

Energy Saving and Traffic Steering Use Case and Testing by O-RAN RIC xApp/rApp Multi-Vendor Interoperability

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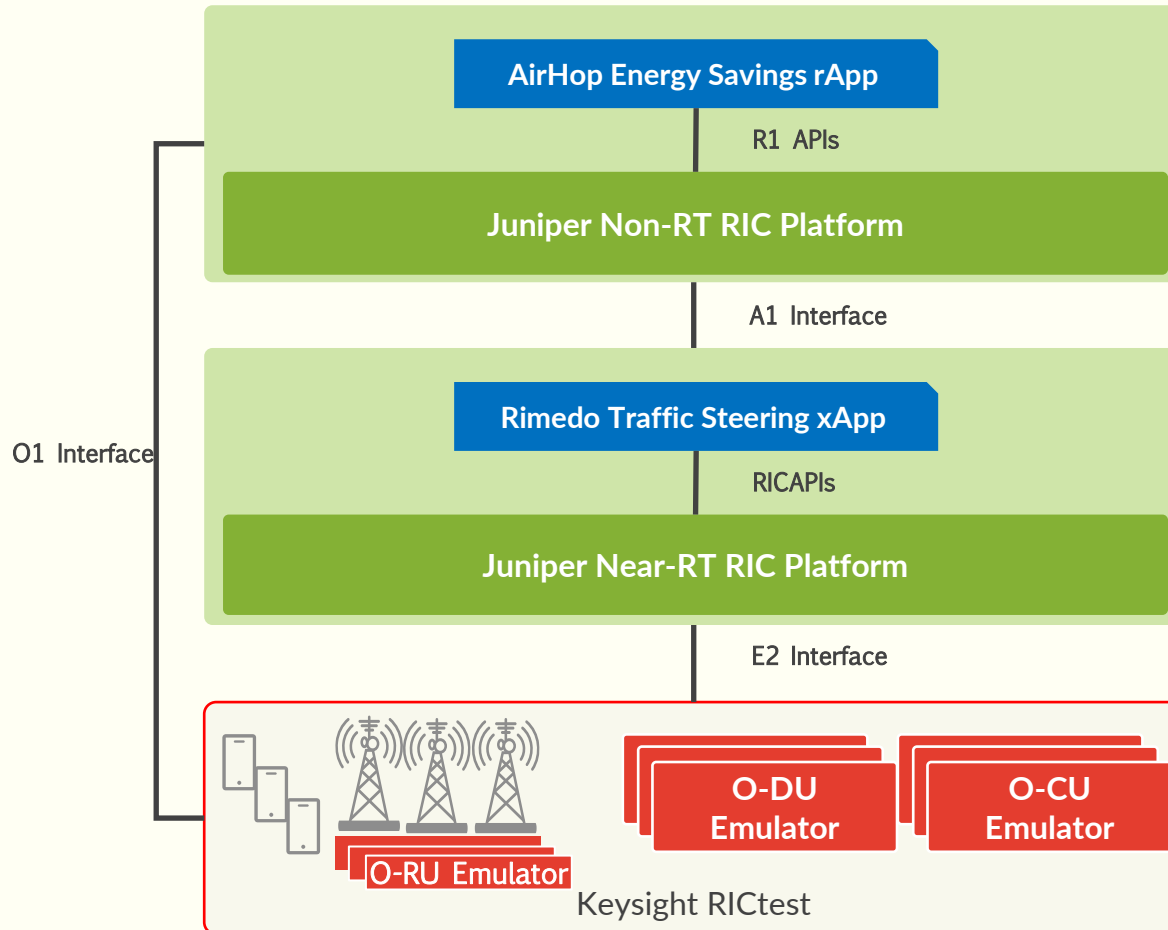
⁵ Vodafone



Goals

- Depict an approach for Operator consideration that realizes benefits of Energy Savings and Traffic Steering.
 - Demonstrate a multi-vendor setup utilizing Traffic Steering xApp and Energy Saving rApp cooperatively.
 - Implement and test enhancements as required.
- Use real Production data to:
 - Describe Energy Savings projections which may incentivize adoption.
 - Inform site configurations.

Collaborative Approach



Multi-vendor r/xApps running simultaneously

AirHop's Energy Savings rApp & Rimedo's Traffic Steering xApp

Based on real network topology and data

From Vodafone Group

Using commercially available Non-RT RIC & Near-RT RIC

From Juniper Networks

Open APIs (Non-RT R1 and Near-RT RIC APIs)

