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Design of data transmission scheme based on RDMA

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With the development of precise radiotherapy, high-throughput data transmission has become a critical component of beam diagnostics, i.e. for closed orbit feedback in the synchrotron, beam profile images captured with view screens, and medical images generated at the therapy terminal. As the volume of generated measurement data rapidly increase, the data transmission mode that utilizes traditional Ethernet protocol can not meet the transmission performance requirements. To break the bottleneck, this paper designs a prototype data transmission system based on RDMA technology. By directly transferring memory data between hosts, the system bypasses the operating system kernel and CPU intervention, thereby minimizing transmission latency and enhancing data throughput. The system utilizes the RoCE v2 network protocol and is implemented through the libverbs dynamic link library to establish stable RDMA sessions and develop corresponding network programs. It uses TCP sockets to exchange control information, ensuring that both parties reach a consistent state before data transmission. Performance evaluations indicate that the network transmission scheme proposed in this paper offers lower latency, higher throughput, and reduced CPU usage compared to schemes using the TCP protocol. Additionally, the optimization of resource management strategies such as the use of Multithreaded Development and Shared Receive Queue ensures the efficient and dynamic management of system resources.

Footnotes

Funding Agency

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Yes

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