

DECADE  
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An integration example of DECADE system  
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## Abstract

This document represents an integration experiment of DECADE. In the experiment, we use Vuze as the application which uses DECADE server for content distribution. This document describes the framework, message flow, environment settings and test steps. We also analyze the performance benefit of the experiment.

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## 1. Introduction

DECADE[draft-ietf-decade-problem-statement-00] is an architecture that provides applications with access and resource control to in-network storage.

This draft introduces an integration example of DECADE architecture. In our DECADE example system, the core component includes DECADE server and DECADE client. DECADE server running at Linux platform is designed to support data reading and writing for DECADE clients. For DECADE client, we choose an open source P2P client software named Vuze[Vuze] which supports the user defining plugin to extend software function. We designed a plugin named DECADE plugin to realize the DECADE function. Test Environment and performance of DECADE-Enable Vuze are described in the draft after introducing the system architecture and main message flow.

Please note that DECADE example system described in the draft is only an example of possible implementation. And Vuze presented in this draft is only one of many P2P applications. DECADE can support other applications, for example live streaming. We only show Vuze Integration experiment in the document.

## 2. Terminology

P2P: Peer-to-Peer computing or networking is a distributed application architecture that partitions tasks or work loads between peers. Peers are equally privileged, equipotent participants in the application.

Vuze: an open source P2P application, which uses BitTorrent protocol for message and data exchanging. Vuze provides a set of interfaces which support users to develop particular extensions.

DECADE Plugin: a plugin built into Vuze to realize DECADE functions including getting/putting data from/to DECADE server and redirection .

DECADE-Enabled Vuze: a Vuze client that is compatible with DECADE by implementing DECADE plugin and DECADE plugin is enabled.

Native Vuze: a Vuze client without DECADE plugin or with DECADE plugin but DECADE function is disabled.

DECADE server: a server software which runs at Linux system, providing the in-network storage function for DECADE Plugin to get and put the data. It's an implementation example of in-network

storage.

Remote Controller: an controller which can control every Vuze client to start or stop downloading tasks It also has the function of collecting statistics information of each Vuze client. It is a main operating platform.

### 3. Vuze Client Design

Note that Vuze client is classified into two different kinds - Native Vuze and DECADE-Enabled Vuze. When running Native Vuze, it behaves as usual BitTorrent client: some Vuze clients upload the data for other Vuze clients to download. When using DECADE-Enabled Vuze, the communication and data exchange process is different. The DECADE server will provide the data for Vuze clients to download. It means that uplink traffic can be reduced sharply and download performance can be improved. It is beneficial for ISPs to save the last-mile uplink bandwidth.

#### 3.1. DECADE-Enabled Vuze architecture Design

DECADE plugin is one core part of our demo system. It has several interfaces with other components as following:

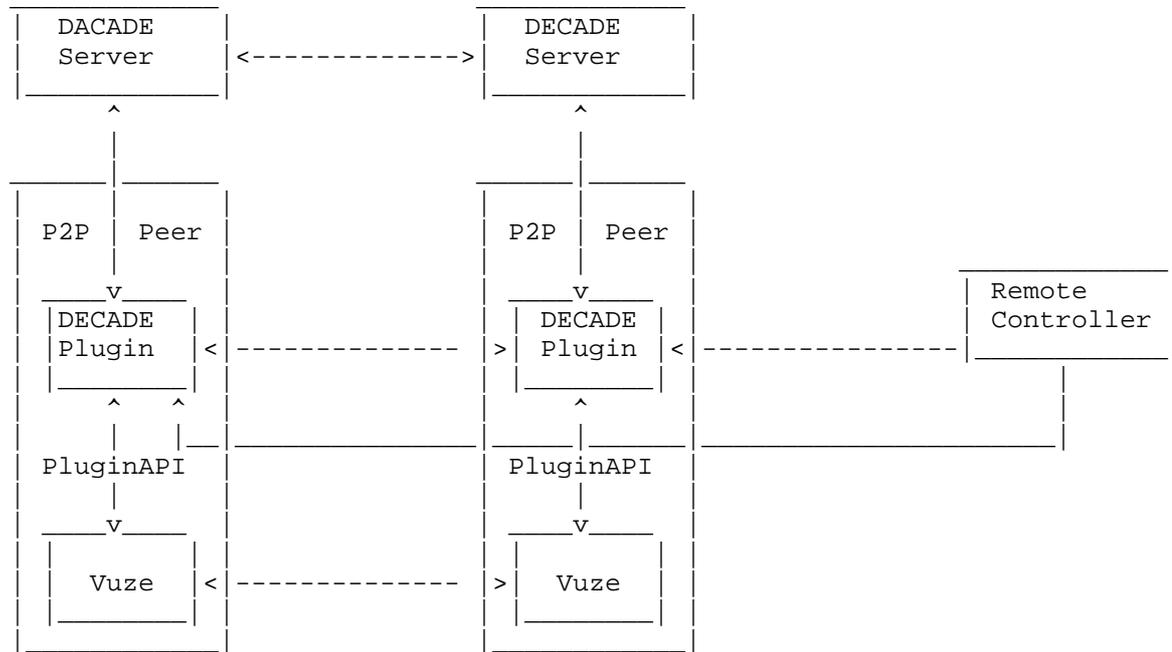
Interface between DECADE plugin and DECADE server: DECADE plugin can upload and download the data from DECADE server. It also includes other functions such as user registration, application registration etc.

