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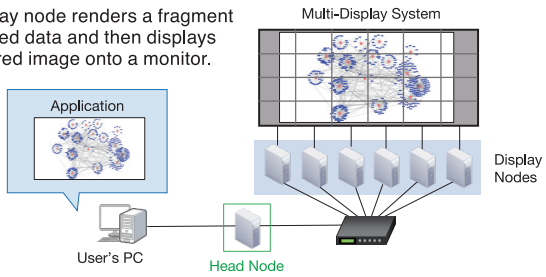
Novel Mechanisms to Support Scientific Visualization on Multi-Display

Multi-Display System

・Multi-Display System (MDS) is a scalable visualization system, which provides **a virtual high-resolution screen** by combining multiple sets of computers and monitors.

・An implementation of MDS is now utilized for scientific visualization.
- MDS can visualize different types of scientific data without a lack of information. (e.g. simulation results, network graph etc.)
- A lot of researchers can observe visualized data simultaneously and exchange ideas with each other on the spot.

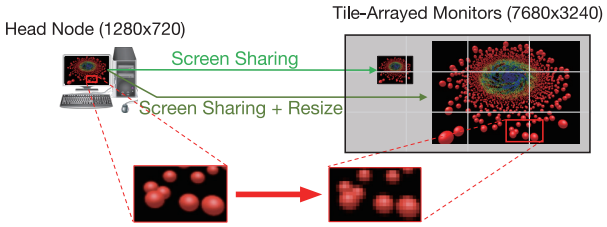
・In general, MDS has a **cluster-based architecture.**
- The head node and the display nodes are cooperated by dedicated visualization software. (e.g. SAGE2, ParaView, COVISE etc.)
- The head node provides to allow users to move/resize the window on the MDS.
- Each display node renders a fragment of visualized data and then displays the rendered image onto a monitor.



High-Resolution Streaming Functionality in SAGE2 Screen Sharing

・SAGE2 (popular visualization middleware) provides a screen sharing functionality, which is the function to stream user's desktop contents to a multi-display.
- A screen sharing functionality that allows users to display their own application on their own PC onto the MDS.

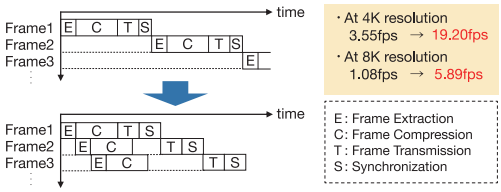
・Problem: Resolution constraint
- The desktop contents are displayed at the same resolution as the monitor of the head node.
- Large difference in the screen resolution will deteriorate the visibility of desktop applications.



・Proposed method: Virtual screen and pipeline streaming
- Xvnc creates the virtual screen at an arbitrary resolution on the head node regardless of the specifications of its monitor.

Without our approach (Jaggy) | With our approach (Clearness)

・To improve the frame rate in the high-resolution streaming, the streaming process is pipelined.

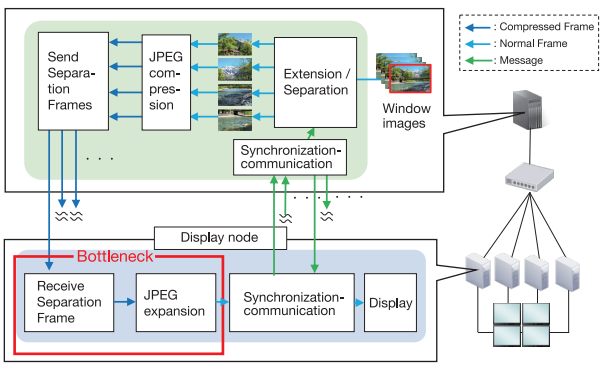


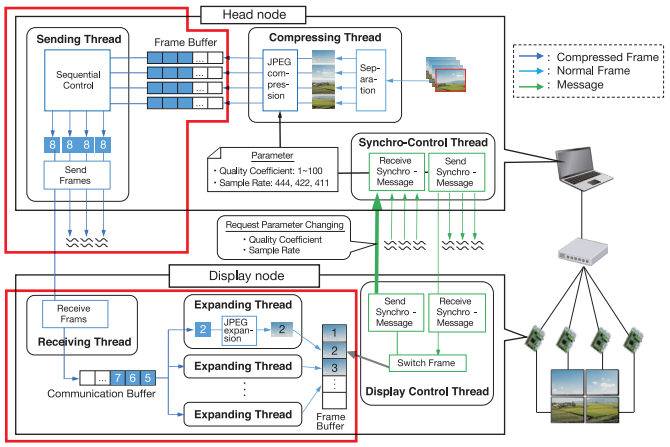
K. Ishida, et al., "High-Resolution Streaming Functionality in SAGE2 Screen Sharing," Advances in Information and Communication, Proceedings of the 2019 Future of Information and Communications Conference (FICC2019), Lecture Notes in Networks and Systems, vol. 70, pp.384-399, Mar. 2019. [DOI:10.1007/978-3-030-12385-7_30]

High Frame Rate MDS on Low-Spec Computers

・To construct MDS by using high-spec computers, the cost is very high. On the other hand, a low-spec computer like Single Board Computer (SBC: e.g. Raspberry Pi, NVIDIA Jetson Nano) does not cost much but also have graphics performance sufficient for a single monitor.

・Problem: Existing MDS middleware require more powerful computer.
- SBC's CPU performance is not enough for exiting MDS middleware. Receiving frame packets and JPEG expansion are the major bottlenecks at decreasing frame rate.
- Using SAGE2 in Raspberry Pi 3, the frame rate is 1-5fps.





・Evaluation and comparison with existing middleware on Raspberry Pi3 (4 display nodes)

・SAGE2 on Raspberry Pi3 : 1.2 fps
・Display Cluster : 2.1 fps
・Proposal Method: 23.2 fps

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