ENI ISG - PoC Proposal

1 PoC Project Details

1.1 PoC Project

PoC Number (assigned by ETSI):

PoC Project Name: Intelligent Coverage Optimization of 5G Massive MIMO BS

PoC Project Host: China Telecom

Short Description: This PoC will provide viable solutions and methodologies for the Coverage Optimization of 5G Massive MIMO BS(Base Station) through the use of a set of AI(Artificial Intelligence)/ML(Machine Learning) algorithms based on a set of data including MR data, BS information(e.g. Engineering parameters, antenna information, etc.), geographic information (e.g. electronic map),etc. Beam management policies will be based on general and specific AI models to help BSs achieve a better coverage efficiency and minimize interference at the same time.

The proposed PoC intends to deploy, test and validate the AI-based methologies framework as those proposed by the above mentioned ENI WIs. More specifically, this PoC plans to improve radio coverage and capacity by using a transferable set of policies.

1.2 PoC Team Members

Table 1.1

	Organization name	ISG ENI participant (yes/no)	Contact (Email)	PoC Point of Contact	Role	PoC Components
1	China Telecom	Yes	Xueqi Yuan (yuanxueqi@chinatelecom.cn) Yanfen Li (liyanfen@chinatelecom.cn) Feng Wang wangfeng6@chinatelecom.cn	X	Service Provider	- Use Cases definition - PoC development - PoC documentation - PoC demos
2	Intel	Yes	Haining Wang (haining.wang@intel.com) Tong Zhang (tong2.zhang@intel.com) Ribo Sun(ribo.sun@intel.com) Kuo Liao(kuo.liao@intel.com) Wei Wen(wei.wen@intel.com)		Manufacturer	-Help with implementation and optimization of AI algorithm, testbed setup and demo
3	Inspur	No	Wei Li liwei05@inspur.com Bin Li li-bin01@inspur.com		Manufacturer	- Help with software development

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

1.3.1 PoC Goals

The detailed goals include:

- **PoC Project Goal: Data Analysis and Policy-Based Coverage Optimization**.

Demonstrate the use of AI based data analysis to enable policy-based coverage optimization for Massive MIMO BS.

1.3.2 PoC Topics

Table 1.2 contains the list of contributions that may be expected against the draft WIs active during the lifetime of the current PoC.

Table 1.2

PoC Topic Description	Document Number (Related WI)	Expected Contribution	Target Date
Infrastructure Management-> Radio Coverage and Capacity Optimization	ENI-014 v3.0.5 (GS ENI 001 Use Cases) ENI-015 v3.0.6 (GS ENI 002 Requirements) ENI-016 v2.0.13 (GS ENI 005 Architecture)	1. Framework of Intelligent Coverage Optimization of 5G Massive MIMO BS 2. Functional blocks of this PoC Project. 3. The feasibility of Intelligent Coverage Optimization of 5G Massive MIMO BS by applying AI/ML algorithms. 4. Report on the suitability of ENI Reference Architecture for this PoC.	Dec. 2021

1.4 PoC Project Stages/Milestones

This table reflects the milestones planning done for this PoC in terms of roadmap for PoC submission, contributions, test plan, demos, and reports. It should be noted that dates pointed out are merely indicative, i.e. they are valid just an ideal sequence plan. However, at this moment, they may be changed during PoC roll out due to current covid-19 situation.

Table 1.4

PoC Milestone	Stages/Milestone description	Target Date	Additional Info
P.S	PoC project submission	10/2020	Presentation during #ENI Rapporteur Call#160
P.S	PoC user story	12/2020	
P.TP.1	PoC Test Plan 1	03/2021	Test plan based on the user story
P.TP.2	PoC Test Plan 2	06/2021	Test of joint system and optimization
P.D1	PoC Demo 1	TBD	ETSI ENI#19 ?
P.D2	PoC Demo 2	TBD	
P.R	PoC Report	09/2021	PoC-Project-End Feedback
P.E	PoC Project End	12/2021	Presented to ISG ENI for information

