# ISG ZSM PoC Final Report: Intent-driven Energy Saving

## 1.1    PoC Project

| PoC Number:<br>*(assigned by ETSI)* | 9 |
|---|---|
| PoC Project Name: | Intent-driven Energy Saving |
| PoC Project Host: | Huawei |
| Short Description: | This PoC Project will describe the use of an intent-driven approach for radio network Energy Saving in the radio network domain. The PoC aims to demonstrate:<br>1) How an intent-driven approach used by a NOP (as MnS consumer/intent owner) to express the RAN energy saving expectation (including energy efficiency targets and user experience targets) to a NEP (as MnS producer/intent handler/intent management entity).<br>2) How the NOP monitors the RAN energy saving effects, by obtaining a detailed intent report (e.g. regarding energy consumption) from NEP.<br><br>(Note: NOP - Network Operator; NEP - Network Equipment Provider)<br>The implementation of the solution of this PoC complies with the 3GPP standards and ZSM standards. The design architecture of the use case follows ZSM 002 (ZSM framework), and uses the intent-driven management service (including intent management operations and intent information model) defined in 3GPP TS 28.312. |

## 1.2    PoC Team Members

| | Organisation name | ISG ZSM participant (yes/no) | Contact (Email) | PoC Point of Contact (*) | Role (**) | PoC Components |
|---|---|---|---|---|---|---|
| 1 | Huawei | Yes | fengxiaohan@huawei.com;<br>liyexing@huawei.com;<br>yuan.xie@huawei.com;<br>xuruiyue@huawei.com; | X | Network Supplier | - Use case definitions<br>-Storyline/ Implementation of the baseline architecture<br>-Design of the Functional Block<br>-Implementation of the specific algorithms<br>-Provide hardware and software |
| 2 | Deutsche Telekom | Yes | klotzm@telekom.de | | Network Operator | -Use case definitions |
| 3 | China Telecom | Yes | wangd5@chinatelecom.cn;<br>liz779@chinatelecom.cn | | Network Operator | - Use case definitions<br>-Business model definition |
| 4 | Xidian University | No | guideyang2050@163.com | | University | -Algorithms Model |

All the PoC Team members listed above declare that the information in this proposal is conformant to their plans at this date

and commit to inform ETSI timely in case of changes in the PoC Team, scope or timeline.

## 1.3 PoC Project Scope

# 1 PoC Project Details

## 1.3.1 PoC Topics

*PoC Topics identified in this clause need to be taken for the PoC Topic List identified by ISG ZSM and publicly available in the ZSM WIKI. PoC Teams addressing these topics commit to submit the expected contributions in a timely manner.*

| PoC Topic Code | PoC Topic Description | Related WI | Expected Contribution | Target Date |
|---|---|---|---|---|
| Topic 3 (Intent-driven Closed-loop automation) | Intent-driven approach for radio network Energy Saving | ZSM-016 | Reference Architecture for this PoC. RAN energy saving intent model, processing procedure. | April 2025 |

## 1.3.2 Other topics in scope

*List here any additional topic for which the PoC plans to provide input/feedback to the ISG ZSM.*

| PoC Topic Code | PoC Topic Description | Related WG/WI | Expected Contribution | Target Date |
|---|---|---|---|---|
| A | | | | |
| B | | | | |
| C | | | | |
| D | | | | |

## 1.4 PoC Project Milestones Review

| PoC Milestone | Milestone description | Target Date | Additional Info |
|---|---|---|---|
| P.S | PoC Proposal submission | Nov 2023 | Official PoC proposal submission |
| P.D1 | PoC Demo 1 | Mar 2024 | Demonstrate standardized intent-driven interface. Please note that the software and setup used in Demo 1 will also be used in Demo 2. In other words, Demo 2 will be built upon Demo1. |
| P.PU | Contribution on lessons learned from Demo 1 | April 2024 | Collect feedback about Demo 1 and lessons learned about the PoC, and make improvements. |
| P.D2 | PoC Demo 2 | May 2024 | Demonstrate intent handling, and RAN energy saving action execution, with intent report returned for energy saving effect evaluation and monitor. |
| P.R2 | PoC Report completed | Jun 2024 | Report final draft |
| P.R3 | PoC Report feedback cleared | July 2024 | PoC-Project-End Feedback |
| P.E | PoC Project End | April 2025 | |

NOTE: Milestones need to be entered in chronological order.

## 1.5 Confirmation of PoC Events Occurrences

This PoC was presented in two separate face-to-face events and the details are captured below:

- **Events Names and Occurrences**:
  - ETSI ZSM#26 held from March 4th to 7th, 2024 in Madrid, Spain.
  - ETSI ZSM#27 held from May 13rd to 16th, 2024 in Montreal, Canada.
- **Events descriptions**:
  - ETSI ZSM#26 meeting: Performed Demo 1, collect feedback about it and make improvements.
  - ETSI ZSM#27 meeting: Performed Demo2, and discussion around it.

