SD-RAN Techinar
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RAN transformation: Starting point

OSS/BSS

SON

Monitoring/Logging/Config/Control Portal

Vendor Specific

Vendor Specific

Vendor Specific

Mobile Core

eNB

BBU

RRU

S1
RAN disaggregation
RAN disaggregation
E2AP & E2SM

• E2AP defines the general protocol by which the nRT-RIC and disaggregated E2 Nodes communicate.
  – Action Types: Report, Insert, Policy, Control

• E2SMs are “contracts” between an xApp and the E2 Node. They define function specific protocols that are implemented on top of the E2AP specification.

• The implementation of a given E2SM on the gNB side requires explicit feature and interface development / stack enhancements
A1, O1 & O2
SD-RAN

μONOS nRT-RIC

O-RAN E2 SMs

New E2 SMs

DU

CU-C

CU-U

RU

E2

E2

E2

A1/O1

SDK

xApp

Aarna Networks

ONF

Intel

Facebook

Airhop

cohere

Radisys

SERCOM

Parallel

Wireless

µONOS
xApp SDKs
SD-RAN Solution

ONF xApps
SDK

3rd party xApps
SDK

μONOS nearRT RIC

Interoperability, QA, tooling, releases, certification

CU-C
CU-U
DU

Vendor A

CU-C
CU-U
DU

Vendor B

ONF CU/DU + E2 Emulator

100k+ UEs

ONF RAN Simulator

RU

Non RT RIC

Orchestrator

Mobile Core
**SD-RAN v1.0**

**SD-RAN on hardware**

- RIC
  - onos-topo* (R-NIB)
  - UE-NIB*
  - atomix
  - onos-cli
- KPM xApp
  - onos-e2sub
  - onos-e2-sm
  - onos-e2t
- O1t* (onos-config)
- OMEC
  - E2/ CU-C
  - E2AP over ASN.1/SCTP
- KPM SM
  - KPM xApp
  - onos-e2-sm
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- SDK
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**Components**

- USRP+NUCs
- UE (OAI)
-RU / DU / CU (OAI) USRP+NUCs
- phone
- SDK
- RanSim
- OMEC
SD-RAN v1.0 Components & Operation

- App requests for CU-CP stats
- E2 node makes SCTP association with RIC
- E2 node sends E2AP Setup Request with KPM SM Ran Function
- RIC sends E2AP Setup Response with Accepted Ran Functions
- RIC sends E2AP Subscription Request for Target Ran Function with Event Trigger and Action Type Report
- E2 Node accepts with E2AP Subscription Response
- E2 Node generates periodic Indications of Type Report with CU-CP KPM IEs
- RIC delivers reported data to app
xApps use SDK to connect - via gRPC - to various RIC platform services in order to:
- Learn RAN topology of E2 nodes, etc.
- Subscribe to telemetry from E2 nodes
- Send control messages to E2 nodes
- Accept configuration via O1 termination
- Accept policies via A1 termination

E2Ts manage connections to E2 nodes:
- Handle E2AP handshake
- Transcode ASN.1 <> Protobuf

Subscription service tracks:
- Subscription requests
- Available E2T nodes
E2 Termination (onos-e2t)

- **E2 Access Protocol (E2AP)**
  - Handled by Manager
  - ASN.1 driven object model

- **E2 Service Models**
  - Handled by plugins
  - ASN1 converted to Protobuf for xApp
  - Loaded in to same process
  - Common interface
SD-RAN v1.0

SD-RAN on hardware

SD-RAN in a Box
SD-RAN Component: CU/DU/RU & UE
Hardware Setup
SD-RAN v1.0

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- RANSim
- NI/KPM/++ SMs

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SD-RAN Dev/Test: sdRan-in-a-Box (RiaB)

OAI version

[Diagram showing the architecture of SD-RAN Dev/Test: sdRan-in-a-Box (RiaB)]
SD-RAN Dev/Test: sdRan-in-a-Box (RiaB)

RANSim version

- onos-kpimon
- Atomix
- onos-cli
- onos-e2sub
- onos-e2t
- onos-config
- onos-topo

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E2 flow
CP flow
UP flow
Prometheus

RAN Simulation Model (YAML)
("static")

Nodes, SM IDs
Locations

E2 Node
E2 Agent
E2 Agent
E2 Agent

UE
E2 Agent

UE

UE Sim API

UE Model (UEs, node associations, routes, RSSI, etc.)

RAN Model (nodes, locations, power, E2T bindings, etc.)

ASN.1/SCTP

E2T
E2T
... E2T

UE
UE
UE
UE
UE
UE
UE
UE

UE Sim API

RAN Sim API

Nodes, locations, events
induce failures, events, etc.

RAN Simulation Model (YAML)
("static")

Nodes, SM IDs
Locations

UEs & events

UEs & events

UE
UE
UE
UE
UE
UE
UE
UE

UE Sim API

control UI counts
induce joins, movement, etc.
manage routes, etc.

metrics

Prometheus

reasim CLI

ONOS GUI
**SD-RAN Roadmap**

**SD-RAN on hardware**
- **UE (OAI)** USRP+NUCs
- **OMEC**
- **SDK**
- **RI**
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- **KPM SM**
- **RC-PRE/ KPM/ ++ SMs**

*Note: The diagram shows the relationships and dependencies between different components of the SD-RAN architecture.*
Thank You

https://opennetworking.org/sd-ran/