

Publisher and player channel quality control

When a WebRTC stream is publishing, picture quality depends on media data transfer channel between client and server, especillay for high definition streams (HD, FullHD, 4K). The ability to control channel quality and notify publisher about bandwidth decrease in time using WebSDK was added since build [5.2.398](#). Subscriber, in its turn, can be notified about bandwidth decrease since build [5.2.409](#).

The publishing and playback bitrate values on client side are periodically comparing with server side one. The steady divergence of those values means channel bandwidth decrease. The peaks and sudden changes are smoothed by [Kalman filter](#).

Server configuration

Current server side publishing bitrate values sending to client for later comparison should be enabled with the following parameter in [flashphoner.properties](#) file

```
inbound_video_rate_stat_send_interval=1
```

Current server side playback bitrate values sending is enabled with the following parameter

```
outbound_video_rate_stat_send_interval=1
```

The settings above define bitrate values sending interval in seconds. It is recommended to send bitrate to client every second.

Channel quality displaying at client side

Let's look at channel quality and bitrate changing graphs displaying using [Media Devices](#) example.

1. A function to prepare to display graphs [code](#)

```
function createOrClearChart(chartId, bitrateComparisonChart) {
  if (!bitrateComparisonChart) {
    var canvas = document.getElementById(chartId);
    var ctx = canvas.getContext('2d');
    bitrateComparisonChart = new ComparisonChart(ctx);
  } else {
    bitrateComparisonChart.clearBitrateChart();
  }
}
```

```
    return bitrateComparisonChart;
}
```

function usage while publishing [code](#)

```
function publish() {
    ...
    publishConnectionQualityStat.chart =
    createOrClearChart('publishBitrateChart',
    publishConnectionQualityStat.chart);

    publishStream = session.createStream({
    ...
    });
    publishStream.publish();
}
```

function usage while playing [code](#)

```
function play() {
    ...
    playConnectionQualityStat.chart =
    createOrClearChart('playBitrateChart', playConnectionQualityStat.chart);

    previewStream = session.createStream({
    ...
    });
    previewStream.play();
}
```

2. Channel quality and bitrate values receiving, bitrate graphs displaying

`CONNECTION_QUALITY.UPDATE` event handling while publishing [code](#)

```
publishStream = session.createStream({
    ...
}).on(CONNECTION_QUALITY.UPDATE, function (quality, clientFiltered,
serverFiltered) {
    updateChart(quality, clientFiltered, serverFiltered,
    publishConnectionQualityStat);
});
publishStream.publish();
```

while playing [code](#)

```
previewStream = session.createStream({
    ...
}).on(CONNECTION_QUALITY.UPDATE, function (quality, clientFiltered,
serverFiltered) {
    updateChart(quality, clientFiltered, serverFiltered,
    playConnectionQualityStat);
});
previewStream.play();
```

a function to update graphs and quality [code](#)

```
function updateChart(calculatedQuality, clientFiltered, serverFiltered,
connectionQualityStat) {
    var timestamp = new Date().valueOf();
    connectionQualityStat.connectionQualityUpdateTimestamp = timestamp;
    connectionQualityStat.chart.updateChart(clientFiltered,
serverFiltered);
    connectionQualityStat.quality = calculatedQuality;
}
```

3. Set channel quality to `UNKNOWN`, if `CONNECTION_QUALITY.UPDATE` event is not received while publishing [code](#)

```
function loadStats() {
    if (publishStream) {
        ...
        if(new Date().valueOf() - CONNECTION_QUALITY_UPDATE_TIMEOUT_MS >
publishConnectionQualityStat.connectionQualityUpdateTimestamp) {
            publishConnectionQualityStat.quality =
CONNECTION_QUALITY.UNKNOWN;
        }
        ...
    }
    ...
}
```

while playing [code](#)

```
function loadStats() {
    ...
    if (previewStream) {
        ...
        if(new Date().valueOf() - CONNECTION_QUALITY_UPDATE_TIMEOUT_MS >
playConnectionQualityStat.connectionQualityUpdateTimestamp) {
            publishConnectionQualityStat.quality =
CONNECTION_QUALITY.UNKNOWN;
        }
        ...
    }
    ...
}
```

4. Channel quality displaying while publishing [code](#)

```
function loadStats() {
    if (publishStream) {
        ...
        if (publishConnectionQualityStat.quality !== undefined) {
            showStat({"quality": publishConnectionQualityStat.quality},
"outConnectionStat");
        }
        ...
    }
}
```

```

    }
    ...
  }
  ...
}