## 1.6    Other dissemination activities

This PoC was presented at TMF MSDO 2024, see "2024-12-10+AN+MSDO+Meeting+notes".

# 2        PoC Technical Details

## 2.1      PoC Overview

### 2.1.1      Use-case Description

This PoC Project will demonstrate the use of intent between NOP (as intent owner) and NEP (as intent handler) in the RAN energy saving scenario, using the intent management operations and intent information model as defined in 3GPP TS 28.312 [3].

According to clause 3.1 of GS ZSM-016 [2], intent owner and intent handler maps to MnS consumer and MnS producer defined in 3GPP TS 28.312 [3] respectively:

- intent owner: logical entity that originates intents and is responsible for managing intents lifecycle. An intent owner is an intent-driven MnS consumer for a specific intent.
- intent handler: logical entity that receives intents and handles them in the domain that is responsible for that intent's fulfilment. An intent handler is an intent-driven MnS producer for a specific intent.

In this PoC, we use an Intent Platform GUI (as shown in figure 1) to convey the Network Operator's intent. The Intent Platform GUI is part of NOP, through which user can input the intent IOC (intent expectation, intent contexts, etc.), so here we mainly focus on demonstrating the interactions between NOP and NEP.

RAN energy saving benefits to lower OPEX for mobile operators, through the reduction of power consumption in the mobile networks. RAN energy saving is achieved by executing energy saving actions with suitable parameter configurations, such as energy saving state switch, start time and end time, the energy saving thresholds. One typical scenario of energy saving is to reduce (or switch-off) radio resources when the traffic demand is low, and re-activate them on a need basis. However, the energy saving actions may deteriorate the service experience (e.g. throughput, coverage), and it is not straightforward to evaluate the influence on service experience of energy saving actions, since the real network is complex with diverse services of different requirements and the traffic distribution is always changing. Therefore, an intent driven approach may be used to determine the optimal energy saving solution to satisfy the NOP's intent expectation for energy saving and service experience.

### 2.1.2      Scope and Content of the PoC

This PoC demonstrates how to automatically promote energy saving with an intent-driven approach.

The detailed use case is as follows:

1. When receiving an intent related to RAN energy saving from NOP, NEP translates the intent and derives the energy saving actions to satisfy the intent. Typically, examples of these actions include "switch on some energy saving algorithms in the cell", "configure the cell overlaid relations" etc.
2. During intent fulfilment, detailed intent report will be sent to NOP to notify the fulfilment status continuously. In this use case, not only the intent fulfilment result will be presented, but more information about energy consumption or energy efficiency will be provided. The energy consumption metrics uses the RanEnergyConsumptionTarget as defined in 3GPP TR 28.312. All this information may be presented to NOP in a visualization view based on the required precision, such as the energy consumption of areas or radio access sites.

## 2.2 PoC Architecture

This PoC will use the intent-driven management service (including intent management operations and intent information model) defined in 3GPP TS 28.312 [3], which might be the instantiation of the management services defined in GS ZSM-016 [2] clause 8.1. Figure 1 illustrates an example of intent driving energy saving approach. Within E2E network and service domain, NOP can create energy saving intent by utilizing the intent management service, which is sent through the standard intent-driven interface. After intent execution, NEP may provide NOP with an intent report with detailed information of relevant performance metrics, such as energy saving effect distribution, domain energy consumption distribution, etc.
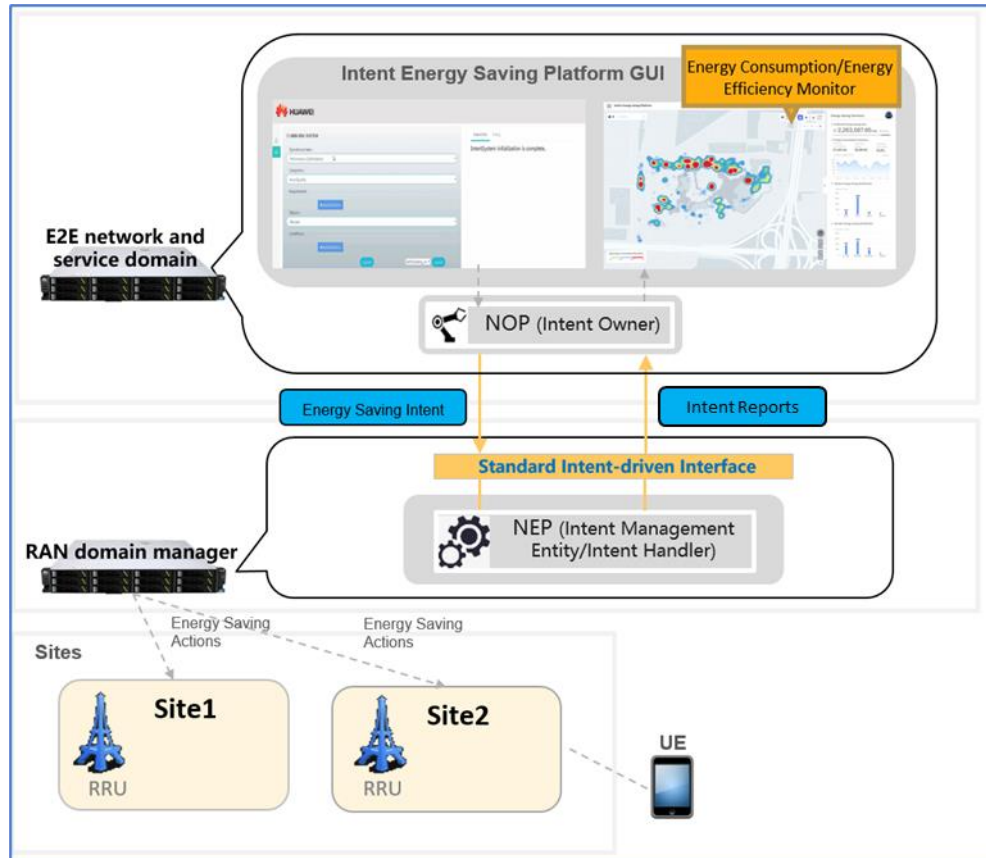


