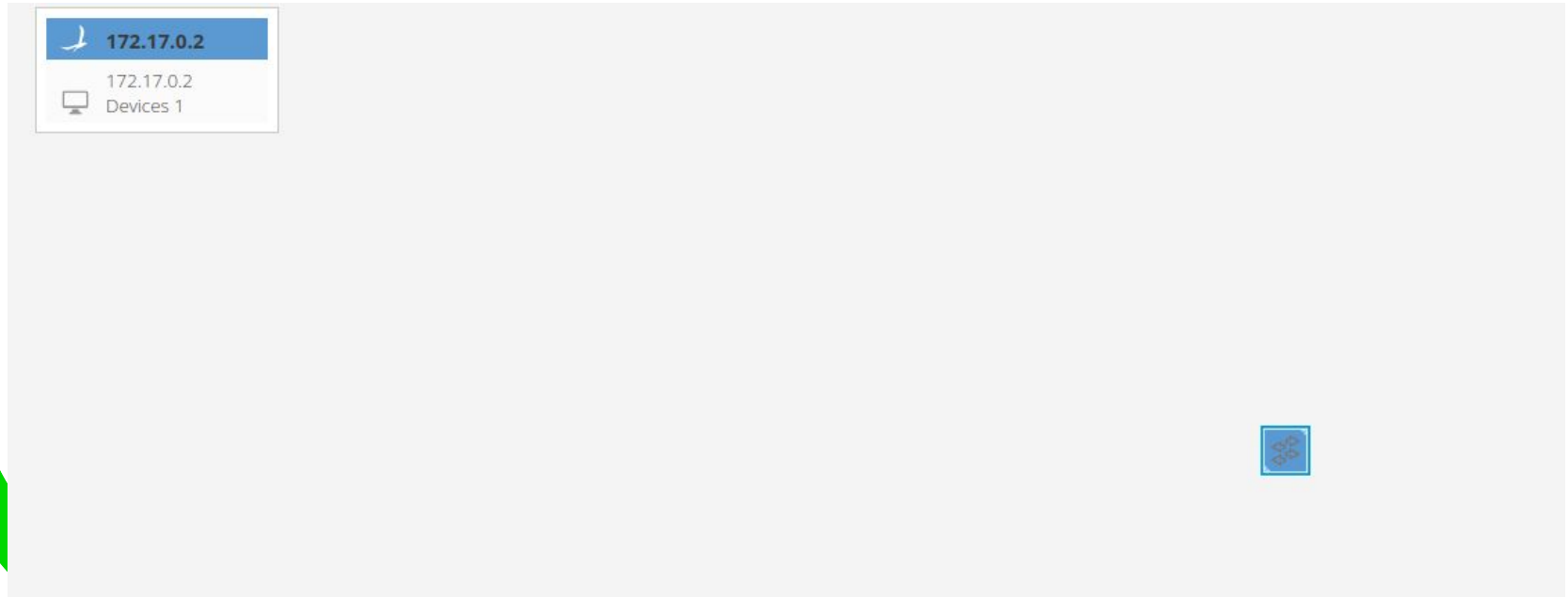
```
{
  "devices": {
    "device:leaf1" : {
      "segmentrouting" : {
        "ipv4NodeSid" : 101,
        "ipv4Loopback" : "192.168.0.201",
        "ipv6NodeSid" : 111,
        "ipv6Loopback" : "2000::c0a8:0201",
        "routerMac" : "00:00:00:00:02:01",
        "isEdgeRouter" : true,
        "adjacencySids" : []
      },
      "basic" : {
        "name": "Leaf1",
        "managementAddress": "grpc://240.127.1.1:50001?device_id=1",
        "driver": "stratum-tofino",
        "pipeconf": "org.stratumproject.fabric-int.montara_sde_9_7_0"
      }
    }
  }
}
```

P4 Avanços: SD-Fabric config (Agora)



```
{
  "devices": {
    "device:leaf1" : {
      "segmentrouting" : {
        "ipv4NodeSid" : 101,
        "ipv4Loopback" : "192.168.0.201",
        "ipv6NodeSid" : 111,
        "ipv6Loopback" : "2000::c0a8:0201",
        "routerMac" : "00:00:00:00:02:01",
        "isEdgeRouter" : true,
        "adjacencySids" : []
      },
      "basic" : {
        "name": "Leaf1",
        "managementAddress": "grpc://240.127.1.1:9339?device_id=1",
        "driver": "stratum-tofino",
        "pipeconf": "org.stratumproject.fabric-int.montara_sde_9_7_0"
      }
    }
  }
}
```