Between Juniper RICs and AirHop, Rimedo applications

O-RAN compliant interfaces O1, A1, E2

Fully standards compliant interfaces

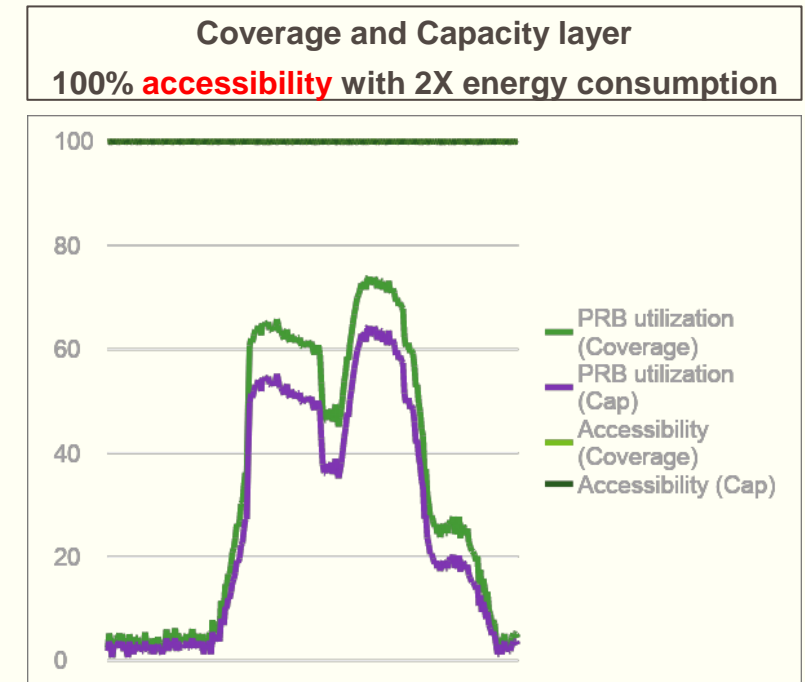
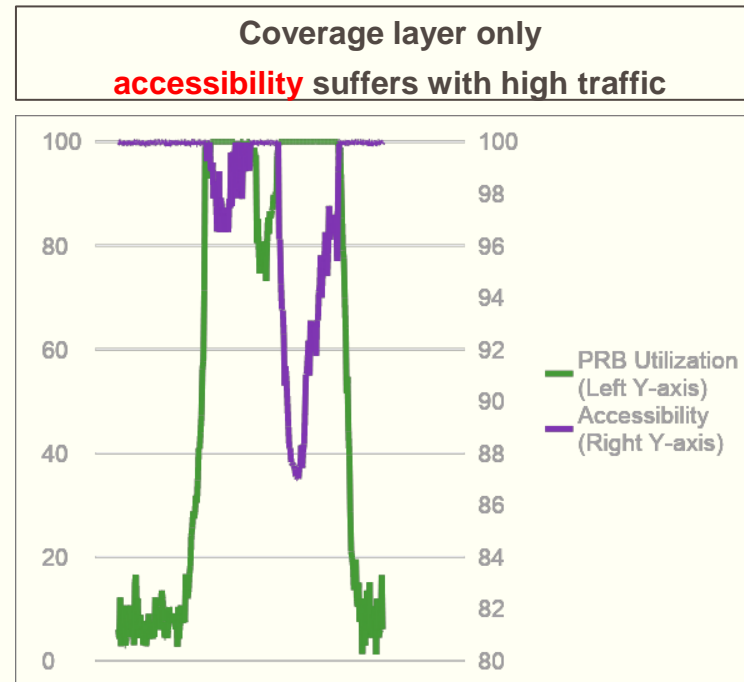
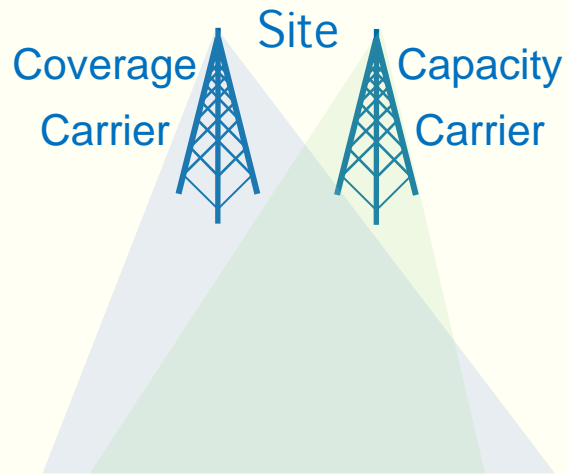
Multiple simultaneous E2SM(s) in action – KPM, RC, CCC

