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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "Development of a New Centralized Data Acquisition System for Seismic Exploration" *by* Feng Guo et al.

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1.RCs: Use of obscure or vague terminology is discouraged, e.g.: "Function extensions", could be replaced e.g. with "applications" or "use cases"

AC: "Use Cases" instead of "Function Extensions" was seleted as the subtitle.

2.RCs: Specific comments A photograph/rendering of the realized instrument should be included.

AC: The photograph of CUGB-CS48DAS has been attached as a figure in the manuscript. And it is the Fig. 1 here for the final response.

3.RCs: Section 3 "Core Technology for Acquisition System" intro text is very hard to

follow. There is e.g. one sentence that stretches over 4 lines. Please revise and clarify.

AC: The sentence stretched over 4 lines has been clarified and revised as "Communication protocols and workflows between modules are defined by the process controller, which determines the operating state of the overall system. The process controller also acts as the hardware emulation layer in the aspect of architecture development, providing the software interface of the instrument with a complete application interface, which is essential for the overall acquisition system to possess high project portability."

4.RCs: Figure 3 and the related subsection 3.1 needs clarification. -It is unclear whether the modules on the figure are purely software modules or are some of them interfacing e.g. on the user display or the seismometer sensors. -Figure 3 introduces the "Web Server". However, there is no mention of a web server in the paper. -There are two message stacks, how do these differ?

AC: First of all, the process controller is the background program part of the upper computer software, which means that it is a module of pure software. The process controller implements data communication and parameter setting between different hardware units, and it does not contain a physical interface connecting to the user display or sensors. Secondly, the 'Web Server' represents the network data receiving server based on UDP protocol in the upper computer software. As the client, the acquisition control module is connected to the Web Server through the network, and transmits the acquired data to the Web Server for subsequent processing and storage. Thirdly, there are two types of Message Stacks. The one connected to the Web Server and Data Processor is related to data upload, which is achieved through the network due to the large data volume. The other Message Stack is used to transmit the command and control messages through UART. These two Message Stacks work separately to complete the whole data acquisition process.

5.RCs: "Electrical Prospecting" should be explained in subsections4.3.

AC: I have attached the pseudo-sections of apparent resistivity and apparent polariz-

ability of CUGB-CS48DAS in comparison with that of DUK-2A. Results (Fig. 2 in the final response) are described in the revised manuscript as:

Field comparative experiment was then implemented later at the suburban area of Beijing, in contrast with the high-density electrical prospecting instrument named DUK-2A. The pseudo-sections of apparent resistivity and apparent polarizability is shown as Figure 8. Figure 8(a) and 8(b) represent the apparent resistivity of DUK-2A and CUGB-CS48DAS, and Figure 8(c) and 8(d) represent the apparent polarizability of DUK-2A and CUGB-CS48DAS.As is shown in Figure 8(a)and 8(b), the pseudo-sections of apparent resistivity of the both instruments are basically consistent, except for some small scaled anomalies. And the pseudo-sections of apparent polarizability shown as Figure 8(c)and 8(d) by DUK-2A and CUGB-CS48DAS also indicate a high consistency. It can be proved that the performance of CUGB-CS48DAS used as an electrical exploration instrument is in compliance with the requirements and has the value of practical application.

6.RCs: Explain the benefits of using the IoT technology in subsection 4.4, by e.g. using an example of how a distributed sensor network could be used for science or engineering uses.

AC: As the comment of the reviewer, the former description of the application of NB-IoT is somehow not specific enough. So a more detailed description of the advantage of NB-IoT in comparison with the current node seismographs and wireless communication networking technology has been added based on our research and development experience. And the revised 4.4 is shown as below:

