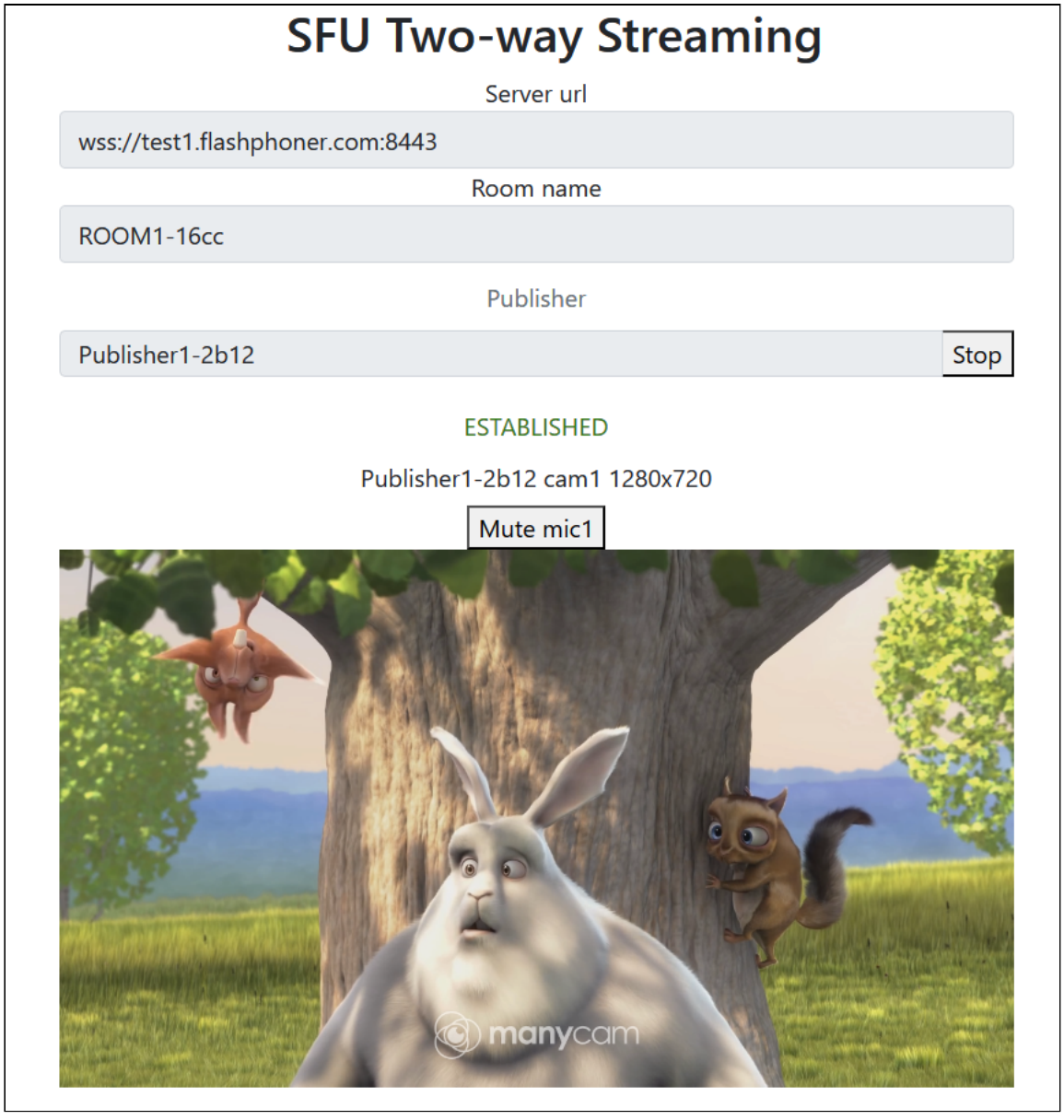
SFU Two Way Streaming

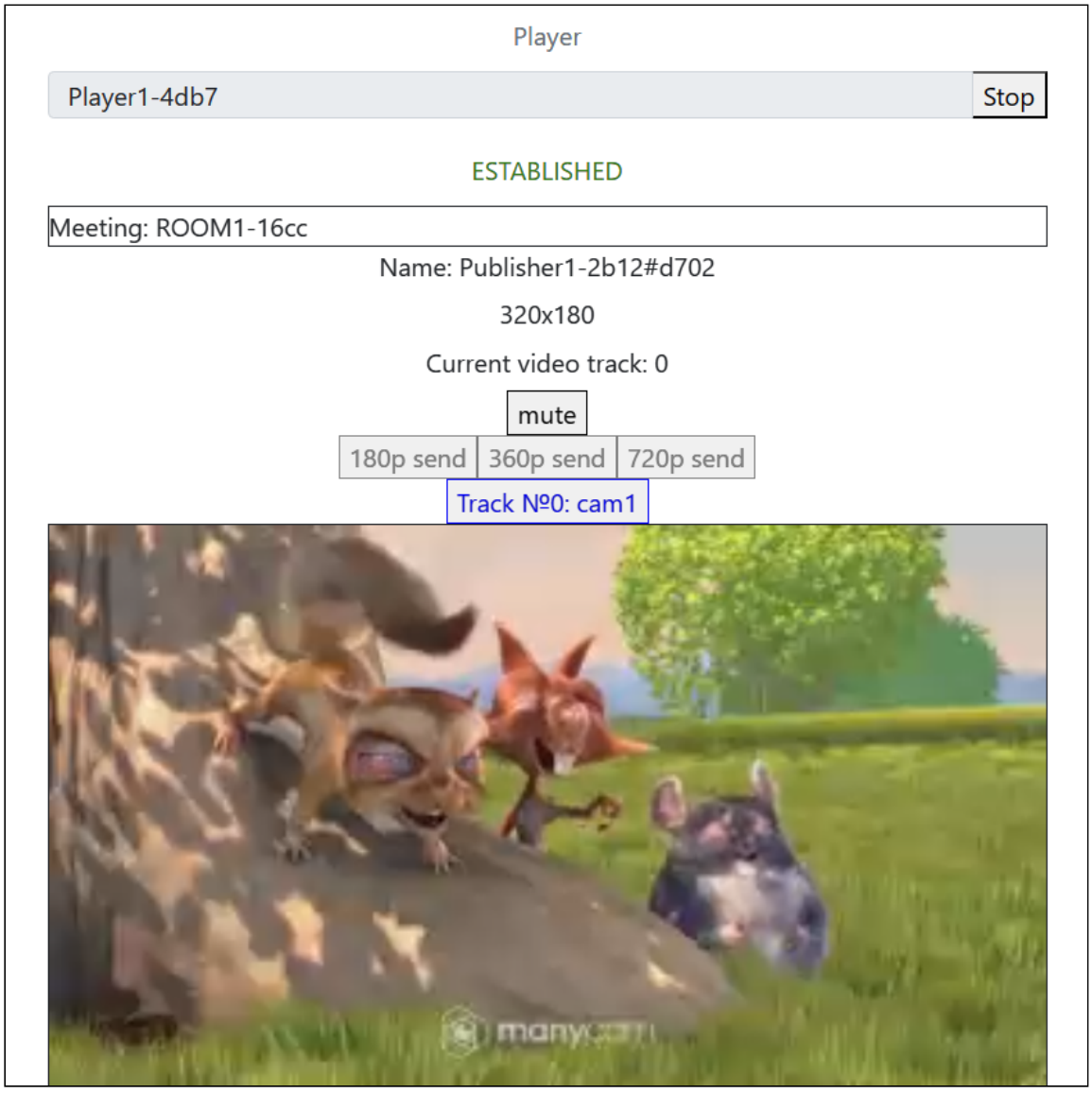
The example shows how to publish and play a number of streams in one WebRTC connection with simulcast. A room is considered to be a publishing unit, that is, viewers who connect to this room receive all the streams published in it.

On the screenshots below:

- Server url - Websocket URL of WCS server
- Room name - room name
- Publisher - publisher user name



- Player - viewer nickname
- 180p send, 360p send, 720p send - quality switch buttons
- Track - video tracks switch button if there are more than one



Note that audio tracks are playing in a separate audio tags.

Example source code

The source code consists of the following modules:

- two-way-streaming.html - HTML page
- two-way-streaming.css - HTML page styles
- two-way-streaming.js - main application logic
- config.json - client configuration file, contains streams publishing description

Analyzing the code

To analyze the example source code, take the file two-way-streaming.js version available here

1. Local variables

Local variables declaration to work with constants, SFU SDK, to display video and to work with client configuration

code

```
const constants = SFU.constants;
const sfu = SFU;
let mainConfig;
let localDisplay;
let remoteDisplay;
let publishState;
let playState;
const PUBLISH = "publish";
const PLAY = "play";
const STOP = "stop";
const PRELOADER_URL="../commons/media/silence.mp3"
```

