Decoded frames interception and handling

Overview

When stream transcoding is enabled, a stream published decoded picture frames in YUV format can be intercepted and changed pixel by pixel on server side. The frame changed will be then encoded and transferred to transcoder output stream as usual frame.

Interceptor implementation

To intercept the decoded frames, Java class implementing `IDecodedFrameInterceptor` interface should be developed. The function `frameDecoded()` of this class will receive decoded frames in YUV format, for example

TestInterceptor.java

```
// Package name should be strictly defined as
com.flashphoner.frameInterceptor
package com.flashphoner.frameInterceptor;

// Import decoded frame interceptor interface
import com.flashphoner.sdk.media.IDecodedFrameInterceptor;
// Import YUV frame description
import com.flashphoner.sdk.media.YUVFrame;


/**
* Custom decoded frames interceptor implementation example
* The example daws a cross over the picture
*/
public class TestInterceptor implements IDecodedFrameInterceptor {

    // Constants to parse pixel
    private final int Y = 0;
    private final int U = 1;
    private final int V = 2;

    // Dark colored pixel
    private final byte[] DarkPixel = new byte []{42, -128, -128};

    /**
    * Function to handle decoded frame
    * @param streamName - stream name
    * @param frame - decoded YUV frame
    */
    @Override
    public void frameDecoded(String streamName, YUVFrame frame) {
        // Get frame height
        int frameHeight = frame.getHeight();
        // Get frame width
        int frameWidth = frame.getWidth();
        // Declare cross lines padding
        int PADDING = 4;
        // Define frame center
        int frameCenterX = frameWidth / 2;
        int frameCenterY = frameHeight / 2;
        // Define vertical line bounds
        int leftBound = frameCenterX - PADDING;
        int rightBound = frameCenterX + PADDING;
        // Define horizontal line bounds
        int topBound = frameCenterY - PADDING;
        int bottomBound = frameCenterY + PADDING;

        // Walk through the frame pixels and draw a cross
        for (int x = 0; x < frameWidth; x++) {
            for (int y = 0; y < frameHeight; y++) {
                if (validateCoord(x, leftBound, rightBound) ||
validateCoord(y, topBound, bottomBound)) {
                    // Read the pixel
                    byte[] pixel = frame.readPixel(x, y);
                    // Modify the pixel
                    pixel[Y] = DarkPixel[Y];
                    pixel[U] = DarkPixel[U];
                    pixel[V] = DarkPixel[V];
```

```
                    // Write the pixel back
                    frame.writePixel(x, y, pixel);
                }
            }
        }
    }

    /**
    * Helper function to validate pixel drawing
    * @param coord - pixel coordinate
    * @param low - low coordinate bound
    * @param high - high coordinate bound
    * @return true if coordinate is valid
    */
    private boolean validateCoord(int coord, int low, int high) {
        return (coord > low && coord < high);
    }
}
```

Then the class should be complied into byte code. To do this, create folder tree accordind to `TestInterceptor` class package name

```
mkdir -p com/flashphoner/frameInterceptor
```

and execute the command

```
javac -cp /usr/local/FlashphonerWebCallServer/lib/wcs-core.jar
./com/flashphoner/frameInterceptor/TestInterceptor.java
```

Now, pack the code compiled to jar file

```
jar -cf testlayout.jar
./com/flashphoner/frameInterceptor/TestInterceptor.class
```

and copy this file to WCS libraries folder

```
cp testinterceptor.jar /usr/local/FlashphonerWebCallServer/lib
```

To use custom frames interceptor class, set its package name to the following parameter in flashphoner.properties file

```
decoded_frame_interceptor=com.flashphoner.frameInterceptor.TestInterceptor
```

and restart WCS.