P4 Avanços: ONOS - GUI (Antes)



P4 Avanços: ONOS - GUI (Agora)



The screenshot shows the ONOS GUI interface. The browser address bar indicates the URL is localhost:8181/onos/ui/#/topo. The ONOS logo and "Open Network Operating System" are visible in the top navigation bar. On the left, a sidebar shows a list of IP addresses, with "240.127.1.2" selected, showing "Devices: 1". The main area displays a network topology with a single device icon labeled "Leaf1". On the right, there are two summary panels. The top panel, "ONOS Summary", provides overall system statistics. The bottom panel, "Leaf1", provides detailed information about the selected device, which is highlighted with a red border.

Version :	2.5.7.rc2
Devices :	1
Links :	0
Hosts :	0
Topology SCCs :	1
Intents :	0
Flows :	36

URI :	device/leaf1
Vendor :	Barefoot Networks
H/W Version :	Tofino
S/W Version :	Stratum
Serial # :	unknown
Protocol :	P4Runtime, gNMI, gNOI
Ports :	34
Flows :	36
Tunnels :	0

P4 Avanços: ONOS - GUI (Agora)



Devices (1 total)

FRIENDLY NAME	DEVICE ID	MASTER	PORTS	VENDOR	H/W VERSION
<input checked="" type="checkbox"/> Leaf1	device:leaf1	240.127.1.2	34	Barefoot Networks	Tofino



Leaf1

URI : device:leaf1
Type : SWITCH
Master ID : 240.127.1.2
Chassis ID : 0
Vendor : Barefoot Networks

H/W Version : Tofino
S/W Version : Stratum
Protocol : P4Runtime_gNMI, gNMI
Serial # : unknown
Pipeconf : org.stratumproject:

Ports

Enabled	ID	Speed	Type	Egress Links	Name
false	[1/0]1	100000	Copper		
false	[2/0]2	100000	Copper		
false	[3/0]3	100000	Copper		
false	[4/0]4	100000	Copper		
false	[5/0]5	100000	Copper		
false	[6/0]6	100000	Copper		
false	[7/0]7	100000	Copper		
false	[8/0]8	100000	Copper		
false	[9/0]9	100000	Copper		
false	[10/0]10	100000	Copper		
false	[11/0]11	100000	Copper		
false	[12/0]12	100000	Copper		
false	[13/0]13	100000	Copper		
false	[14/0]14	100000	Copper		





```
bf_switchd: drivers initialized
Skipping P4 program load for dev_id 0
*** Aborted at 1690222321 (unix time) try "date -d @1690222321" if you are using GNU date ***
PC: @ 0x0 (unknown)
*** SIGBUS (@0x7f49e8800000) received by PID 7 (TID 0x7f4a083b8880) from PID 18446744073315287040; stack trace:
***
@ 0x7f49f68f50e0 (unknown)
@ 0x7f4a0744e865 bf_sys_dma_pool_create
@ 0x7f49f82e77e7 (unknown)
@ 0x7f49f82e9d7e bf_switchd_lib_init
@ 0x43766e (unknown)
@ 0x41bf7b (unknown)
@ 0x41d114 (unknown)
@ 0x7f49f5ac42e1 __libc_start_main
@ 0x41bbea (unknown)
@ 0x0 (unknown)
Bus error (core dumped)
```