2. Default configuration

Default room configuration and stream publishing configuration to use if there is no `config.json` file found

code

```
const defaultConfig = {
    room: {
        url: "wss://127.0.0.1:8888",
        name: "ROOM1",
        pin: "1234",
        nickName: "User1",
        failedProbesThreshold: 5,
        pingInterval: 5000
    },
    media: {
        audio: {
            tracks: [
                {
                    source: "mic",
                    channels: 1
                }
            ]
        },
        video: {
            tracks: Array(1).fill({
                source: "camera",
                width: 1280,
```

```
                height: 720,
                codec: "H264",
                constraints: {
                    frameRate: 25
                },
                encodings: [
                    {rid: "180p", active: true, maxBitrate: 200000,
scaleResolutionDownBy: 4},
                    {rid: "360p", active: true, maxBitrate: 500000,
scaleResolutionDownBy: 2},
                    {rid: "720p", active: true, maxBitrate: 900000}
                ],
                type: "cam1"
            })
        }
    }
};
```

3. Object to store current publishing/playback state

The object should keep Websocket session data, WebRTC connection data and room data, and shoukd form HTML tags ids to access them from code

code

```
const CurrentState = function (prefix) {
    let state = {
        prefix: prefix,
        pc: null,
        session: null,
        room: null,
        display: null,
        roomEnded: false,
        starting: false,
        set: function (pc, session, room) {
            state.pc = pc;
            state.session = session;
            state.room = room;
            state.roomEnded = false;
        },
        clear: function () {
            state.room = null;
            state.session = null;
            state.pc = null;
            state.roomEnded = false;
        },
        setRoomEnded: function () {
            state.roomEnded = true;
        },
        buttonId: function () {
            return state.prefix + "Btn";
        },
        buttonText: function () {
            return (state.prefix.charAt(0).toUpperCase() +
state.prefix.slice(1));
```

```
        },
        inputId: function () {
            return state.prefix + "Name";
        },
        statusId: function () {
            return state.prefix + "Status";
        },
        formId: function () {
            return state.prefix + "Form";
        },
        errInfoId: function () {
            return state.prefix + "ErrorInfo";
        },
        is: function (value) {
            return (prefix === value);
        },
        isActive: function () {
            return (state.room && !state.roomEnded && state.pc);
        },
        isConnected: function () {
            return (state.session && state.session.state() ===
constants.SFU_STATE.CONNECTED);
        },
        isRoomEnded: function () {
            return state.roomEnded;
        },
        setStarting: function (value) {
            state.starting = value;
        },
        isStarting: function () {
            return state.starting;
        },
        setDisplay: function (display) {
            state.display = display;
        },
        disposeDisplay: function () {
            if (state.display) {
                state.display.stop();
                state.display = null;
            }
        }
    };
    return state;
}
```

4. Initialization

`init()` code

The `init()` function is called on page load and:

- initializes state objects
- reads `config.json` file or default configuration
- initializes input fields

```
const init = function () {
    let configName = getUrlParam("config") || "./config.json";
    $("#publishBtn").prop('disabled', true);
    $("#playBtn").prop('disabled', true);
    $("#url").prop('disabled', true);
    $("#roomName").prop('disabled', true);
    $("#publishName").prop('disabled', true);
    $("#playName").prop('disabled', true);
    publishState = CurrentState(PUBLISH);
    playState = CurrentState(PLAY);
    $.getJSON(configName, function (cfg) {
        mainConfig = cfg;
        onDisconnected(publishState);
        onDisconnected(playState);
    }).fail(function (e) {
        //use default config
        console.error("Error reading configuration file " + configName + ": "
+ e.status + " " + e.statusText)
        console.log("Default config will be used");
        mainConfig = defaultConfig;
        onDisconnected(publishState);
        onDisconnected(playState);
    });
    $("#url").val(setURL());
    $("#roomName").val("ROOM1-" + createUUID(4));
    $("#publishName").val("Publisher1-" + createUUID(4));
    $("#playName").val("Player1-" + createUUID(4));
}
```

5. Establishing server connection

`connect()`, `SFU.createRoom()` code

The `connect()` function is called by `Publish` or `Play` click:

- creates `PeerConnection` object
- cleans previous session state displayed
- sets up room configuration and creates Websocket session
- subscribes to Websocket session events

```
const connect = async function (state) {
    //create peer connection
    let pc = new RTCPeerConnection();
    //get config object for room creation
    const roomConfig = getRoomConfig(mainConfig);
    roomConfig.url = $("#url").val();
    roomConfig.roomName = $("#roomName").val();
    roomConfig.nickname = $("#" + state.inputId()).val();
    // clean state display items
    setStatus(state.statusId(), "");
    setStatus(state.errInfoId(), "");
    // connect to server and create a room if not
```

```
    try {
        const session = await sfu.createRoom(roomConfig);
        // Set up session ending events
        session.on(constants.SFU_EVENT.DISCONNECTED, function () {
            onStopClick(state);
            onDisconnected(state);
            setStatus(state.statusId(), "DISCONNECTED", "green");
        }).on(constants.SFU_EVENT.FAILED, function (e) {
            onStopClick(state);
            onDisconnected(state);
            setStatus(state.statusId(), "FAILED", "red");
            if (e.status && e.statusText) {
                setStatus(state.errInfoId(), e.status + " " + e.statusText,
"red");
            } else if (e.type && e.info) {
                setStatus(state.errInfoId(), e.type + ": " + e.info, "red");
            }
        });
        // Connected successfully
        onConnected(state, pc, session);
        setStatus(state.statusId(), "ESTABLISHED", "green");
    } catch (e) {
        onDisconnected(state);
        setStatus(state.statusId(), "FAILED", "red");
        setStatus(state.errInfoId(), e, "red");
    }
}
```

6. Publishing or playback start after session establishing

`onConnected()` code

The `onConnected()` function:

- sets up `Stop` button click actions
- subscribes to room error events
- calls publishing or playback function

```
const onConnected = function (state, pc, session) {
    state.set(pc, session, session.room());
    $("#" + state.buttonId()).text("Stop").off('click').click(function () {
        onStopClick(state);
    });
    $('#url').prop('disabled', true);
    $("#roomName").prop('disabled', true);
    $("#" + state.inputId()).prop('disabled', true);
    // Add errors displaying
    state.room.on(constants.SFU_ROOM_EVENT.FAILED, function (e) {
        setStatus(state.errInfoId(), e, "red");
        state.setRoomEnded();
        onStopClick(state);
    }).on(constants.SFU_ROOM_EVENT.OPERATION_FAILED, function (e) {
        onOperationFailed(state, e);
    }).on(constants.SFU_ROOM_EVENT.ENDED, function () {
```

```
        setStatus(state.errInfoId(), "Room " + state.room.name() + " has
ended", "red");
        state.setRoomEnded();
        onStopClick(state);
    }).on(constants.SFU_ROOM_EVENT.DROPPED, function () {
        setStatus(state.errInfoId(), "Dropped from the room " +
state.room.name() + " due to network issues", "red");
        state.setRoomEnded();
        onStopClick(state);
    });
    startStreaming(state);
}
```

7. Streams publishing

`publishStreams()`, `SFURoom.join()` code

The `publishStreams()` function:

- initializes a basic HTML container tag to display local video
- gets local media access accorging to configuration file
- adds media tracks to WebRTC connection
- joins the room on server

```
const publishStreams = async function (state) {
    if (state.isConnected()) {
        //create local display item to show local streams
        const display =
initLocalDisplay(document.getElementById("localVideo"));
        state.setDisplay(display);
        try {
            //get configured local video streams
            let streams = await getVideoStreams(mainConfig);
            let audioStreams = await getAudioStreams(mainConfig);
            if (state.isConnected() && state.isActive()) {
                //combine local video streams with audio streams
                streams.push.apply(streams, audioStreams);
                let config = {};
                //add our local streams to the room (to PeerConnection)
                streams.forEach(function (s) {
                    let contentType = s.type || s.source;
                    //add local stream to local display
                    display.add(s.stream.id, $("#" + state.inputId()).val(),
s.stream, contentType);
                    //add each track to PeerConnection
                    s.stream.getTracks().forEach((track) => {
                        config[track.id] = contentType;
                        addTrackToPeerConnection(state.pc, s.stream, track,
s.encodings);
                        subscribeTrackToEndedEvent(state.room, track,
state.pc);
                    });
                });
```

```
                //start WebRTC negotiation
                await state.room.join(state.pc, null, config);
            }
        } catch (e) {
            if (e.type === constants.SFU_ROOM_EVENT.OPERATION_FAILED) {
                onOperationFailed(state, e);
            } else {
                console.error("Failed to capture streams: " + e);
                setStatus(state.errInfoId(), e.name, "red");
                onStopClick(state);
            }
        }
    }
}
```

7.1. Media tracks addition to WebRTC connection

`addTrackToPeerConnection()`, `PeerConnection.addTransceiver()` code

```
const addTrackToPeerConnection = function(pc, stream, track, encodings) {
    pc.addTransceiver(track, {
        direction: "sendonly",
        streams: [stream],
        sendEncodings: encodings ? encodings : [] //passing encoding types
for video simulcast tracks
    });
}
```