Utilizing the power of E2 interface

Network emulation using RICtest

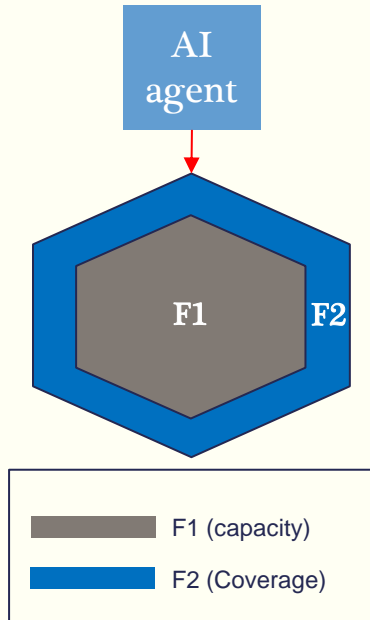
From Keysight Technologies

AirHop: Dynamic Multi-Carrier Energy Savings Management

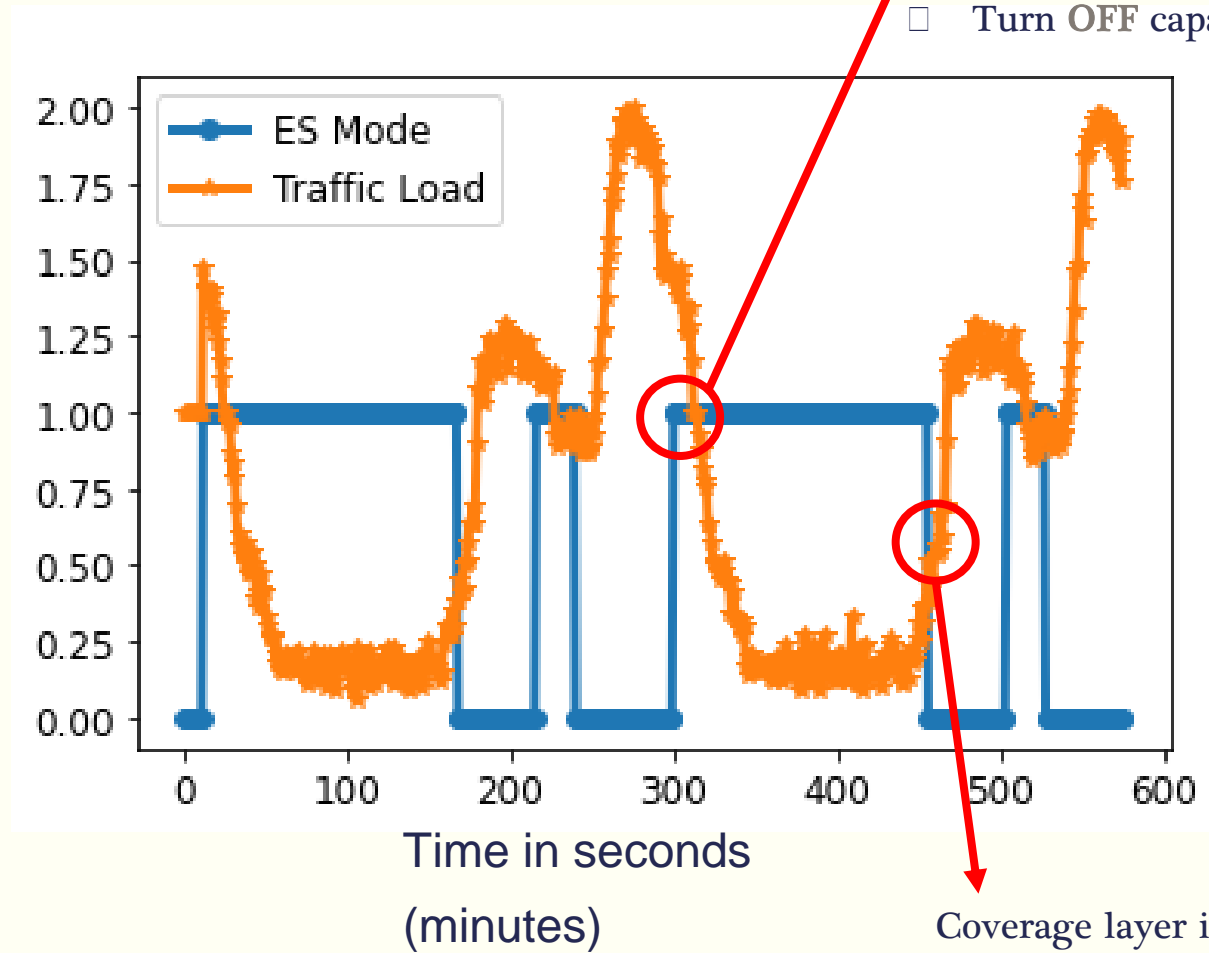


- CSPs experience varied levels of service demand through the day and across users' segments
- CSPs want energy consumption to dynamically adapt to the mobile network service demand
- Energy Savings rApp leverages AI base learning and RAN programmability

AirHop: Using AI for Smart RAN Energy Savings



PRB Utilization (Traffic)



Coverage layer is going to become underloaded
(Load drops below 100%)

□ Turn **OFF** capacity layer (ES mode from 0 to 1)

ES Mode
determines the
state of
Admissions
Control

Coverage layer is going to become overloaded
(Load exceeds 100%)

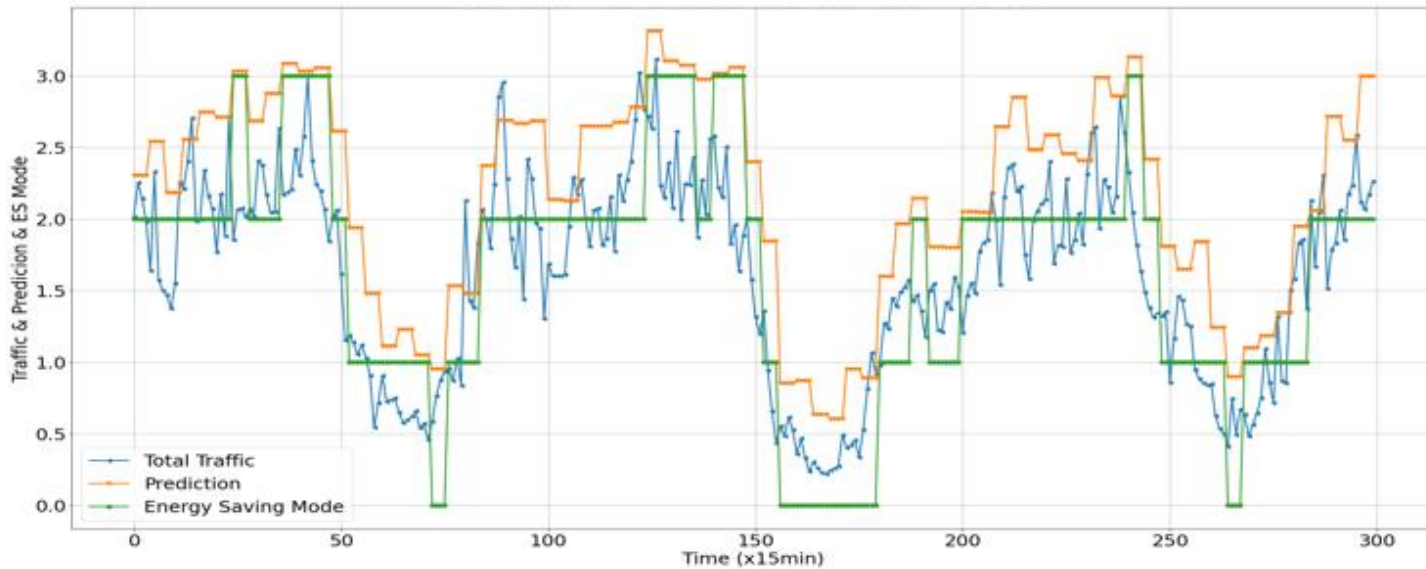
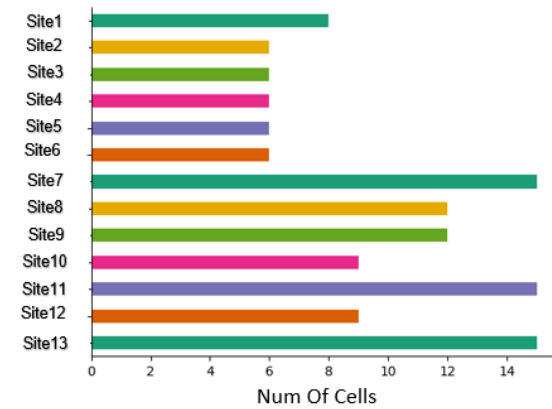
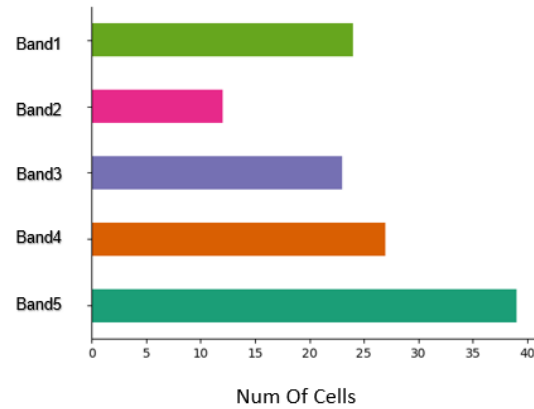
□ Turn **ON** capacity layer (ES mode from 1 to 0)

AI Model Considerations

- Vodafone Dataset
 - 13 sites and 41 sectors across 5 bands
 - Granularity: 15 minute
 - Duration: 2 weeks