Interface between DECADE plugin and Vuze client: DECADE plugin can register the listener to intercept the BitTorrent message such as "BT\_Request" message from or to Vuze client, encapsulate the data from DECADE server into "BT\_Piece" message and put the "BT\_Piece" message into incoming message queue, read the block/piece data from the disk when seeding (to upload the data to DECADE server), and start or stop the download task, all these functions are supported in the Plugin API provided by Vuze.

Interface between DECADE plugins: When DECADE plugin intercepts the "BT\_Request" message from other Vuze clients, local DECADE plugin sends "Redirect" message to remote DECADE plugin to authorize it to download the piece data from the DECADE server.

Interface between DECADE plugin and Remote Controller: DECADE plugin registers with Remote Controller after starting up, Remote Controller can control all the Vuze clients to start, stop or resume the download task through DECADE plugins.

The system architecture is as follow:



### 3.2. DECADE-Enabled Vuze Communication Procedure

A DECADE plugin can change the data path of BitTorrent download by using a "Redirect" message.

The detailed communication procedure is as following:

O When each client starts the download task ,it will try to connect the tracker to get peer list and then send "BT\_Request" message to other peers in peer list.

O If the DECADE plugin is enabled, then it will intercept the incoming "BT\_Request" message from other Vuze clients, and then reply with a "Redirect" message which includes DDECADE server's address, authorization token and so on to the requester.