```

while playing [code](#)

```

function loadStats() {
  ...
  if (previewStream) {
    ...
    if (playConnectionQualityStat.quality !== undefined) {
      showStat({"quality": playConnectionQualityStat.quality},
        "inConnectionStat");
    }
    ...
  }
  ...
}

```

a function to display quality [code](#)

```

function showStat(stat, type) {
  Object.keys(stat).forEach(function(key) {
    if (typeof stat[key] !== 'object') {
      let k = key.split(/(?=[A-Z])/);
      let metric = "";
      for (let i = 0; i < k.length; i++) {
        metric += k[i][0].toUpperCase() + k[i].substring(1) + "
";
      }
      if ($("#" + key + "-" + type).length == 0) {
        let html = "<div style='font-weight: bold'>" +
metric.trim() + ": <span id='" + key + "-" + type + "' style='font-
weight: normal'></span>" + "</div>";
        // $(html).insertAfter("#" + type);
        $("#" + type).append(html);
      } else {
        $("#" + key + "-" + type).text(stat[key]);
      }
    }
  });
}

```

Testing

1. For the test we use:
2. WCS [5.2.409](#) or newer
3. Media Devices example in Chrome browser

4. publishing channel with 100 Mbps upload and download bandwidth
5. bandwidth shaping tool, [winShaper](#) on Windows or [Network Link Conditioner](#) on MacOS for example
6. Publish and play 720p stream on Media Devices page

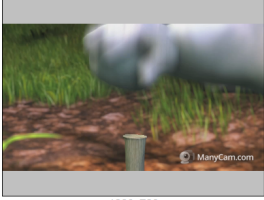
Media Devices

Video stats
 Codec: H264
 Codec Rate: 90000
 Fir Count: 0
 Pli Count: 2
 Nack Count: 0
 Packets Sent: 22877
 Bytes Sent: 22689293
 Height: 720
 Width: 1280
 Bitrate: 5407720

Audio stats
 Codec: opus
 Codec Rate: 48000
 Packets Sent: 2111
 Bytes Sent: 196162
 Bitrate: 37808

Connection
 Quality: PERFECT

Local

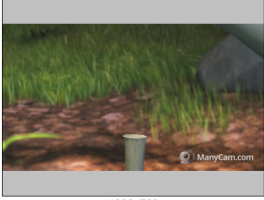


1280x720

test
Stop

PUBLISHING

Player



1280x720

test
Stop

PLAYING

Video stats
 Codec: H264
 Codec Rate: 90000
 Fir Count: 0
 Pli Count: 2
 Nack Count: 0
 Packets Received: 11748
 Bytes Received: 12118656
 Packets Lost: 0
 Height: 720
 Width: 1280
 Bitrate: 5521368

Audio stats
 Codec: opus
 Codec Rate: 48000
 Packets Received: 1110
 Bytes Received: 102910
 Packets Lost: 0
 Bitrate: 37712

Connection
 Quality: PERFECT

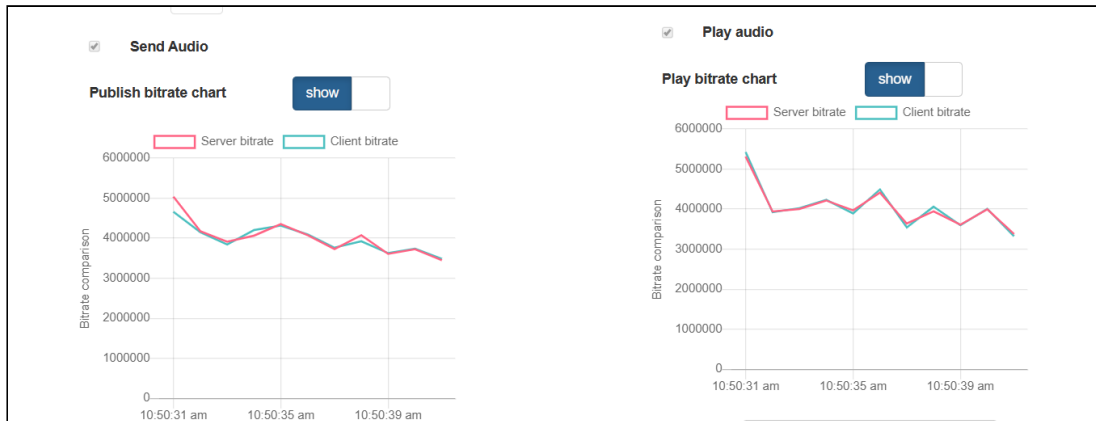
wss://centos1.flashphoner.com:8443 Disconnect