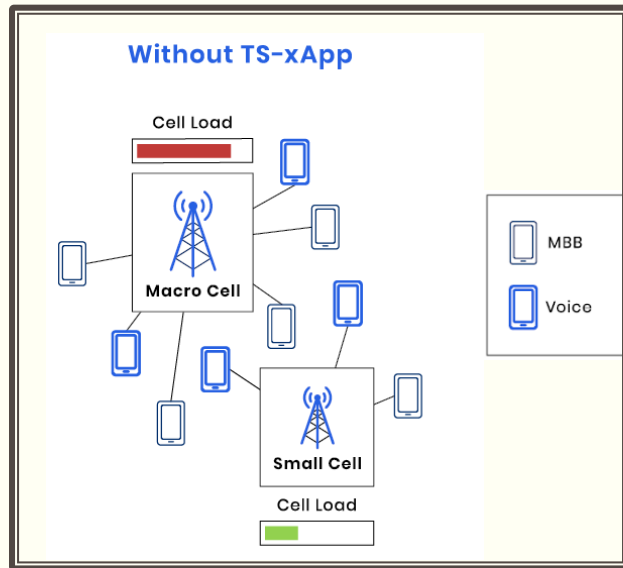
AirHop: Results with Vodafone Dataset

- Energy saving mode = 0 → Coverage carrier only
- Energy saving mode = 1 → Coverage + 1 Capacity carrier
- Energy saving mode = 2 → Coverage + 2 Capacity carrier
- Energy saving mode = 3 → Coverage + 3 Capacity carrier

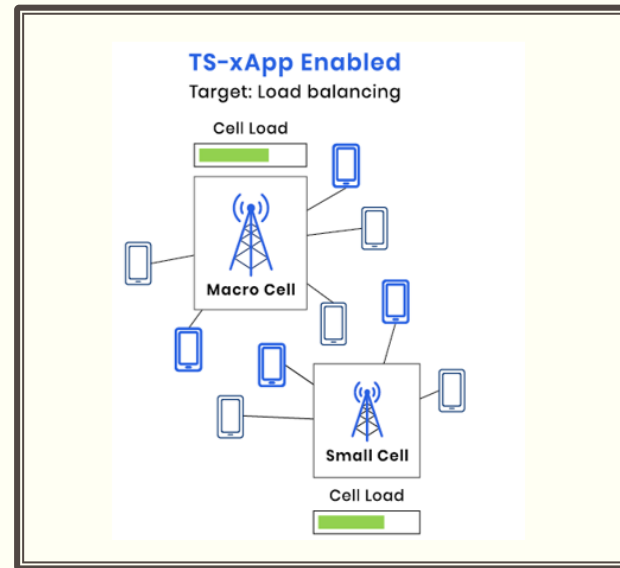


- ✓ ~25% energy saving on the capacity layers
- ✓ Maintain **accessibility** level of 99.999%.

