ENI ISG - PoC Proposal

1 PoC Project Details

1.1 PoC Project

PoC Number (assigned by ETSI):

PoC Project Name: Intelligent Scheduling of Computational Power for Smart Grids

PoC Project Host: China Telecom

Short Description: This PoC intends to demonstrate the intelligent data centre computing power scheduling according to electricity supply constraints. By integrating computing power data and electricity data, it matches and schedules computing tasks, computing resources, and electricity supply. Based on meeting the service quality requirements of computing tasks, it responds to regulation signals from the power grid side, optimizes operational costs, reduces carbon emissions, and promotes the consumption of renewable energy through green electricity trading, with special attention to the Artificial Intelligence / Machine Learning (AI/ML) aspects, in the context defined by ENI.

Intelligent Scheduling of Computational Power for Smart Grids. In particular, this PoC addresses the optimization of computational power allocation and scheduling in response to dynamic grid demands and supply conditions. For the distribution of computational tasks, the availability of computational resources, and the variability in power supply: such as fluctuating renewable generation and real-time electricity pricing etc., there are inherent mismatches between computational load requirements and grid operational constraints. As a result, computational tasks cannot be efficiently executed without coordinated, adaptive scheduling across power and computational domains. To this end, this PoC aims to construct an intelligent scheduling mechanism that integrates computational power with smart grid operations, enabling responsive task execution, enhanced grid stability, lower operational costs, and improved integration of renewable energy sources.

Note that we will prepare to demonstrate under the use case [#5-3: Network Operations]. In general, we aim to explore collaborative scheduling technologies, operational and maintenance management models, market policy mechanisms, and other aspects through cross-industry collaboration, addressing issues such as computing resource shortages or idleness due to the uneven geographical distribution of computing and electricity resources, fluctuations in new energy supply, and curtailment of green electricity. Thus, this ENI system architecture implementation even can be applicable to other user cases.

1.2 PoC Team Members

Table 1.1

	Organization name	ISG ENI participant (yes/no)	Contact (Email)	PoC Point of Contact (see note 1)	Role (see note 2)	PoC Components
1	China Telecom	Yes	Yu Zeng (zengyu@chinatelecom.cn)	X	*Service Provider*	*- Use Cases* *- PoC development* *- PoC documentation* *- PoC demos*
2	China South Grid	No			Service Provider	*- Use Cases* *- PoC development* *- PoC demos*
3	Asiainfo	Yes	Zhongke Zhang (zhangzk10@asiainfo.com)		Vendor	*- PoC development* *- PoC documentation &* demos
4	China Unicom	No	Bingming Huang (huangbm7@chinaunicom.cn)		Service Provider	*- Use Cases* *- PoC development*
5						
NOTE 1: Identify the PoC Point of Contact with an X. NOTE 2: The Role will be network operator/service provider, infrastructure provider, application provider or other as given in the Definitions of ETSI Classes of membership.						

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 PoC will demonstrate aspects of Use Cases that were identified by in GS ENI 001, namely:
Use Case #5-3: Network Operations
The PoC will also demonstrate aspects of requirements that were identified in GS ENI 002, including:
 Cross-Domain Scheduling
 Dynamic Cost Optimization

This PoC intends to describe a method for intelligent scheduling of computational power in coordination with smart grid operations. The detailed goals include:

PoC Project Goal #1: Cross-Domain Synergy Scheduling. Demonstrate how to dynamically match computational tasks and resources with real-time grid supply conditions, such as time-of-use electricity pricing and renewable energy availability, to achieve efficient synergy between computational demand and power grid operations.

PoC Project Goal #2: Dynamic Cost-Stability Optimization. Demonstrate how to respond to grid regulation signals, optimize overall operational costs for computational infrastructure, and enhance grid stability through flexible and responsive computational load scheduling.

1.3.2 PoC Topics

PoC Topics identified in this clause need to be taken for the PoC Topic List identified by ISG ENI and publicly available, i.e. the three topics identified in clause 4.5 of the ENI PoC Framework. PoC Teams addressing these topics commit to submit the expected contributions in a timely manner.

Table A.2

PoC Topic Description (see note)	Related WI	Expected Contribution	Target Date
Network Operations -> Intelligent Network application	GS ENI 002 Requirements (release 4) GS ENI 001 Use Cases (release 4)	1.Functional blocks for this PoC. 2.Intelligent network management. 3.The resource management and orchestration.	30/12/2026
NOTE: This column should be filled according to the contents of table 1.			

1.4 PoC Project Stages/Milestones

Table A.4

PoC Milestone	Stages/Milestone description	Target Date	Additional Info
P.S	PoC Project Start	12/2025	Presentation during #ENI 36
P.D1	PoC Demo 1	03/2026	Demo in ENI#37
P.D1	PoC Demo 1	06/2026	Deno in ENI#38
…	…		
P.C1	PoC Expected Contribution 1	09/2026	contributions to ENI requirements.
P.C2	PoC Expected Contribution 2	09/2026	contributions to ENI use case.
…	…		
P.R	PoC Report	09/2026	PoC-Project-End Feedback
P.E	PoC Project End	12/2026	Presented to ISG ENI for information
NOTE: Milestones need to be entered in chronological order.			

