SC23 Network Research Exhibition: Demonstration Preliminary Abstract

Long-Distance Streaming for SBC MD System

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Abstract

The Multi-Display (MD) system realizes a virtual single screen using multiple monitors. It is utilized for the purpose of sharing high-resolution videos among multiple users. In this study, an MD using Single-Board Computers (SBCs as Raspberry Pi) is proposed with the aim of reducing MD deployment costs. This MD consists of two types of nodes: the head node and display nodes. The head node receives full screen frame images from remote application node, then it processes image frames to alleviate the load on display nodes implemented with SBCs. However, the processing performed by the head node becomes a bottleneck, leading to delays in video playback for high frame rates or high-resolution videos.

Furthermore, performing compression and transmission for each frame after division leads to processing wait times when done in a single process. This situation diminishes the performance and scalability of the MD. To address these challenges, the implementation of MD utilizes OS virtualization techniques. The frame compression part of the head node is parallelized as an independent process, capable of concurrently processing multiple frames. This parallel implementation aims to reduce frame processing time and alleviate MD bottlenecks.

In this demonstration, long-distance transfer of frame streaming for display within the MD is conducted to observe the impact of delays on frame division processing in the MD.

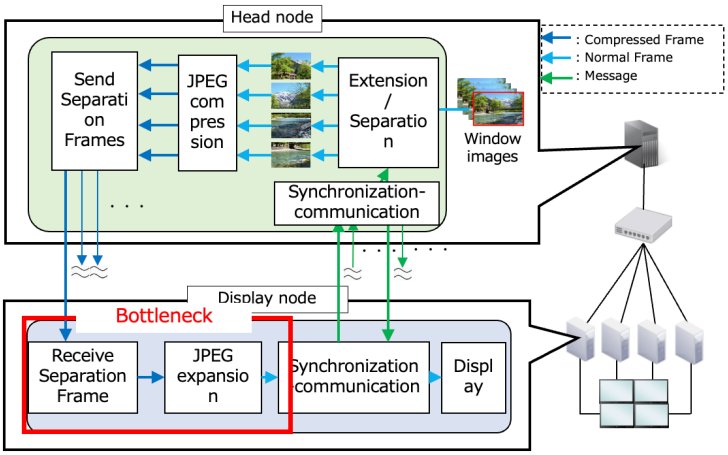


Fig. 1. System Overview

Goals

This study involves the performance evaluation of MD middleware operating on SBCs, and conducts evaluation experiments for long-distance screen streaming transfer and receiver functionality.

The internal structure of the streaming receiver in the MD system consists of three types of containers: the splitting container responsible for image frame division, the compression container responsible for image frame compression and transmission, and the synchronization control container responsible for synchronization control of display node groups (Fig. 1).

The division container and the synchronization control container operate as individual processes within the head node, respectively.

Additionally, the compression container operates in a one-to-one correspondence with the displays comprising the MD, connecting to their respective display nodes.

For the transfer of image frames required between the division container and the compression container, shared memory (SYSTEM V IPC) capable of high-speed inter-process data communication is utilized to minimize the overhead associated with frame data transfer.

Within this framework, image rendering is accomplished asynchronously through the mechanism of the splitting process and receiver processing. Consequently, it is believed that even if there are delays in the arrival of image frames at the receiver, it will not affect screen rendering.

Resources

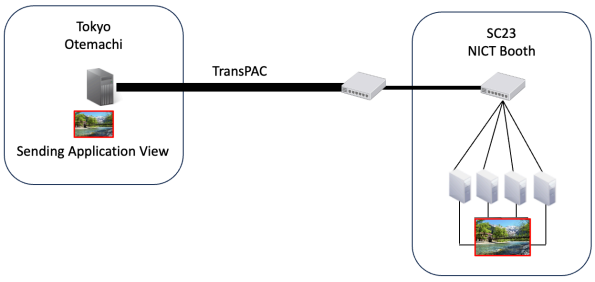


Fig. 2. Network Overview

In this demonstration, wide-area network is utilized to perform streaming transmission of application screens between SC23 Dever and Tokyo Otemachi. An overview diagram of the network environment is presented in Figure 2. Additionally, in the experiment, the screen rendering speed (FPS) is measured and compared with the local environment. The screen resolutions of WGX, Full-HD, and 4K are compared for the purpose of this demonstration.