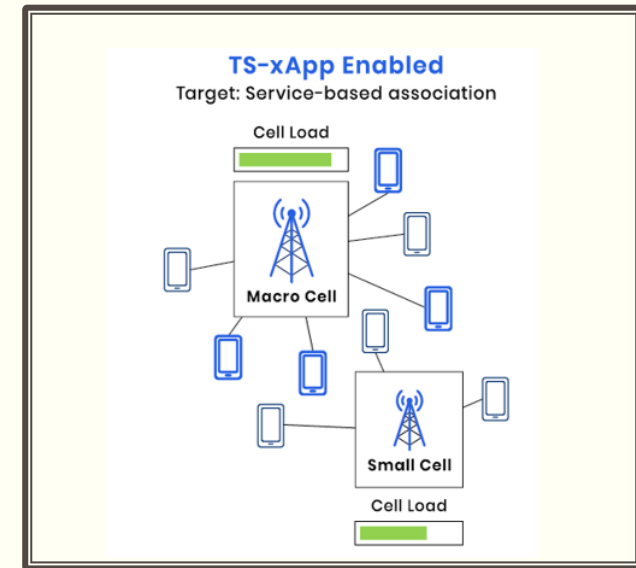
Rimedo: Traffic Steering xApp



Unmanaged **Accessibility**

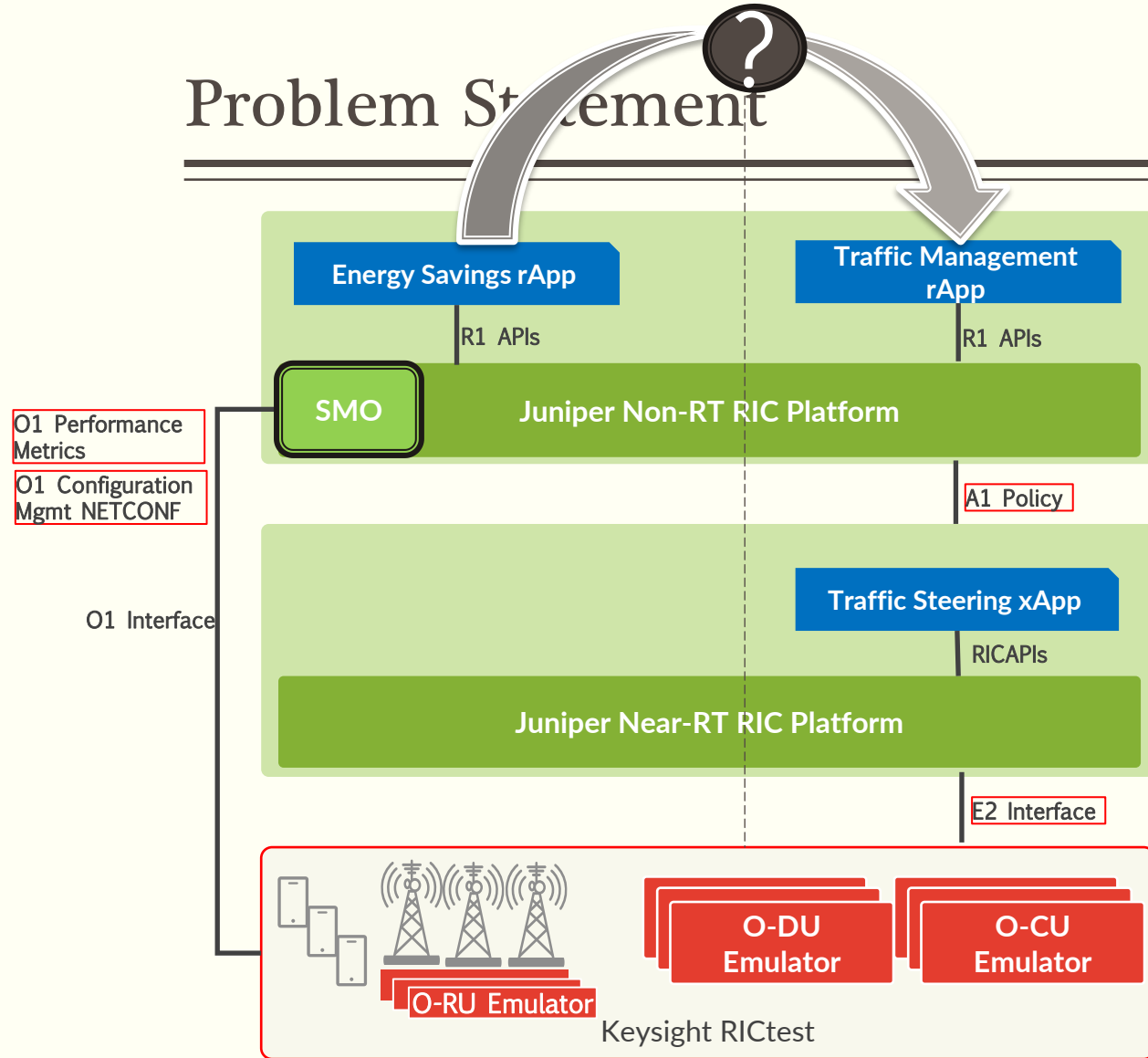


Managed **Accessibility**:
Load Balancing



Managed **Accessibility**:
Service-Based Association
(e.g. band affinities)

Problem Statement



Energy Savings rApp

- Cell switch actions affect Admissions Control and cell availability.

Traffic Steering xApp

- Knowledge of Admissions Control critical to role

Accessibility

- Service availability is dependent on state of Admissions Control

Potential for Conflict

- TS hands one or more UEs over to an ES candidate cell
- TS may not have effective algorithms to identify changes in environment
- TS does not optimally hand over needful UEs to new cell

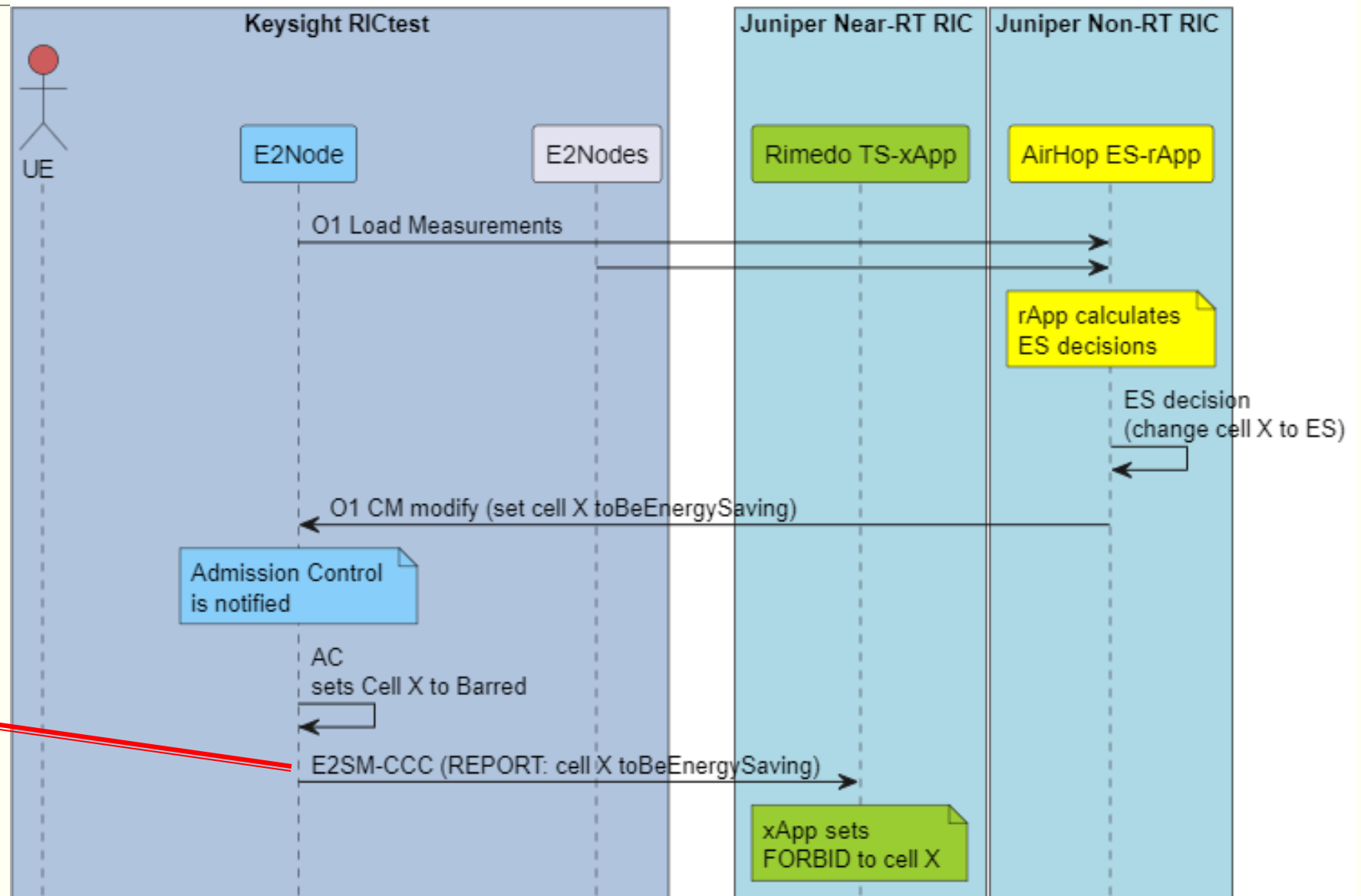
Challenge

How can TS be aware of state of Admissions Control for cell being managed by ES?