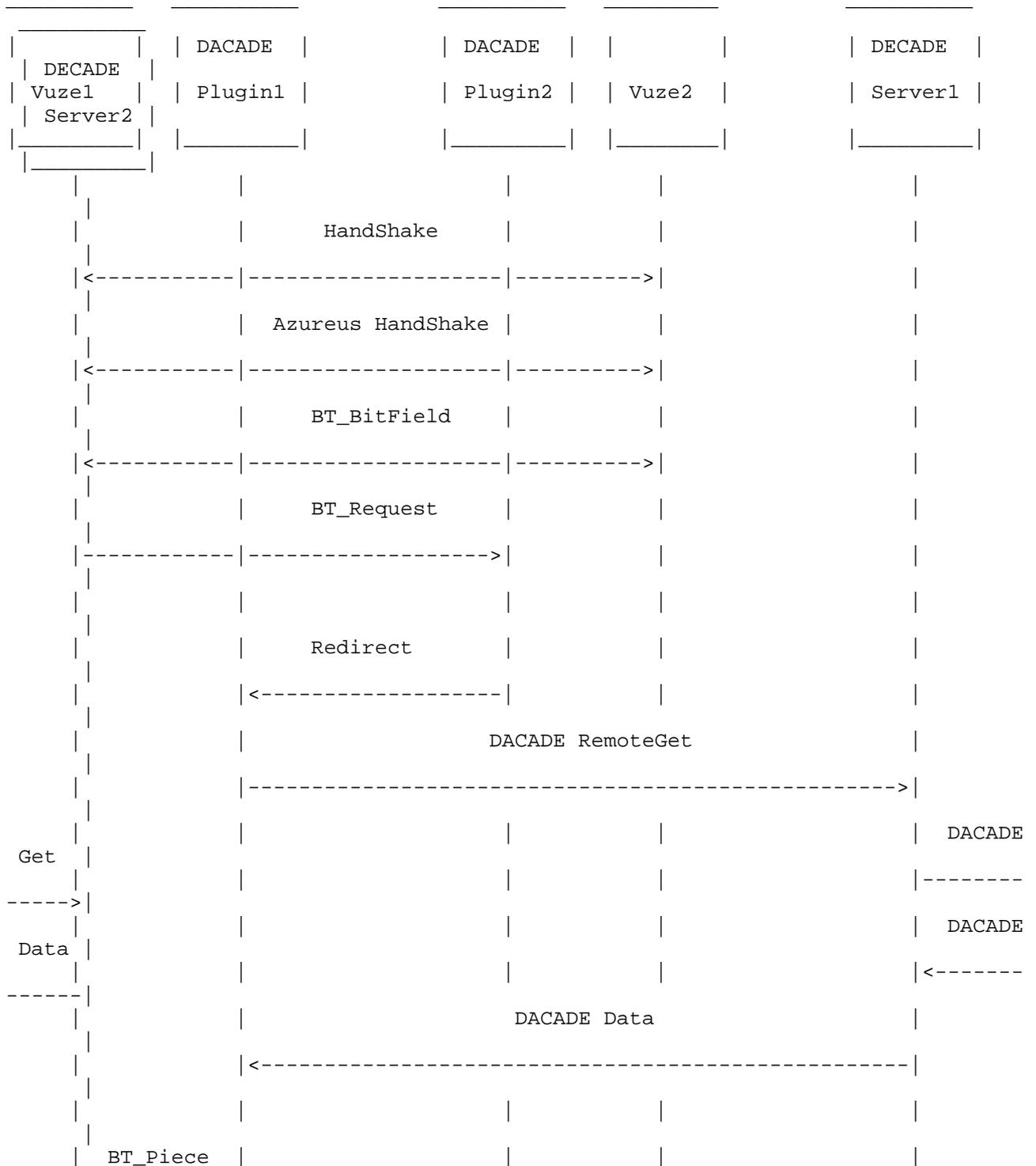
O When a DECADE plugin receives a "Redirect" message, it will connect to the DECADE server according to message context and send "Remote Get" message to the DECADE server to request the data, then wait for response.

O When a DECADE server receives a "Remote Get" message, it will check the server IP address in the message, Case 1: if the address equals

to its own IP address, then it will send the data to the requester from its local disk/memory; Case 2: if the address is not equal to its own IP address, then it will send the "Remote Get" message to that address, to fetch the data, and then send the data to the requester. The data will be cached in the server locally for use by other requesters.

0 When a DECADE plugin obtains the data, it will encapsulate the data into a standard "BT\_Piece" message and send to Vuze client, then the client can write the data block into storage.

The detailed communication diagram is as follow:



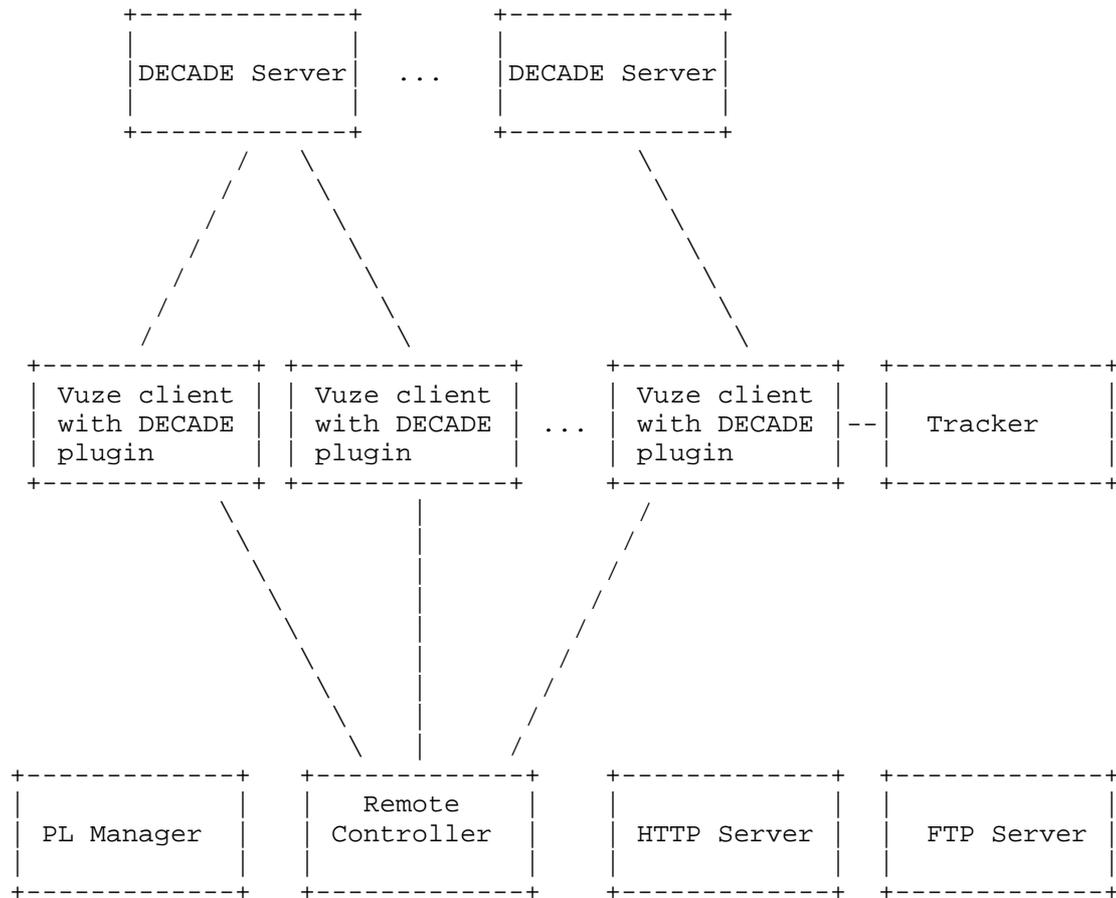


#### 4. Test Environment Setting

Test environment includes Vuze client, tracker, DECADE Plugin, DECADE Servers and other supportive components such as HTTP Server, FTP Server and Remote Controller. For performance comparison of Native Vuze and DECADE-Enabled Vuze, we set the same amount of total network

bandwidth resource in these two test cases. It means the total uplink bandwidth of all the Vuze clients in the native Vuze test case is equal to the bandwidth of DECADE server in DECADE-Enabled Vuze test case.

4.1. Test Platforms



4.1.1. DECADE Server

DECADE Server runs at Amazon EC2 [Amazon-EC2]small instances.

4.1.2. Vuze Client with DECADE Plugin

Vuze clients include seeding client and leechers. Leechers run at PlanetLab.[PlanetLab] and the seeding client runs at Window 2003 server. DECADE Plugin will be automatically loaded and run after

Vuze client starts up.

#### 4.1.3. Remote Controller

Remote controller can list all the Vuze clients in user interface and control them to download the specific BitTorrent file. It runs at Window 2003 server.

#### 4.1.4. Tracker

Vuze client provides tracker capability, so we did not deploy our own tracker. Vuze embedded tracker is enabled when making a torrent file, the seeding client is also the tracker.

#### 4.1.5. PL Manager

PL Manager [PlanetLab-experiment-manager] is a tool developed by University of Washington, which presents a simple GUI to control PlanetLab nodes and perform common tasks such as:

- Selecting nodes for your slice.
- Choosing nodes for your experiment based on CoMon information about the nodes.
- Reliably deploying your experiment files.
- Executing commands / sets of commands on every node in parallel.
- Monitoring the progress of the experiment as a whole, as well as viewing console output from the nodes.

#### 4.1.6. HTTP Server

Torrent file will be put in the HTTP Server and the leechers will retrieve the torrent file from HTTP Server after receiving the download command from Remote Controller. We use Apache Tomcat which is an open source software as HTTP Server.