2 PoC Technical Details

2.1 PoC Overview

To achieve high speed, massive connection, ultra-low time-delay and high-quality user experience, 5G Massive MIMO adopt beam forming technology to form multiple 5G broadcast beam configurations, great change, along with great challenges has taken place . Before the 4G network, equipped with passive RF devices, antenna beam pattern are fixed, and when problems like poor coverage or high interference appeared in the network, the main way to optimize network performance is to adjust electrical tilt angle. However, 5G Massive MIMO realizes adaptive beam pattern adjustment to

fit different scenario. Flexible combination of beam envelope gain, horizontal beamwidth, vertical beamwidth, electric tilt angle and azimuth angle enables flexible adjustment of the beam increases management complexity. Thus for subsequent Massive MIMO coverage optimization, traditional manual tuned instruction based policy to optimize target area coverage is not suitable for 5G Massive MIMO, so more precise AI based models can be used to provide further and more precise stragety for optimization. This PoC will realize intelligent coverage optimization based on AI to improve 5G network performance.

In terms of improving radio coverage, AI can be helpful in many aspects, such as scenario analysis, UE(user equipment) data filtration and localization, channel modeling optimization, and intelligent beam management. Various AI methodologies and algorisms can be validated according to real scenarios, the coverage can benefit both from general and specific AI models and further reducing interference. The PoC team is eager to work with Intel, and Inspur and potential partners to form a closed loop in the radio coverage optimization sphere.

This PoC is proposed to demonstrate the use of AI in a coverage optimization context in order to perform categorization and coverage optimization strategy analysis. To achieve these goals, the following methodologies (see Figure 1 "ML and AI based UE fingerprint localization, scenario analysis, channel model optimization and intelligent beam management") are used:

Firstly, the trigger mechanism of coverage optimization module is that from MR data, the percentage of UE whose RSRP or SINR can not meet required level reaches certain level.

1. The first stage is Input Processing. In this stage, the detailed information of MR data, BS information(e.g. Engineering parameters, antenna information, etc.), geographic information (e.g. electronic map),etc. are extracted from external database. Thus, for the first part of PoC Project Goal: Data Input. One part of this module is to identify valid data, such as MR data filtration, another part of this module is to adopt AI-based methods to process related data, for example, user fingerprint localization module can use MR data and main & neighbor BS station information to fullfill some missing MR geographic information or to correct some UE positioning information. The other part of this stage is to normalize data, such as integrate BS's engineering information and pre-processed MR data to into a relative coordinate system,etc.

2. The second stage is Data Analysis, by the use of pre-processed MR data, geographic information,etc., general and specific ML algorisem can achieve scenario analysis, which is utilized as key condition for future AI algorism based channel model optimization. As for channel model optimization, the MR data, road test information, and scenario analysis result are processed by specific AI algorism. Combined with pre-processed data(e.g BS engineering information and MR data), the channel model optimization result, and current objective function, Intelligent Beam Management module can give the optimal antenna beam stragety. This shall demonstate necessary condidition for another part of PoC Project Goal: Policy-Based Coverage Optimization: using AI algorithms to enable policy-based coverage optimization.

3. The third stage is Decision and Output. In this stage, according to the pre-determined optimization policy, the system will decide the optimization plan. This plan will be used by operator to optimize BS's coverage.