1.5 Additional Details

2 PoC Technical Details

2.1 PoC Overview

With the continuous growth of computational tasks and data processing demands, the imbalance between the supply of computational resources and the dynamic demands of power grids has become increasingly evident. There are higher requirements for the operational efficiency of computational infrastructure, the stability of grid interaction, the level of automation, and the openness of scheduling capabilities. This PoC offers an effective solution to this supply-demand contradiction. It enables the flexible orchestration and allocation of computational resources across different tasks and timeframes. This approach not only meets the diverse performance requirements of various computational services but also maximizes the utilization of both computational and electrical resources, reduces operational costs, and enhances overall economic efficiency. Ultimately, it achieves an optimal balance between service quality and cost-effectiveness, delivering dual benefits.

To fulfill these demands, intelligent scheduling integrates vertically across computational clusters and grid management systems on a unified logical platform, creating an end-to-end, coordinated decision-making process. It flexibly combines various computational and grid regulation capabilities through pipeline optimization for users. Based on a loosely coupled architecture that respects the independent operation of power and computing systems, it provides tightly coupled, demand-responsive scheduling services for different business scenarios.

In recent years, intelligent resource scheduling technology has gained widespread attention and rapid development in various domains such as cloud data centers, high-performance computing, and distributed computing platforms. However, the problem of efficient coordination and scheduling between computational power systems and heterogeneous power grid systems has not been fully resolved. The integrated "computing-grid" ecosystem encompasses computational infrastructure on the demand side and the power grid on the supply side, each following different operational and optimization rules. Therefore, an adaptive scheduling and coordination technology that connects computational tasks with grid operations can effectively support the requirement for reliable, end-to-end service quality guarantees across the computing-grid nexus. Through the real-time matching of computational loads on the execution plane and the collaborative optimization on the control and management plane, it enhances the customized service capability of the computing-grid system for differentiated computational demands.

This PoC intends to describe an architectural framework and a method for intelligent scheduling that enables the synergistic interaction between computational task demands and smart grid supply conditions, aiming to ensure service quality, optimize costs, and promote green energy integration within this coupled ecosystem.

2.2 PoC Architecture

2.2.1 Intelligent Scheduling of Computational Power for Smart Grids Architecture

The Intelligent Scheduling of Computational Power for Smart Grids Architecture is shown in Fig. 1. We have deployed an intelligent scheduling interface and a computational power and electricity synergy management system between the computational infrastructure and the smart grid. Among them, the intelligent scheduling interface serves as the coordination channel for computational tasks and power dispatch instructions. With configurable data parsing, processing, and forwarding capabilities, the interface accurately identifies and schedules computing loads while achieving dynamic mapping between computational demand and power supply according to the policies provided by the management system. It ensures the consistency and reliability of task execution in a computational-power coordinated environment and enables adaptive synergy between heterogeneous computational and grid systems.

The computational power and electricity synergy management system interacts with the control planes of both the computational resource layer and the power grid layer, enabling collaborative session coordination between computing tasks and electricity supply. To address the differences between computational workloads and grid operations—such as variability in task types, resource availability, and power constraints: the system optimizes the matching of computational demand with grid resources and intelligently generates scheduling policies for the intelligent interface. This enhances the end-to-end quality of computational services while supporting grid stability and green energy integration.

The core layer further incorporates three key modules: data analysis, electricity scheduling, and computational power scheduling. These modules interact through transformer models for LLM applications to facilitate intelligent decision-making and information exchange with external market systems, including the electricity trading market system, computing power trading market system, and carbon emission trading system.

The infrastructure layer consists of three foundational modules: computing power data, electricity data, and the power and environment monitoring system, which collectively support real-time data acquisition and operational monitoring for the entire architecture.

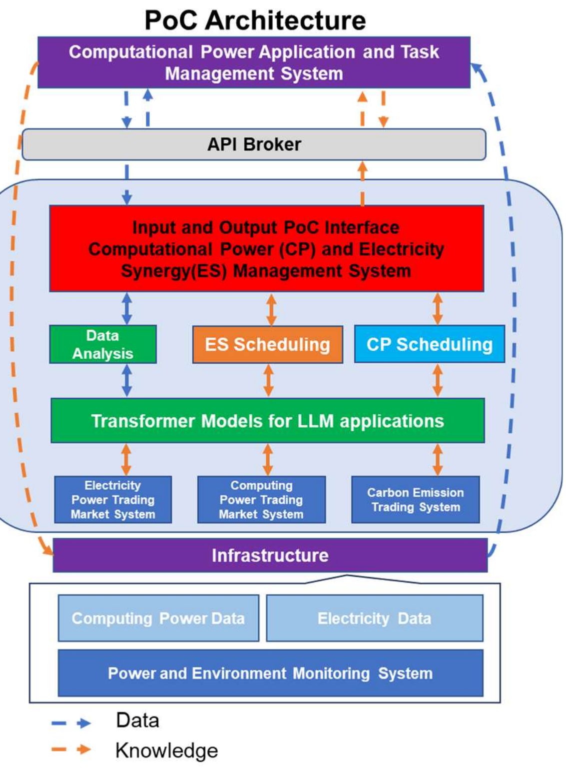

Figure 1: Intelligent Scheduling of Computational Power Architecture

2.2.2 Space Intelligent Slice Mapping

The intelligent scheduling of computational power system architecture, as illustrated in the following figure 2, is a four layers structure including: the application layer, the core layer, the data acquisition layer, and the infrastructure layer.