A separate folder for custom Java libraries

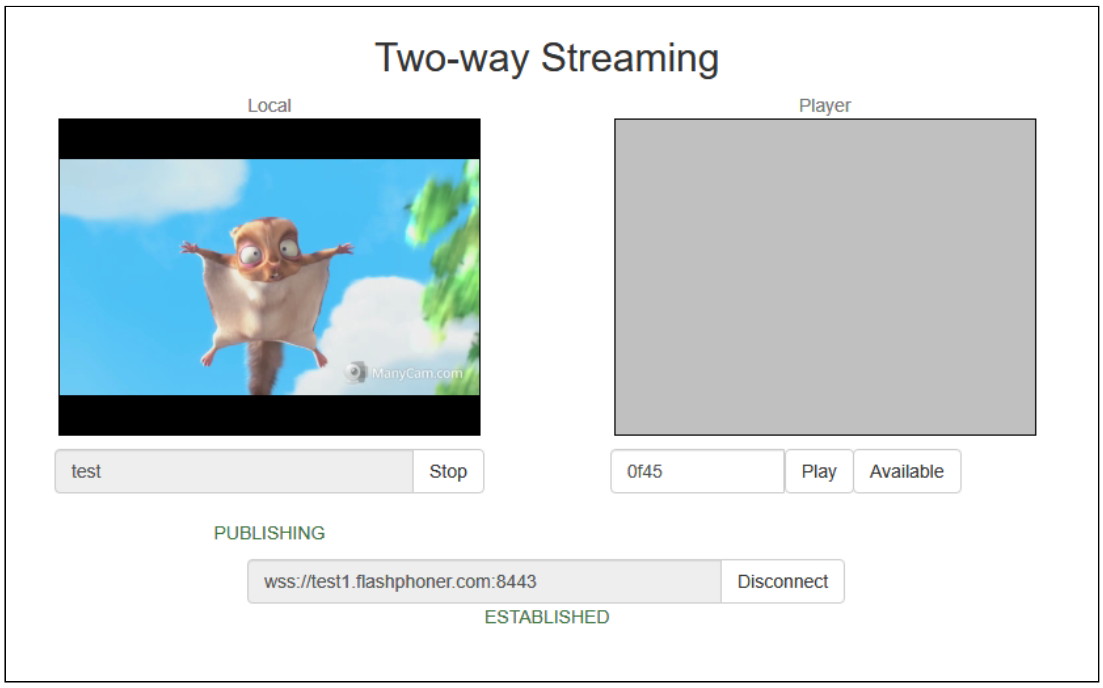
Since build 5.2.1512, custom layout Java libraries (jar files) should be placed to the folder `/usr/local/FlashphonerWebCallServer/lib/custom`

```
cp testlayout.jar /usr/local/FlashphonerWebCallServer/lib/custom
```

This folder is kept while updating WCS to a newer builds. A jar files do not need to be copied again after updating.