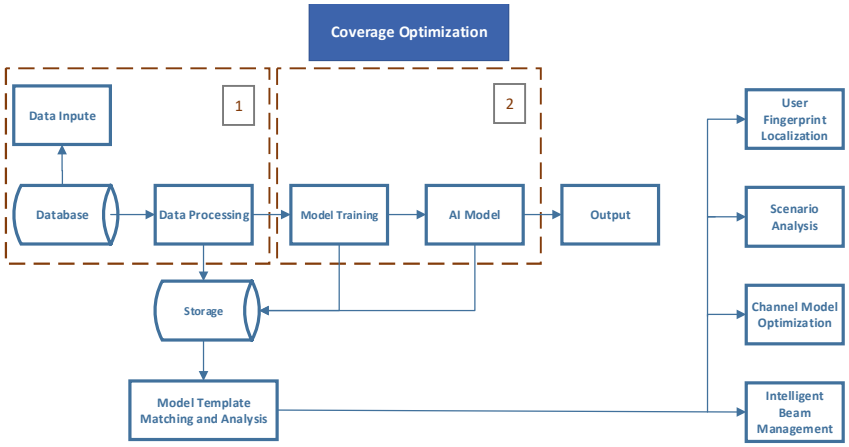

Figure 1: Stages of this PoC

A.2.2 PoC Architecture

This PoC proposes the deployment interaction scenario, where the PoC System interacts with the ENI System as an assisted system.

To achieve this target, in a context where the ENI System performs part of functionalities, the reference point between different PoC systems and the ENI System need to be carefully implemented because there is a lot of information exchanged between them. Certain operations will need multiple connections and coordinations among related systems. Figure 2 depicts this interaction scenario:

Figure 2 shows an interaction of internal and external reference points. In this scenario, different subsystems of coverage optimization can be connected to the ENI system where infrastructure data are collected through the data acquisition process are provided to the ENI system. This enables the ENI System to analyse the data according to the requirements so that optimal coverage policies are obtained and applied through Wireless Network System.

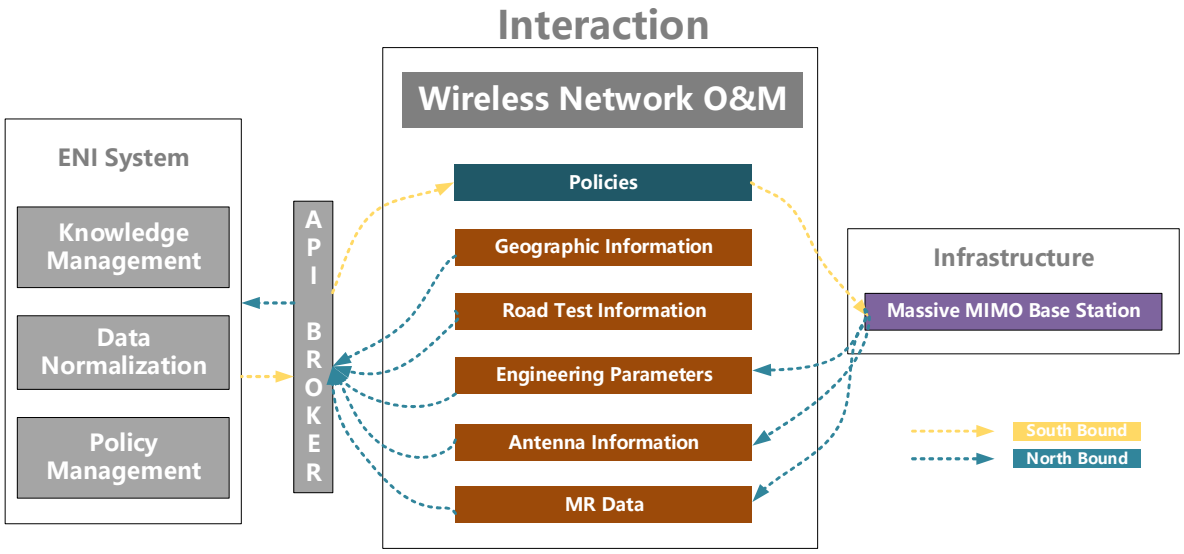

Figure 2. Interaction

A.2.3 PoC Success Criteria

All goals are met when the described functionality is proved to be available.

A.2.4 Additional information

[1] RGS/ENI-014 (GS ENI 001), “Experiential Networked Intelligence (ENI); ENI use cases”, v3.0.8

[2] RGS/ENI-015 (GS ENI 002), “Experiential Networked Intelligence (ENI); ENI requirements”, v3.0.6.

[3] RGS/ENI-016 (GS ENI 005), “Experiential Networked Intelligence (ENI); System Architecture”, v2.0.13.