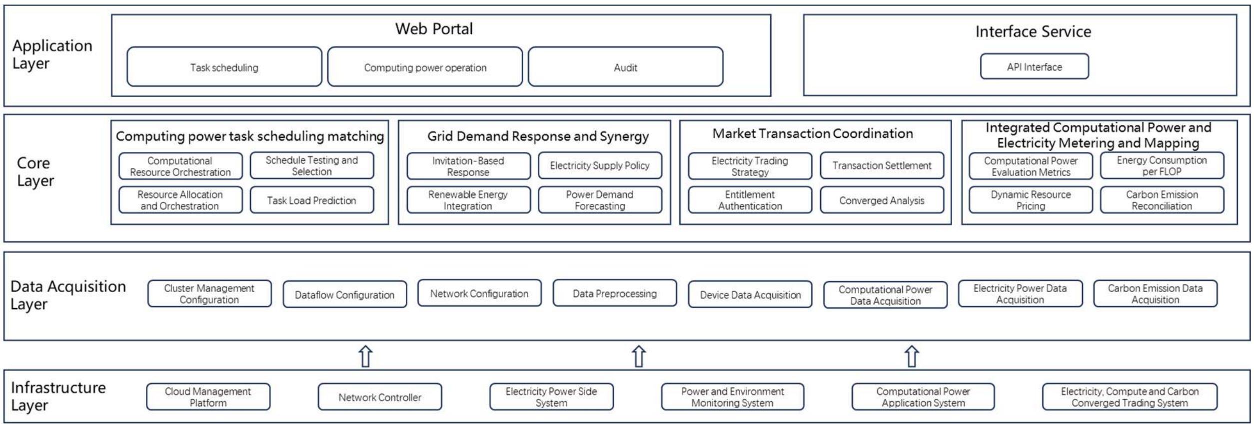

Figure 2: Intelligent Scheduling of Computational Power Architecture

The application layer provides user-facing interfaces and management functions, including a web portal & app for access, alongside core modules for task scheduling, computational power operations, supervision & audit, and comprehensive API interface services.

The core layer forms the intelligent engine of the architecture. It integrates three pivotal functional domains:

1) Computational power task scheduling matching: this includes computational task scheduling & matching, computational resource orchestration, resource allocation and orchestration, schedule testing and selection, and task load prediction.

2) Grid demand response and synergy: this domain handles grid demand response and synergy, invitation response, power supply strategy, renewable energy integration, and load forecasting to ensure grid stability.
3) Market transaction coordination: this facilitates market trading synergy through modules for trading strategy, rights certification, transaction settlement, and integrated analysis. Furthermore, it incorporates foundational metrics and mechanisms such as integrated metering and mapping of computational power and electricity, computational power evaluation metrics, dynamic resource pricing, power consumption per unit of computational power, and carbon emission accounting.

The data acquisition layer is responsible for unified data collection and pre-processing from diverse sources. Its key modules encompass cluster provisioning and configuration, device data acquisition, traffic configuration, computational power data acquisition, network configuration, electricity data acquisition, data preprocessing, and carbon emission data acquisition.

The infrastructure layer represents the underlying systems and platforms that interact with the architecture, including the cloud management platform, network controller, power-side systems, power and environment monitoring system, computational power application system, and the electricity-computational power-carbon integrated market system.

.

2.3 PoC Success Criteria

Explain how the proposal intends to verify that the goals are presented in clause A.1.2 have been met.

EXAMPLE:

Functional: The Proof of Concept successfully demonstrates the core intelligent scheduling mechanism, validating its operational workflow and decision-making logic within the integrated computational power and grid ecosystem.

Performance: Compared to conventional, siloed approaches, the system enables dynamic and synergistic adaptation of computational resources and power supply in direct response to real-time service demands and grid conditions, leading to enhanced efficiency and responsiveness.

Availability: System reliability and robustness can be continuously improved through advanced, predictive scheduling optimization algorithms, which proactively balance loads and manage resources to mitigate potential disruptions.

.

2.4 Additional information

[1] GS ENI 001 “Experiential Networked Intelligence (ENI); ENI use cases”, v4.1.1, Sec 5.3.
[2] GS ENI 002 “Experiential Networked Intelligence (ENI); ENI requirements”, v4.1.1