**Figure 1 Use case of this PoC**

The following figure depicts the PoC architecture mapping to the ZSM framework (ZSM 002 [1].
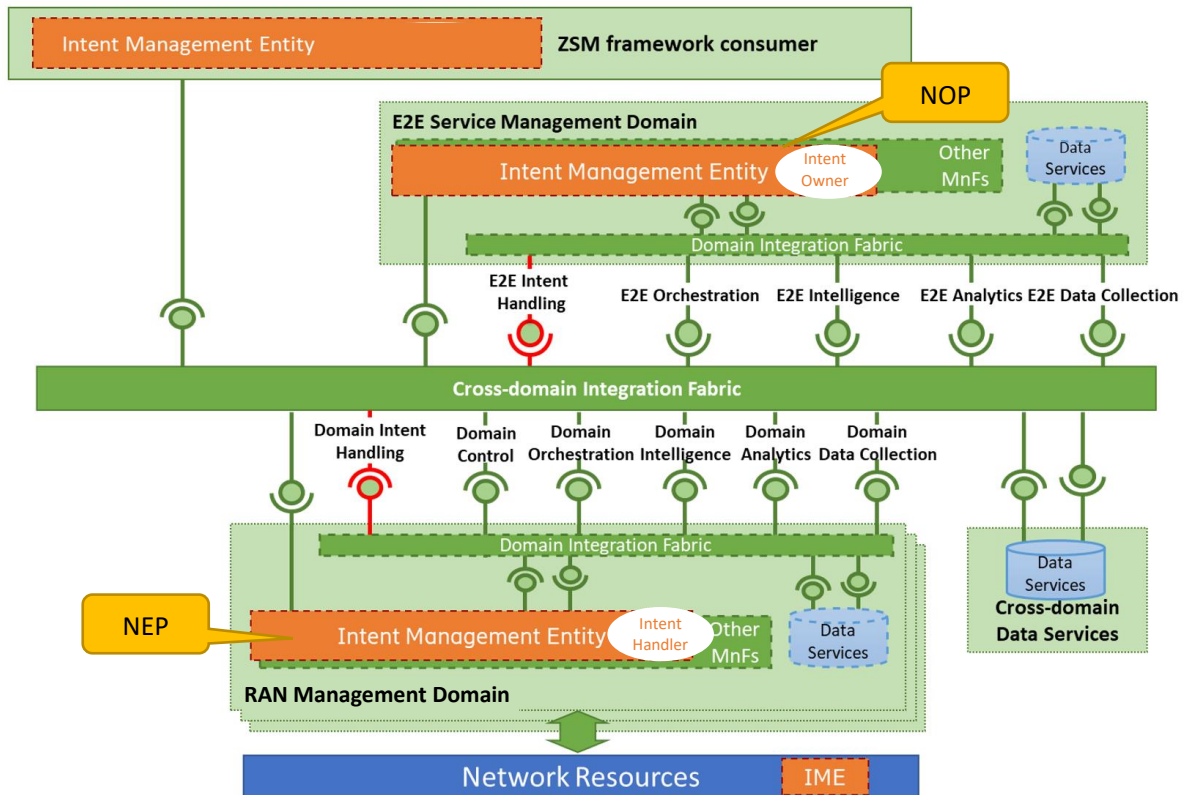
**Figure 2 Architecture of Intent Based RAN Energy Saving**

In order to achieve use case described in Figure 1, the architecture mainly consists of the following:

1. The E2E network and service domain may send energy saving intent through the standard intent-driven interface to the RAN domain manager. The E2E network and service domain is equivalent to NOP in Figure 2. The standard intent-driven interface in Figure 1 corresponds to Domain Intent Handling Interface in ZSM architecture, and the NEP in Figure 1 corresponds to intent handler/intent management entity in Figure 2.

