Editor-in-chief
Geoscientific Instrumentation, Methods and Data Systems
Dear editor and reviewer

Thank you for your warm work and insightful comments and suggestions, we really appreciate your valuable comments which helped us improve the quality of our manuscript (**gi-2022-23,** titled **Development of a power station unit in a distributed hybrid acquisition system of seismic and electrical methods based on NB-IoT**). After careful considerations, we made following revisions according to your comments:

Anonymous Referee #3

1) **RC：**Which kind of electrical method is used in the acquisition stations? What are the differences between the seismic AS and electrical AS when interfacing the two links to PSU?

   AC：Thank you for this comment. Before this PSU has developed, our research team had some development experiences on a cabled acquisition station with 1 seismic channel and 1 electrical channel. In this case, high-density electrical method and seismic joint exploration could be carried out with convenience. Therefore, the connection way is the same.

   The revised part is as follows:
   Combining the seismic and electrical acquisition stations developed by our team, a new type of power station unit (PSU) is proposed, thus a geophysical instrument networking method is also proposed in this article. The point is to retain the original functions of the LAUL and integrate the upward communication and human-computer interaction capabilities of the LCI by wireless communication. Therefore a 120-channel acquisition arrangement is developed based on a single PSU. This arrangement can be further expanded through wireless networking, which could be very convenient for joint geophysical exploration including seismic exploration and high-density electrical method exploration on complex terrain (R. G. Heath, 2008). Compared with traditional wired systems, the proposed structure can reduce a considerable number of equipments to form an efficient work and data transmission flow.

2) **RC:** How is the networking method is designed using NB-Iot in terms of network topology and routing algorithm? What’s the data throughput and package latency? Is there any test launched for evaluation of these network performance?

   AC: Thank you for your insight comment. The topology of this NB-IoT network is shown in the figure. The PSU communicate with NB-IoT base station through internal NB-IoT module, and then communicate with the OneNET cloud platform. Client access data from the OneNET platform. The communication protocol was set to LWM2M.

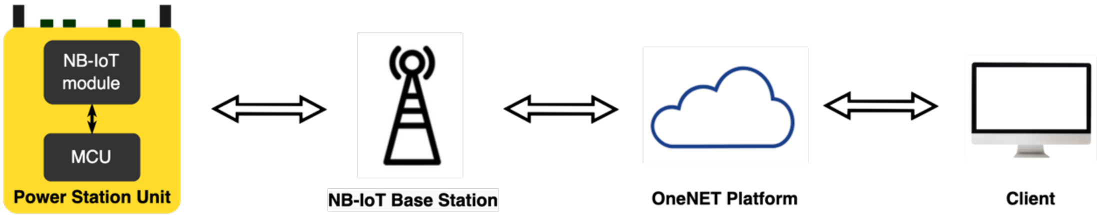

Figure 5: NB-IoT based networking topology

We implemented indoor experiment to verify the network performance of NB-IoT module. The result shows that the downstream data throughput is 8.86 kbps averaged and the package latency is 1183 ms.

The revised part is as follow:

3.4 Design of ARM® main control board

The ARM® board integrates the core board of the AM4379 (Texas Instrument, 2013) processor and various communication interfaces. The structure of main control board is shown in Figure 4.

The ARM® board communicates with FPGA using General Purpose Memory Controller (GPMC) interface and interacts with the power board through the UART serial port. Acquisition data is stored by micro-SD card. Remote monitoring and control are carried out through NB-IoT. In addition, 2.4 GHz and 5 GHz dual-band Wi-Fi module is introduced to realize wireless control and data transmission. For back-up data transmission and debugging interfaces, ethernet and RS232 serial ports are also reserved. In this case, an industrial-grade core board SOM-TL4379 based on TI AM4379 is used.

NB-IoT realizes remote data transmission between PSU and upper computer in low power consumption. The NB-IoT chip named M5310-A communication module supports LTE Cat-NB1/NB2 and has the characteristics of low power consumption (3 μA @ PSM mode) and ultra-high operating temperature range. The network topology is shown in Figure 5. Data is transmitted from MCU through UART interface to the NB-IoT module, then uploaded to the OneNET cloud platform via the NB-IoT base station (China mobile, 2018). Client then accesses the uploaded data from the OneNET cloud platform.

5.2 Remote control experiment

To upload quality control information and realize the human-computer interaction, the communication experiment based on NB-IoT is carried out to achieve the data transmission from end to cloud. As is shown in Figure 10, the remote-control functions are including online device scanning, acquisition status control, battery status, GPS information, network signal strength, etc. In the evaluation experiment, PSU supplied power to 8 seismic-electrical hybrid acquisition stations simultaneously, and the acquisition stations are controlled to enter several working conditions through remote commands. Other indoor performance experiments have been implemented as well, and the result shows that the downstream data throughput is 8.86 kbps averaged and the package latency is 1183 ms based on LWM2M protocol. By remote controlling, long-term monitoring during joint prospecting of seismic and electrical methods can be carried out, and it has good application prospects in urban underground space detection and shallow surface-wave exploration. Using the NB-IoT network can avoid serious interference from the wireless network, providing better signal coverage and signal quality.

3) **RC:** As for the power test experiment, is the power consumption of cable taken into account? The electrical current of cable segments at different positions will be different due to the AC power consumption, how is the electrical model of the system composed of electrical cable and acquisition stations is constructed?

AC: Thank you for your insight comment. In this experiment, we read the output power data from the LTC2945 chip which is the output power of the whole acquisition line, including the power consumption on the cable. As you mentioned, the electrical model in this case would be complicated due to many aspects, therefore we measured and recorded the actual output power value instead of simulation or calculation to obtain a precise result. To reduce the power consumption on the cable, the PSU is designed to have 2 output ports, one on each side.

The revised part is as follow:
We then implemented an output power evaluation experiment with AS to illustrate the output power variation with different AS quantities. Acquisition stations of one seismic and one electrical acquisition channel have been chosen as the load, and the interval between acquisition stations is 20 m in the experiment. All two power output port are used to decrease the power consumption on the cable. Output curve with AS quantity increasing is illustrated as Figure 9, which was fitted from 7 sets of discrete output power value points listed in the table at the upper left corner. This experiment proved that the proposed PSU could supply power to 120 AS.

4) **RC:** Is any field test is launched to validate the field performance?

AC: Thank you for your comment. Unfortunately, there's no big test launched to validate the performance on field, only several separated performance tests shown in the manuscript were implemented. We are also looking forward to an opportunity to test the whole system once on the actual field.

5) **RC:** In line 58, AC is used to denote acquisition station, while AS is used to denote the same in figure 1(b) and figure2. There are some other spell errors the author should pay attention to, such as "carry" in line 275.

AC: Thank you for your comment for those mistakes. We unified the abbreviation of Acquisition Station by AS. And several spelling errors as well as the format mistakes had also been corrected.

We did try our best to improve the manuscript, and we really appreciate for Editors & Reviewers' warm work earnestly, and hope that the correction and revision will meet with approval.

Once again, thank you very much for your comments and suggestions.

Feng GUO, Qisheng ZHANG, Shenghui LIU
China University of Geosciences Beijing
zqs@cugb.edu.cn