7.2. Tracks onended event subscription

`subscribeTrackToEndedEvent()`, `MediaTrack.addEventListener()`, `SFURoom.updateState()` code

```
const subscribeTrackToEndedEvent = function (room, track, pc) {
    track.addEventListener("ended", async function () {
        //track ended, see if we need to cleanup
        let negotiate = false;
        for (const sender of pc.getSenders()) {
            if (sender.track === track) {
                pc.removeTrack(sender);
                //track found, set renegotiation flag
                negotiate = true;
                break;
            }
        }
        if (negotiate) {
            //kickoff renegotiation
            await room.updateState();
        }
    });
};
```

8. Streams playback

`playStreams()`, `SFURoom.join()` code

The `playStreams()` function:

- initializes a base container tag to display incoming media streams
- joins to the room on server

```
const playStreams = async function (state) {
    if (state.isConnected() && state.isActive()) {
        try {
            //create remote display item to show remote streams
            const display = initDefaultRemoteDisplay(state.room,
document.getElementById("remoteVideo"), null, null);
            state.setDisplay(display);
            //start WebRTC negotiation
            await state.room.join(state.pc, null, null, 1);
        } catch (e) {
            if (e.type === constants.SFU_ROOM_EVENT.OPERATION_FAILED) {
                onOperationFailed(state, e);
            } else {
                console.error("Failed to play streams: " + e);
                setStatus(state.errInfoId(), e.name, "red");
                onStopClick(state);
            }
        }
    }
}
```

9. Publishing stopping

`state.disposeDisplay()` code

```
const disposeStateDisplay = function (state) {
    state.disposeDisplay();
}
```

10. Publish/Play click action

`onStartClick()`, `playFirstSound()`, `connect()` code

The `onStartClick()` function:

- validates input fields
- in Safari browser, calls `playFirstSound()` before playback to automatically play incoming audio
- calls `connect()` function

```
const onStartClick = function (state) {
    if (validateForm("connectionForm", state.errInfoId())
```

```
        && validateForm(state.formId(), state.errInfoId())
        && validateName(state, state.errInfoId())) {
        state.setStarting(true);
        let otherState = getOtherState(state);
        $("#" + state.buttonId()).prop('disabled', true);
        // Disable other session button to prevent a simultaneous connections
        if (!otherState.isStarting()) {
            $("#" + otherState.buttonId()).prop('disabled', true);
        }
        if (state.is(PLAY) && Browser().isSafariWebRTC()) {
            playFirstSound(document.getElementById("main"),
PRELOADER_URL).then(function () {
                connect(state);
            });
        } else {
            connect(state);
        }
    }
}
```

11. Stop click actions

`onStopClick()`, `Session.disconnect()` code

The `onStopClick()` function:

- stops playback or publishing
- disconects Websocket session

```
const onStopClick = async function (state) {
    state.setStarting(false);
    disposeStateDisplay(state);
    if (state.isConnected()) {
        $("#" + state.buttonId()).prop('disabled', true);
        await state.session.disconnect();
        onDisconnected(state);
    }
}
```

12. Websocket session disconnection actions

`onDisconnected()` code

The `onDisconnected()` functions:

- sets up `Publish/Play` click actions
- enables `Server url` and `Room name` fields access, if there's no parallel session

```
const onDisconnected = function (state) {
    state.clear();
    $("#" +
```

```
state.buttonId()).text(state.buttonText()).off('click').click(function () {
        onStartClick(state);
    }).prop('disabled', false);
    $("#" + state.inputId()).prop('disabled', false);
    // Enable other session buttons
    let otherState = getOtherState(state);
    if (!otherState.session) {
        $("#" + otherState.buttonId()).prop('disabled', false);
        $("#" + otherState.inputId()).prop('disabled', false);
        $('#url').prop('disabled', false);
        $("#roomName").prop('disabled', false);
    }
}
```

13. Helper functions

13.1. Start publishing or playback

`startStreaming()` code

```
const startStreaming = function(state) {
    if (state.is(PUBLISH)) {
        publishStreams(state);
    } else if (state.is(PLAY)) {
        playStreams(state);
    }
}
```

13.2. Stop publishing or playback

`state.display.stop()` code

```
const CurrentState = function (prefix) {
    let state = {
        ...
        disposeDisplay: function () {
            if (state.display) {
                state.display.stop();
                state.display = null;
            }
        }
    };
    return state;
}
```