New Flow: E2SM-CCC: REPORT: CELL: energySavingControl

```

    ▼ Member: cesSwitch
      [Path with value: /indicationMessage
      [Member with value: cesSwitch:true]
      True value
      Key: cesSwitch
      [Path: /indicationMessageFormat/list
    ▼ Member: energySavingControl
      [Path with value: /indicationMessage
      [Member with value: energySavingCont
      String value: toBeNotEnergySaving
      Key: energySavingControl
      [Path: /indicationMessageFormat/list
    ▼ Member: energySavingState
      [Path with value: /indicationMessage
      [Member with value: energySavingStat
      String value: isNotEnergySaving
      Key: energySavingState
      [Path: /indicationMessageFormat/list
  
```



```

E2SM-CCC
(Report: cell X
Key: energySavingControl
String: toBeEnergySaving
Key: energySavingState
String: isNotEnergySaving
)
  
```

New Flow: E2SM-CCC: REPORT: CELL: energySavingState

Evacuation

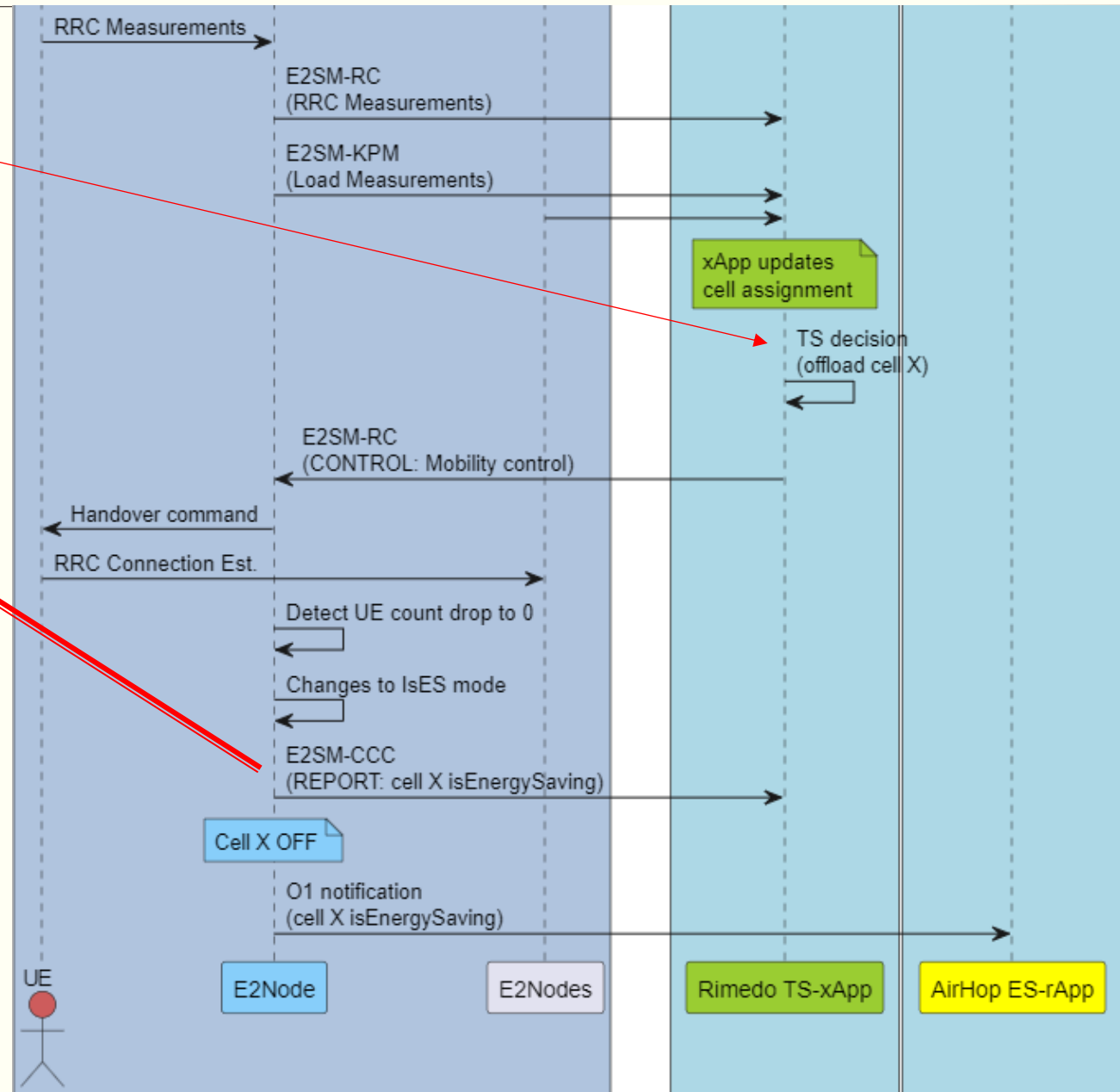
- Traffic Steering responds by offloading the ES candidate cell

E2SM-CCC

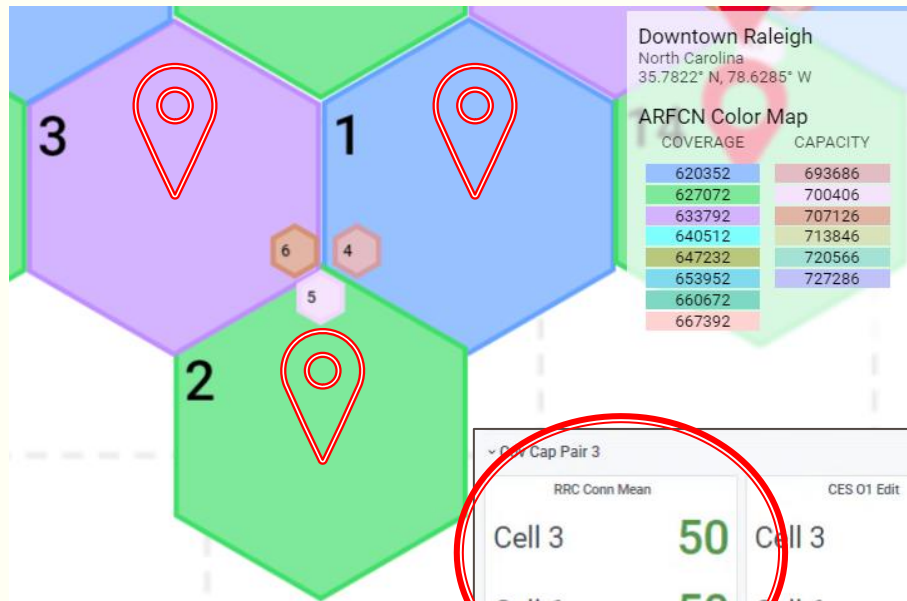
```
(Report: cell X  
Key: energySavingControl  
String: toBeEnergySaving  
Key: energySavingState  
String: isEnergySaving )
```