2. NEP may request to execute the desired actions on RAN nodes. The RAN domain in this use case corresponds to the Network Resources in ZSM architecture (Figure 2).

3. NEP should report the real-time Network performance (RAN energy saving performance and service experience performance) to NOP, allowing operators to confirm the rationality and effectiveness of the energy-saving targets in a timely manner.

## 2.3.    Overall Workflow of our PoC

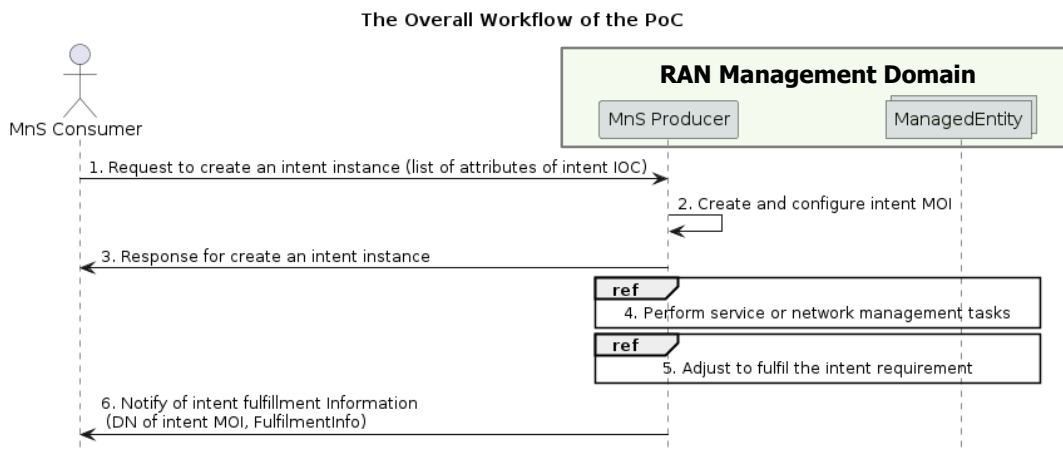The overall workflow of our PoC is illustrated in figure 3.

**Figure 3: The Overall Workflow of the PoC**

The procedure, as illustrated in figure 3, consists of the following steps:

1. MnS Consumer sends a request to create an intent instance to MnS Producer with intent information for the new intent to be created.

2. Based on the received request, the MnS Producer creates the concrete intent instance and configure the new created intent MOI with the received intent information.

3. MnS Producer sends a response to the MnS Consumer.

4. Based on the created intent, MnS Producer identifies the MOI for managed entities (e.g. ManagedElement, ManagedFunction) and derives one or more executable management tasks (including deployment and configuration parameters) for these managed entities, then MnS producer deploys or configures corresponding managed entities with deployment and configuration parameters to satisfy the intent instance.

5. MnS Producer analyses and adjusts the managed entities to ensure the intent is continuously satisfied.

6. MnS Producer should notify MnS Consumer about the intent report information which are required by the MnS consumer.

## 2.4.    Gaps identified between ZSM standardization and this PoC

This clause provides the gaps between ZSM standardization and PoC implement for your reference.
- Items exists in the standard, but are not reflected in the POC:
  1. Intent negotiation related operations (e.g. Judge, Feasibility, Best).
  2. Intent fulfilment evaluation.
- ~~Items exists in the POC, but are not recommended for standardization:~~
  ~~1. The observable adjustment approaches for intent assurance~~
  ~~2. Time-based benefit evaluation of intent assurance outcomes.~~

## 2.5.    Future Steps and Developments

The new POC project would be initiated to address the gaps demonstrated in clause 2.4, specifically, for the items that exist in the standard, but are not reflected in the POC.

## 2.6    Additional information

The references used throughout this document are listed below.

[1]     ETSI GS ZSM 002: "Zero-touch network and Service Management (ZSM); Reference Architecture".
[2]     ETSI GS ZSM 016: "Zero-touch network and Service Management (ZSM); Intent-driven Closed Loops".
[3]     3GPP TS 28.312: "Technical Specification Group Services and System Aspects; Management and orchestration; Intent driven management services for mobile networks".