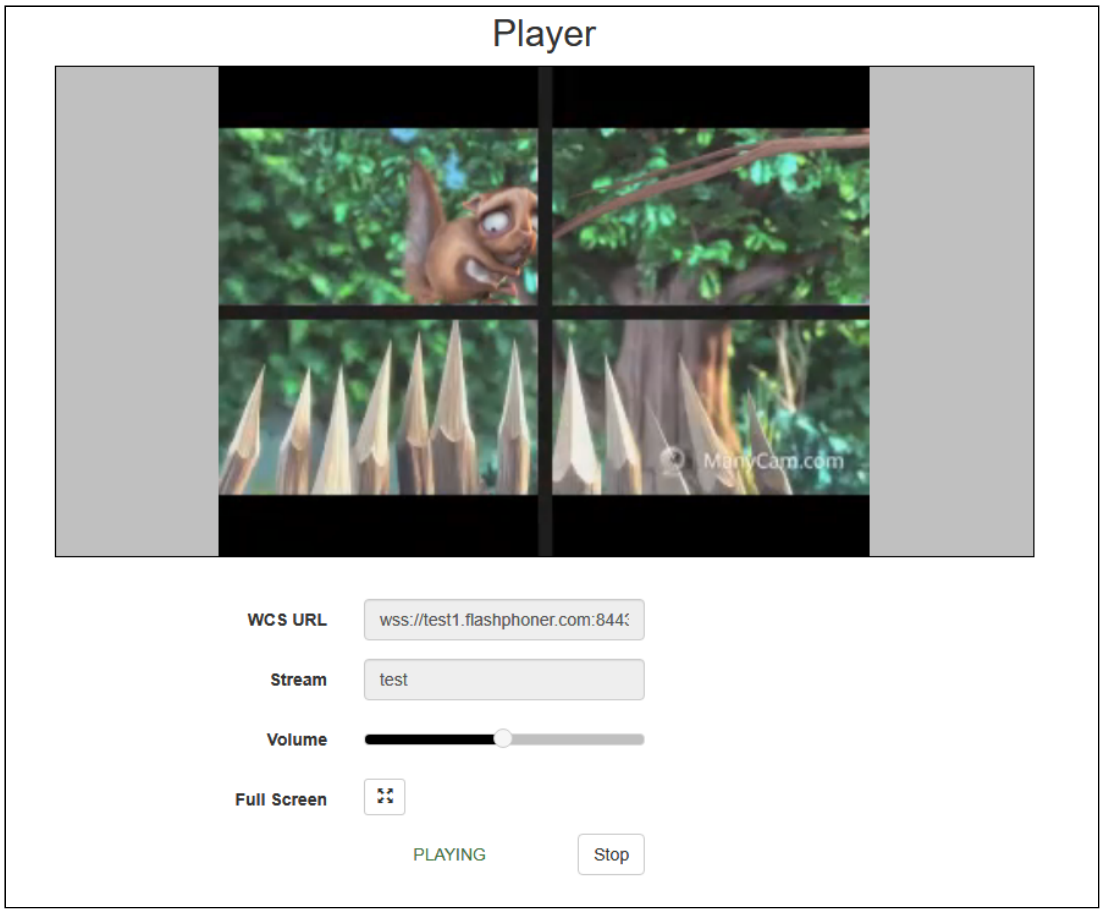
Testing

1. Publish a test stream in Two Way Streaming example
   `https://test1.flashphoner.com:8444/client2/examples/demo/streaming/two_way_streaming/two_way_streaming.html`,
   where `test1.flashphoner.com` is WCS server address



2. Play the stream in Player example with explicit resolution setting to enable transcoding, for example
   `https://test1.flashphoner.com:8444/client2/examples/demo/streaming/player/player.html?resolution=320x240`,

where `test1.flashphoner.com` is WCS server address



The pixels changed will be in the stream picture.

Controlling interceptors with REST API

Since build 5.2.2055 it is possible to control decoded frames interceptors with REST API

A REST query should be HTTP/HTTPS POST query as follows:

- HTTP: `http://streaming.flashphoner.com:8081/rest-api/video_interceptor/set`
- HTTPS: `https://streaming.flashphoner.com:8444/rest-api/video_interceptor/set`

Where:

- `streaming.flashphoner.com` - WCS server address
- `8081` - WCS server REST / HTTP port
- `8444` - WCS server HTTPS port
- `rest-api` - mandatory prefix
- `/video_interceptor/set` - REST method used

REST methods and responses

/video_interceptor/set

Set decoded frames interceptor class to the stream. The interceptor will receive a decoded frames when stream will be decoded, for example, added to mixer. Only one interceptor may be set to the stream simultaneously

REQUEST EXAMPLE

```
POST /rest-api/video_interceptor/set HTTP/1.1
Host: localhost:8081
Content-Type: application/json

{
    "streamName":"stream1",
    "className":"com.flashphoner.frameInterceptor.TestInterceptor"
}
```

RESPONSE EXAMPLE

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
Content-Type: application/json
```

RETURN CODES

Code	Reason
200	OK
404	Not found
500	Internal server error

/video_interceptor/find_all

Find all the interceptors

REQUEST EXAMPLE

```
POST /rest-api/video_interceptor/find_all HTTP/1.1
Host: localhost:8081
Content-Type: application/json

{
    "streamName":"stream1",
    "className":"com.flashphoner.frameInterceptor.TestInterceptor"
}
```

RESPONSE EXAMPLE

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
Content-Type: application/json

[
    {
        "hashcode":21982654,
        "className":"com.flashphoner.frameInterceptor.TestInterceptor",
        "processedFrames":169,
        "streamName":"stream1",
        "status":"PROCESSING"
    }
]
```

RETURN CODES

Code	Reason
200	OK
404	Not found

/video_interceptor/remove

Remove the interceptor from the stream

REQUEST EXAMPLE

```
POST /rest-api/video_interceptor/remove HTTP/1.1
Host: localhost:8081
Content-Type: application/json

{
    "streamName":"stream1"
}
```

RESPONSE EXAMPLE

```
HTTP/1.1 200 OK
Access-Control-Allow-Origin: *
Content-Type: application/json
```

RETURN CODES

Code	Reason
200	OK
404	Not found

Parameters

Parameter	Description	Example
streamName	Published stream name	`"streamName":"stream1"`
className	Interceptor class name	`"className":"com.flashphoner.frameInterceptor.TestInterceptor"`
hashcode	Interceptor object Id	`"hashcode":21982654`
status	Current interceptor state	`"status":"PROCESSING"`
processedFrames	Processed frames counter	`"processedFrames":169`

The interceptor may be in one of the following states:

- `WAITING` - the interceptor waits for the stream decoding
- `PROCESSING` - the interceptor receives a frames decoded and handles them
- `UNSUPPORTED` - decoded frames interception is not supported (for GPU decoded streams)