Cell Resumption

- During Cell Resumption, the flow is the same, but with the Control and the State reset to original values.
- TS xApp actively onboards UEs on Admissions Control and cell availability



Testing: Setup



Vodafone Sample

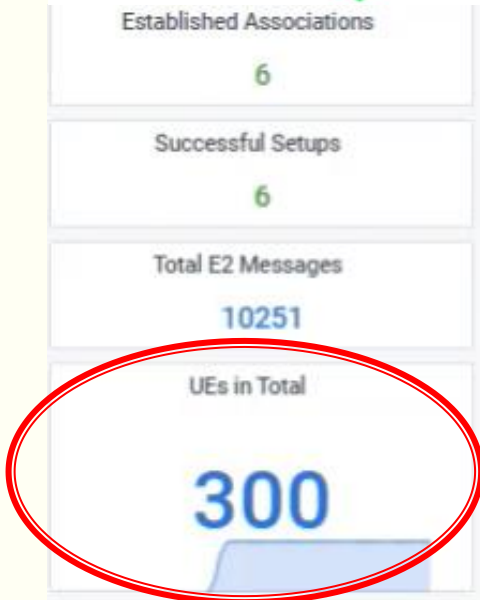
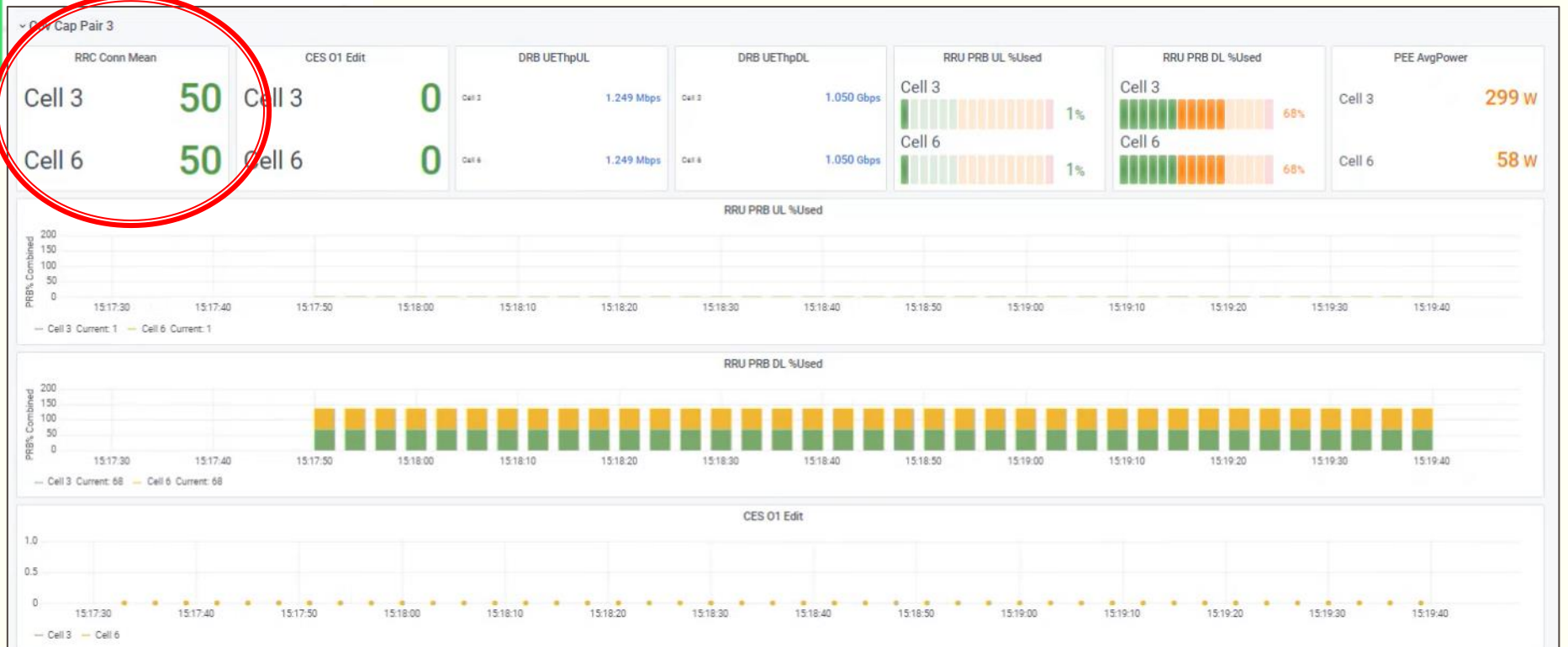
- 3 coverage carriers, [1,2,3] 3 capacity carriers [4,5,6]
- 50 UEs per Cell, 300 UEs total
- Inverted bell curve over time for Traffic Load