Desafios: Funciona apenas com Docker



```
Mounting hugepages...
Skipping kernel module installation.
I20230904 17:58:14.707542 1 logging.cc:64] Stratum version: 263affc8822f04ff53f34936af8d05a28665f15a built at 2023-07-11T21:54:59+00:00 on host ff44026cfe6e by user root.
I20230904 17:58:14.708158 1 bf_sde_wrapper.cc:1776] bf_sysfs_fname: /sys/class/bf/bf0/device/dev_add
Install dir: /usr (0x340c020)
bf_switcxd: system services initialized
bf_switcxd: loading conf_file /usr/share/stratum/tofino/skip_p4.conf...
bf_switcxd: processing device configuration...
Configuration for dev_id 0
Family : Tofino
pci_sysfs_str : /sys/devices/pci0000:00/0000:00:03.0/0000:05:00.0
pci_domain : 0
pci_bus : 5
pci_fn : 0
pci_dev : 0
pci_int_mode : 1
sbus_master_fw: /usr/
pcte_fw : /usr/
serdes_fw : /usr/
sds_fw_path : /usr/share/tofino_sds_fw/avago/firmware
micro_p4_fw_path:
bf_switcxd: processing P4 configuration...
P4 profile for dev_id 0
p4_name: dummy
libpds:
libp4thrift:
context:
config:
Agent[0]: /usr/lib/libp4mgr.so
diag:
action diag:
non_default_port_ppgs: 0
SAI default initialize: 1
bf_switcxd: library /usr/lib/libp4mgr.so loaded
bf_switcxd: agent[0] initialized
Health monitor started
Operational mode set to ASIC
Initialized the device types using platforms infra API
ASIC detected at PCI /sys/class/bf/bf0/device
ASIC pci device id is 16
bf_switcxd: drivers initialized
Skipping P4 program load for dev_id 0
Setting core_pll_ctrl0=cd44cbfe

bf_switcxd: dev_id 0 initialized

bf_switcxd: initialized 1 devices
Skip p4 lib init
Skip mav diag lib init
bf_switcxd: spawning cli server thread
bf_switcxd: running in background; driver shell is disabled
```




```
I20230904 17:58:24.036288 1 bf_chassis_manager.cc:120] Added port 12 in node 1 (SDK Port 32).
I20230904 17:58:24.036339 1 bf_chassis_manager.cc:156] Enabled port 12 in node 1 (SDK Port 32).
I20230904 17:58:24.060714 1 bf_chassis_manager.cc:120] Added port 13 in node 1 (SDK Port 24).
I20230904 17:58:24.060765 1 bf_chassis_manager.cc:156] Enabled port 13 in node 1 (SDK Port 24).
I20230904 17:58:24.085988 1 bf_chassis_manager.cc:120] Added port 14 in node 1 (SDK Port 16).
I20230904 17:58:24.085140 1 bf_chassis_manager.cc:156] Enabled port 14 in node 1 (SDK Port 16).
I20230904 17:58:24.109287 1 bf_chassis_manager.cc:120] Added port 15 in node 1 (SDK Port 8).
I20230904 17:58:24.109337 1 bf_chassis_manager.cc:156] Enabled port 15 in node 1 (SDK Port 8).
I20230904 17:58:24.133566 1 bf_chassis_manager.cc:120] Added port 16 in node 1 (SDK Port 0).
I20230904 17:58:24.133616 1 bf_chassis_manager.cc:156] Enabled port 16 in node 1 (SDK Port 0).
I20230904 17:58:24.157784 1 bf_chassis_manager.cc:120] Added port 17 in node 1 (SDK Port 4).
I20230904 17:58:24.157836 1 bf_chassis_manager.cc:156] Enabled port 17 in node 1 (SDK Port 4).
I20230904 17:58:24.181958 1 bf_chassis_manager.cc:120] Added port 18 in node 1 (SDK Port 12).
I20230904 17:58:24.182011 1 bf_chassis_manager.cc:156] Enabled port 18 in node 1 (SDK Port 12).
I20230904 17:58:24.206162 1 bf_chassis_manager.cc:120] Added port 19 in node 1 (SDK Port 20).
I20230904 17:58:24.206214 1 bf_chassis_manager.cc:156] Enabled port 19 in node 1 (SDK Port 20).
I20230904 17:58:24.230362 1 bf_chassis_manager.cc:120] Added port 20 in node 1 (SDK Port 28).
I20230904 17:58:24.230417 1 bf_chassis_manager.cc:156] Enabled port 20 in node 1 (SDK Port 28).