Recently, the NB-IoT chip named BC95 was introduced to make it possible for connecting the Internet of things. Via the UART interface, data exchange between the host control module and BC95 can be accomplished. Commercial network become available thanks to the internal GSM/GPRS module of BC95.That means the CUGB-CS48DAS acquisition system has the ability to connect to the NB-IoT network. When constructing

urban underground space monitoring and natural disaster warning systems, we hope to deploy seismic acquisition stations in the areas covering the entire city to monitor the activity of underground media. However, it is not simple to build up the communication network between acquisition stations and the central station covering an area as large as a city. Taking the node seismograph as an example, the wireless data transmission methods between node and the central station are mainly a relay type transmission based on a multi-hop network, for example the scheme of WTU-508 system, and a wireless data transmission scheme based on a high-power directional Access Point (AP) connecting directly with the central station using the star topology. Among them, the multi-hop network has a short single-station interval, and the communication distance of the directional AP is basically no further than 5 km ideally. Therefore, there are plenty of limitations that cannot adapt to the complex environment of the city. The LTE-based data transmission method is also one of the strategies, but the LTE network coverage capability is also limited, and it should be authorized by the telecom operator before using, which is not conducive to the early development. The advantage of NB-IoT is that there is no need to build an extra network for communication and the signal coverage of NB-IoT is even better. The base station of NB-IoT can increase the gain by 20dB compared with that of LTE, which means that stations can communicate normally in buildings and even underground garages and other places with obstacles. This advantage provides great convenience for the layout of seismic instruments. Moreover, this is implicitly also an advantage comparing with the current node seismographs, since it is difficult to build up a network covering both above and under ground. In addition, with the cloud server of NB-IoT, it is also possible to establish a QC monitoring center without setting up an instrument vehicle or a central station like that in traditional seismic survey. As is illustrated in Figure 8, data from host control module are sent to the BC95 through the UART interface, then uploaded to the cloud server using the NB-IoT network. The data could be information of sensors or states of acquisition process, etc. Conversely, commands can also be sent to the CUGB-CS48DAS from cloud server to control the acquisition process. The advantage of the Internet of Things

is that there are a large number of connectable devices, and in theory, the monitoring network can be expanded continuously.

7.RCs: Technical corrections p. 3, line 30, fix grammar, e.g. “The acquisition control module implements the logic control of the acquisition unit array and transmission of acquired data.”

AC: Corrected as prompted.

8.RCs: The following text structure is used often in the text: “. . .mainly comprises. . .” Thisgrammar structure is quite rare, and it is suggested that the author considers replacing part of these structures with e.g. “. . .consists of. . .” or other suitable expressions.

AC: I have looked up the dictionary and found that it is okay to replace consist of with comprise. So I guess it is the word “mainly” here probably be controversial. The structure “. . .mainly comprises. . .” I used here means that the most important part of A is a, b, c. So I am not sure if it is correct to use this structure. Since that, I do replaced them as the reviewer suggested.

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Fig. 1.

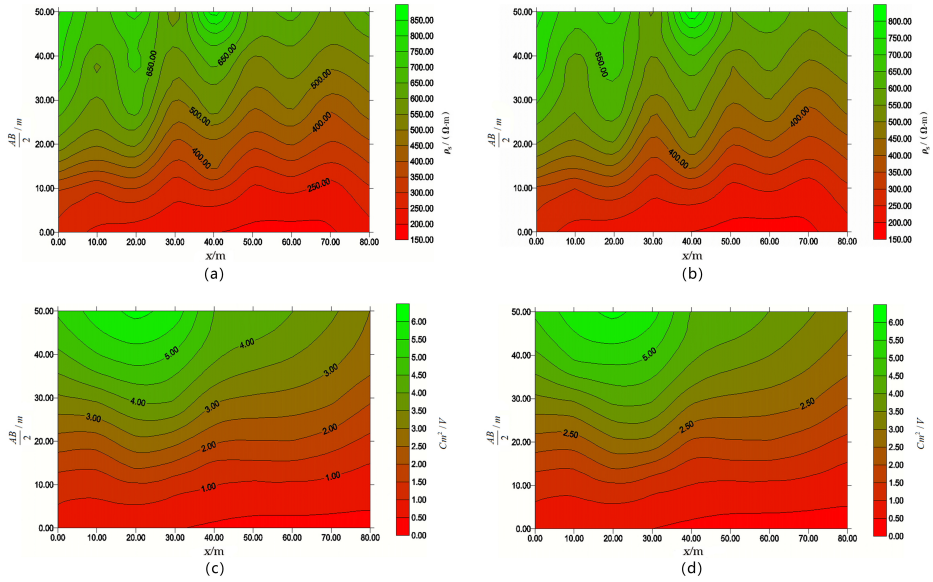

Fig. 2.