Coverage Carrier Load

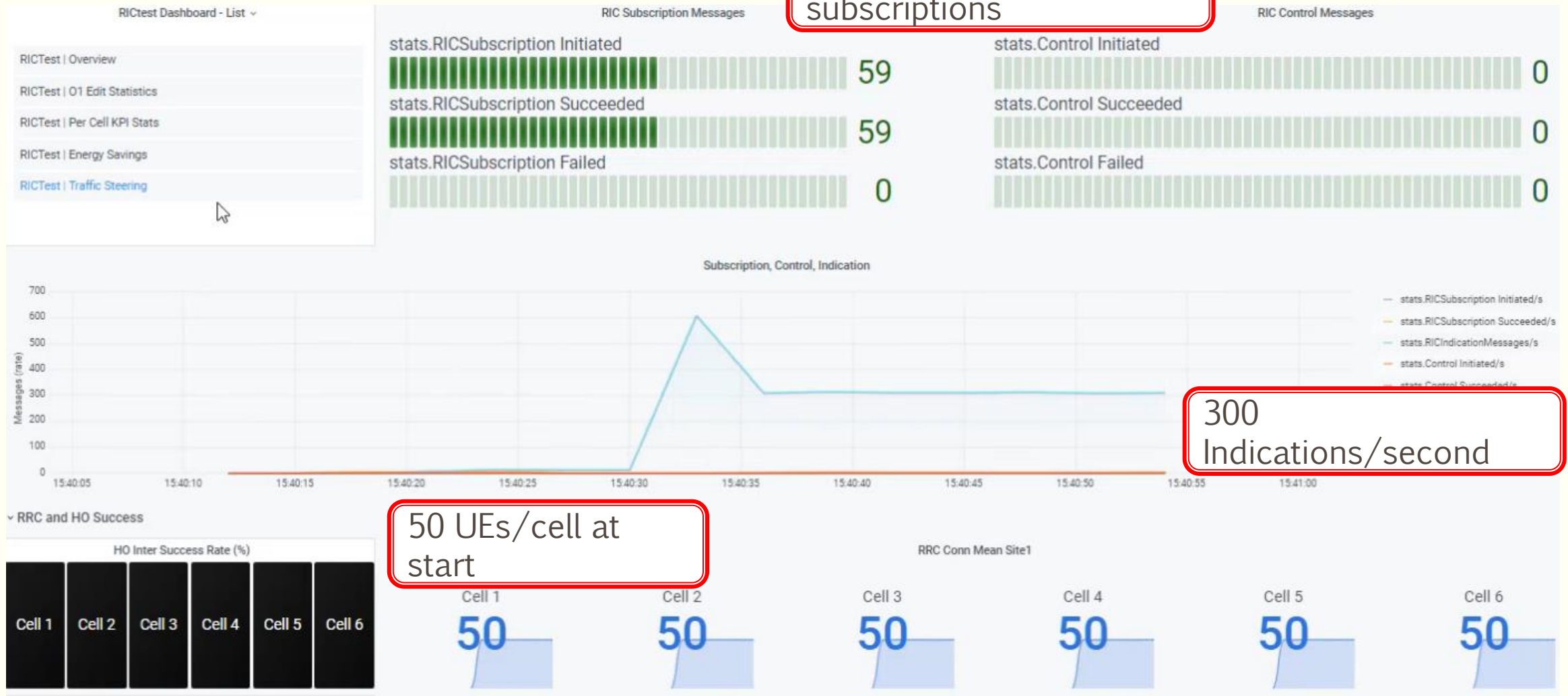


Capacity Carrier Load



Testing: Ramp Up

Incrementing subscriptions



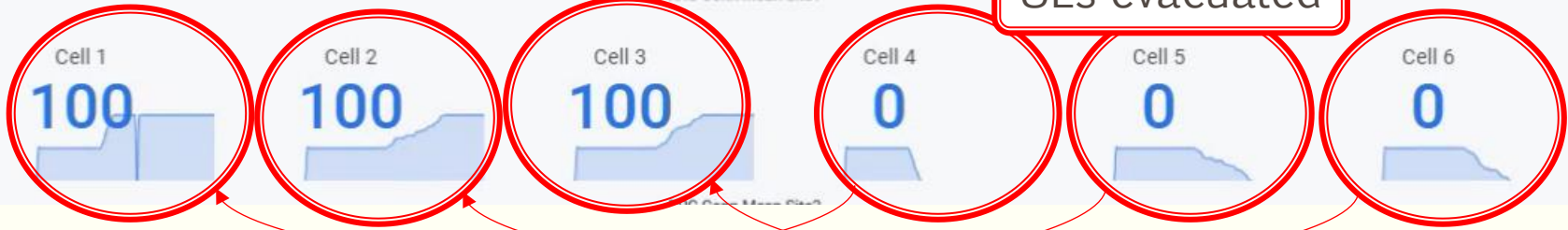
Testing: E2SM-CCC: REPORT: CELL

Controls for Handover Actions



Handover Successes

UEs evacuated



Testing: ES and TS cell switch cycle

 Coverage Carrier Load  Capacity Carrier Load



Goals: Result and Discussion

- Use real Production data to:
 - Describe Energy Savings projections which may incentivize adoption.
 - Inform site configurations.

“In terms of results, all the capacity carriers achieved energy savings of 25% with 99.999% accessibility based on the Vodafone anonymized dataset, as simulated by the Keysight RICtest.”

- “Vodafone anonymized dataset“ consisted of 13 sites and 41 sectors across 5 bands, with reporting period of 15 minutes, with duration of 2 weeks.
- Individual sites were extracted and modeled by RICtest for 24-hour periods. One of these sites was used for Use Case testing.

Goals: Result and Discussion

- Use real Production data to:
 - Describe Energy Savings projections which may incentivize adoption.
 - Inform site configurations.

“In terms of results, all the capacity carriers achieved energy savings of 25% with 99.999% accessibility based on the Vodafone anonymized dataset, as simulated by the Keysight RICtest.”

- Airhop's projections reported the energy saving gains as the percentage of time that the AI model decided to turn off the capacity layers and took an average over all capacity layers.
- In one example, the site has 5 cells (1 coverage and 4 capacity layers). The coverage layer is always ON, so the ES percentage is zero. The first capacity layer is OFF around 10% of the time, the second capacity layer 33%, the third capacity layer 73%, and the fifth layer 98%.
- The reported percentage number (25%) is averaged over all capacity layers of the dataset.

Goals: Result and Discussion

- Depict an approach for Operator consideration that realizes benefits of Energy Savings and Traffic Steering.
 - Demonstrate a multi-vendor setup utilizing Traffic Steering xApp and Energy Saving rApp co-operatively.
 - Implement and test enhancements as required.

“The interaction and the cooperation between AirHop’s Energy Savings rApp and Rimedo Labs’ Traffic Steering xApp was achieved with (O-RAN E2 Service Model Cell Configuration and Control (E2SM-CCC) inherent design principles.”

- Admissions Control state transfer via O-CES structure in CCC was successful.
- TS actively assists ES.

Thank You.