Carrier Edge Computing Infrastructure Technology for High-presence Virtual Reality Services

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Abstract

Technical studies are underway at NTT Network Technology Laboratories on edge computing that uses computing resources in carrier facilities. This article introduces a technical demonstration of a use case providing a virtual reality application via an edge computing infrastructure performed in collaboration with Toppan Printing Co., Ltd.

Keywords: edge computing, virtual reality, Akraino

1. Introduction

Cloud computing is widely used for executing applications on the cloud and providing a variety of services. Cloud computing benefits the user by making it unnecessary to manage computing resources such as servers. However, various networks may exist between the user and the cloud, and as a result, the distance to cloud servers and the effects of limitations and quality fluctuations in the communications bandwidth of each network can make it difficult to provide low-latency, broadband services in a stable manner.

In response to this problem, attention is being focused on edge computing as a means of providing services by deploying computing resources such as servers at locations near users [1]. Within this field of edge computing, NTT Network Technology Laboratories is conducting technical studies on a system for installing computing resources in carrier facilities (telecommunications buildings etc.) near users. The aim here is to provide new services having low-latency and broadband capabilities that have traditionally been difficult to achieve on the cloud.

This article introduces a technical demonstration performed in collaboration with Toppan Printing Co., Ltd. on a virtual reality (VR) application requiring low-latency communications as a promising use case for edge computing.

2. Edge computing infrastructure technology for high-presence VR services

VR applications can be broadly divided into two types: the viewing of previously generated video (such as 360-degree video), and real-time generation of three-dimensional (3D) video according to user viewpoint movement and operation.

The former type using previously generated video places constraints on the user such as the inability to move about freely in virtual space or to move objects.

In contrast, the latter type using real-time 3D video makes it possible to move about freely in virtual space and to manipulate objects by generating the video according to sensor information such as the position and orientation of a head mounted display (HMD) using a graphics processing unit (GPU) or other type of processor in real time. It is thought that this type of VR, especially that having high-quality

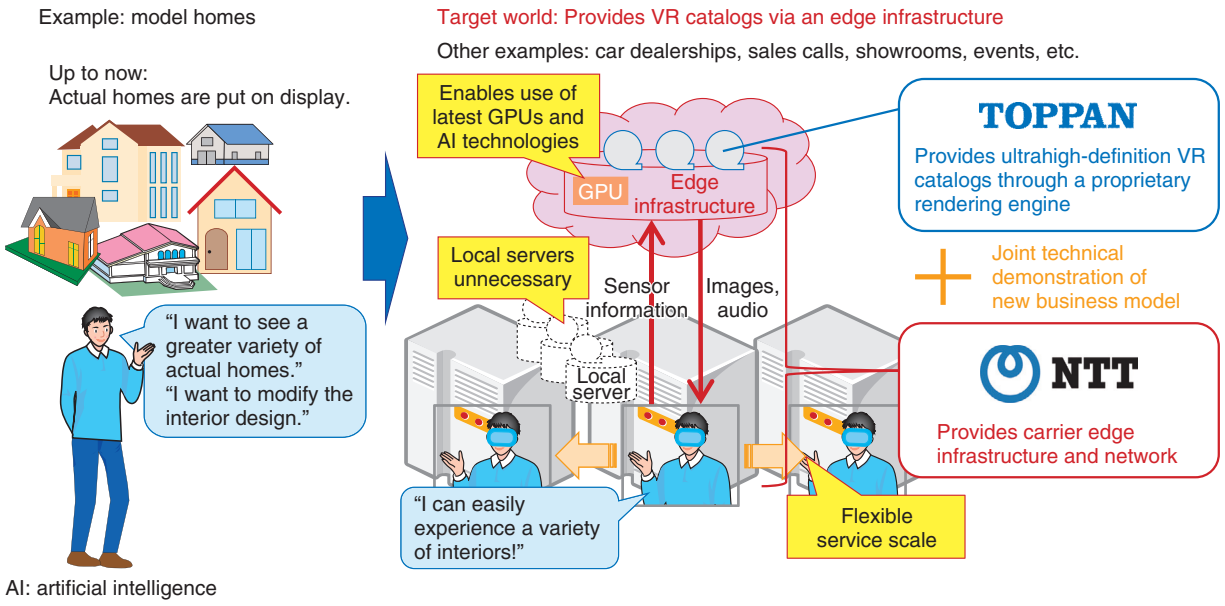

Fig. 1. VR digital catalog application via edge computing infrastructure.

characteristics (high definition, high frame rate), has the potential to be applied to digital catalogs. A digital catalog using VR would enable the user to vary the components, colors, and patterns of a product in virtual space at car dealerships, home builder offices, and all types of showrooms. We focus in this article on high-quality VR with an emphasis on digital catalogs.

To prevent VR sickness in VR applications that generate 3D video in real time, the sequence of processes from a user terminal operation to the display of 3D video on the terminal screen must be completed in an extremely short period of time (such as several tens of milliseconds) [2]. It is for this reason that this type of VR application has usually been provided using local terminals without a network connection. However, it is difficult to achieve high-quality VR with stand-alone HMDs or smartphones, and a specialized personal computer mounting a high-performance GPU can be costly in terms of equipment and operation. In the face of such problems, we considered the possibility of using edge computing to provide low-latency, high-quality VR even in a remote manner, thereby eliminating the need for individual users to manage high-performance specialized computers.

In the joint experiment presented here, we ran a VR application from Toppan Printing for display of model homes on NTT's edge computing test bed, generated video in real time on this edge computing infrastructure based on sensor information from a smartphone terminal, and tested the delivery of that video data on the terminal. The results of this demonstration confirmed that a high-quality VR-supporting digital catalog application from Toppan Printing could be provided via a remote edge computing infrastructure on the network (**Fig. 1**).

We also tested proprietary technology for achieving high-quality services such as the suppression of delay jitter in traffic control oriented to VR video.

3. Research and development (R&D) of edge computing infrastructures

In addition to work on edge computing applications including VR, R&D is underway at NTT Network Technology Laboratories on edge computing infrastructures to support efficient facility construction and scaling and high operability at low cost. As part of this effort, we are participating in Akraino Edge Stack, an open source software (OSS) project under the Linux Foundation [3, 4].

The Akraino project is aimed at achieving edge computing not only for telecommunications carriers but also for various types of enterprises and industries by combining OSS technologies reflecting industry best practices according to requirements and restrictions of each edge-specific use case. Our aim here is

to collaborate with global partners through an open community to promote fast-paced and efficient R&D of edge computing and create a global ecosystem in this field.

4. Future outlook

We will continue our collaborative efforts with Toppan Printing to achieve an edge computing infrastructure that can provide ultralow-latency and high-quality VR services in a flexible manner.

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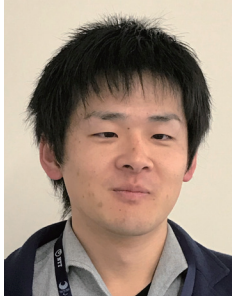
Trademark notes



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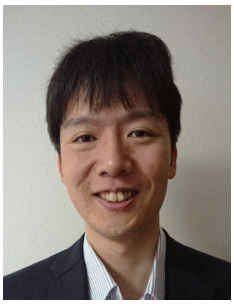

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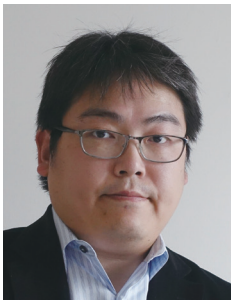

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