#### 4.2. Benchmark Setting

For the performance comparison of Native Vuze and DECADE-Enabled Vuze, the same system bandwidth is provided through some parameter settings. In the Native Vuze, the system bandwidth is defined as the amount of the uplink bandwidth from all the Vuze clients. The maximum upload bandwidth (Bu) is configured to every Vuze client before the test. Suppose the number of the Vuze clients is N, the system bandwidth is  $Bu * N$ . In the DECADE-Enabled Vuze case, the same

bandwidth ( $B_u * N$ ) is configured to the corresponding Ethernet port of DECADE Server.

#### 4.3. Test Steps

Test steps of DECADE-Enabled Vuze is as follows:

- O Start DECADE Server, Remote Controller and all the Vuze clients.
- O One of DECADE Vuze clients seeds, generates the torrent file. DECADE Plugin automatically uploads the data to DECADE Server.
- O Manually put the torrent file into home directory of HTTP server. If the default directory of torrent file in Vuze client is set to the home directory of HTTP server, this step can be ignored.
- O Remote Controller sends the download command to other DECADE-Enabled Vuze clients (leechers).
- O Leechers fetch torrent file from HTTP server.
- O Leechers request and get peer list from the tracker.
- O Leechers send BT\_Request message to peers and get Redirect messages from peers.
- O Leechers get objects from DECADE Servers and finish the download.
- O Collecting and analyzing the log from all the Vuze clients.

Test steps of Native Vuze is similar to DECADE-Enabled Vuze. The difference is that Native Vuze client does not use DECADE server to put and get data.

#### 5. Performance Analysis

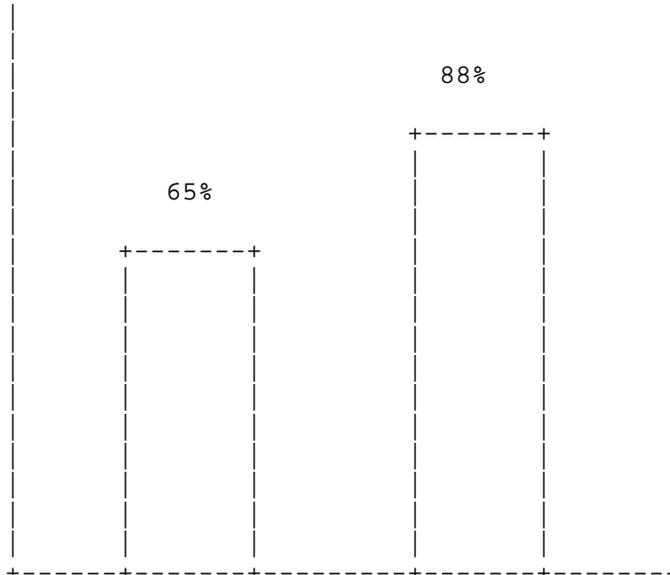
Performance advantage is shown according to the test result of experiment:

- O There is no upload data traffic from Vuze clients in the DECADE-Enabled Vuze experiment, but in the Native Vuze experiment, the upload data traffic from Vuze clients is same as download data traffic. Bandwidth resource is reduced in the last mile in the DECADE-Enabled Vuze experiment. The test result is illustrated in the following table. The download traffic and upload traffic include

data traffic and signal traffic. For the upload traffic in the DECADE-enabled Vuze, the data traffic is zero so the all traffic is signal overhead. Though we used the same torrent file in the two cases, but the number of Vuze client was not the same because the nodes in the Planet-lab are not always stable, so the download traffic is much different in two cases.

	Download traffic	Upload traffic
DECADE-Enabled Vuze	480MB	12MB
Native Vuze	430MB	430MB

Higher system resource efficiency in the DECADE-Enabled Vuze experiment, system resource efficiency is defined as the ratio of system download rate to the total system bandwidth. The test result is illustrated in the following figure.



Native Vuze      DECADE-Enabled Vuze

## 6. Security Considerations

This draft does not introduce any security considerations.

## 7. IANA Considerations

This document does not have any IANA Considerations.

## 8. Acknowledgments

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