I20230904 17:58:24.254583 1 bf_chassis_manager.cc:120] Added port 21 in node 1 (SDK Port 36).
I20230904 17:58:24.254637 1 bf_chassis_manager.cc:156] Enabled port 21 in node 1 (SDK Port 36).
I20230904 17:58:24.278813 1 bf_chassis_manager.cc:120] Added port 22 in node 1 (SDK Port 44).
I20230904 17:58:24.278869 1 bf_chassis_manager.cc:156] Enabled port 22 in node 1 (SDK Port 44).
I20230904 17:58:24.303071 1 bf_chassis_manager.cc:120] Added port 23 in node 1 (SDK Port 52).
I20230904 17:58:24.303126 1 bf_chassis_manager.cc:156] Enabled port 23 in node 1 (SDK Port 52).
I20230904 17:58:24.303238 1 bf_chassis_manager.cc:120] Added port 24 in node 1 (SDK Port 60).
I20230904 17:58:24.303303 1 bf_chassis_manager.cc:156] Enabled port 24 in node 1 (SDK Port 60).
I20230904 17:58:24.352911 1 bf_chassis_manager.cc:120] Added port 25 in node 1 (SDK Port 184).
I20230904 17:58:24.352980 1 bf_chassis_manager.cc:156] Enabled port 25 in node 1 (SDK Port 184).
I20230904 17:58:24.375525 1 bf_chassis_manager.cc:120] Added port 26 in node 1 (SDK Port 176).
I20230904 17:58:24.375913 1 bf_chassis_manager.cc:156] Enabled port 26 in node 1 (SDK Port 176).
I20230904 17:58:24.415376 1 bf_chassis_manager.cc:120] Added port 27 in node 1 (SDK Port 168).
I20230904 17:58:24.415442 1 bf_chassis_manager.cc:156] Enabled port 27 in node 1 (SDK Port 168).
I20230904 17:58:24.443178 1 bf_chassis_manager.cc:120] Added port 28 in node 1 (SDK Port 160).
I20230904 17:58:24.443236 1 bf_chassis_manager.cc:156] Enabled port 28 in node 1 (SDK Port 160).
I20230904 17:58:24.466044 1 bf_chassis_manager.cc:120] Added port 29 in node 1 (SDK Port 144).
I20230904 17:58:24.466104 1 bf_chassis_manager.cc:156] Enabled port 29 in node 1 (SDK Port 144).
I20230904 17:58:24.488970 1 bf_chassis_manager.cc:120] Added port 30 in node 1 (SDK Port 152).
I20230904 17:58:24.489027 1 bf_chassis_manager.cc:156] Enabled port 30 in node 1 (SDK Port 152).
I20230904 17:58:24.511910 1 bf_chassis_manager.cc:120] Added port 31 in node 1 (SDK Port 128).
I20230904 17:58:24.511967 1 bf_chassis_manager.cc:156] Enabled port 31 in node 1 (SDK Port 128).
I20230904 17:58:24.534922 1 bf_chassis_manager.cc:120] Added port 32 in node 1 (SDK Port 136).
I20230904 17:58:24.534978 1 bf_chassis_manager.cc:156] Enabled port 32 in node 1 (SDK Port 136).
I20230904 17:58:24.542274 1 bf_chassis_manager.cc:120] Added port 3300 in node 1 (SDK Port 64).
I20230904 17:58:24.542477 1 bf_chassis_manager.cc:156] Enabled port 3300 in node 1 (SDK Port 64).
I20230904 17:58:24.552229 1 bf_chassis_manager.cc:120] Added port 3302 in node 1 (SDK Port 66).
I20230904 17:58:24.552461 1 bf_chassis_manager.cc:156] Enabled port 3302 in node 1 (SDK Port 66).
I20230904 17:58:24.552592 1 bfrt_switch.cc:60] Chassis config pushed successfully.
I20230904 17:58:24.561874 1 p4_service.cc:121] Pushing the saved forwarding pipeline configs read from /etc/stratum/pipeline_cfg.pb.txt...
I20230904 17:58:24.562047 1 p4_service.cc:142] Empty forwarding pipeline configs file: /etc/stratum/pipeline_cfg.pb.txt.
I20230904 17:58:24.562477 1 hal.cc:220] Stratum external facing services are listening to 0.0.0.0:9339, 0.0.0.0:9559, localhost:9559...
```




- Entender os requisitos para sessões no SD-Core
- Emulação de UEs e gNBs para sessões UPF no ambiente de integração





Obrigado!