Timeout msec

ESTABLISHED

The **PERFECT** channel quality is displayed for publisher and player

7. Check publishing and playing bitrate graphs on perfect channel



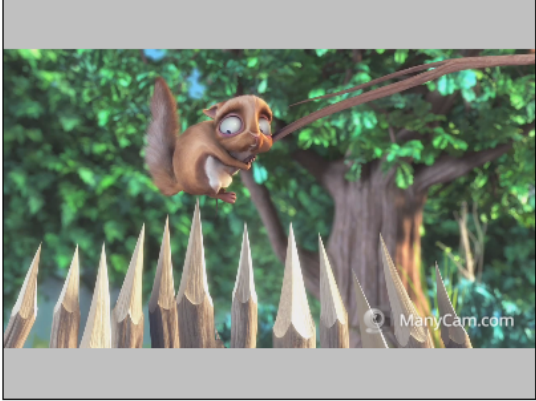
8. Shape outgoing traffic to 768 kbps, simulating a typical 3G connection

Video stats
Codec: H264
Codec Rate: 90000
Fir Count: 0
Pli Count: 8315
Nack Count: 1562
Packets Sent: 410527
Bytes Sent: 408125317
Height: 720
Width: 1280
Bitrate: 4171488

Audio stats
Codec: opus
Codec Rate: 48000
Packets Sent: 40545
Bytes Sent: 3618193
Bitrate: 37200

Connection
Quality: BAD

Local



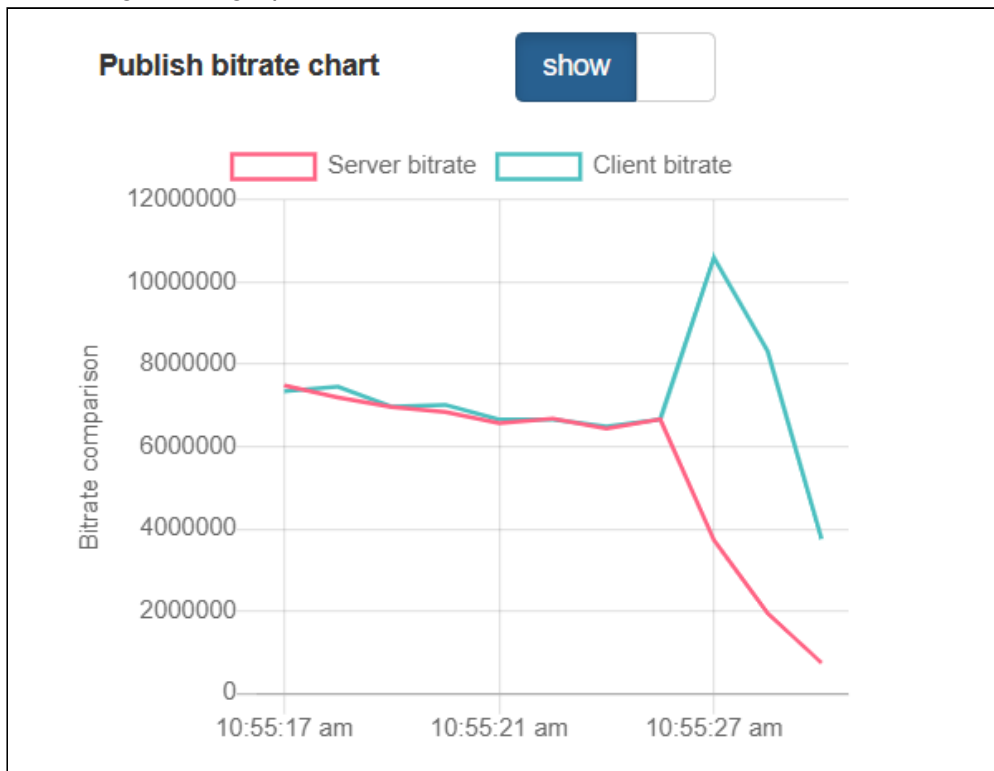
1280x720

test Stop

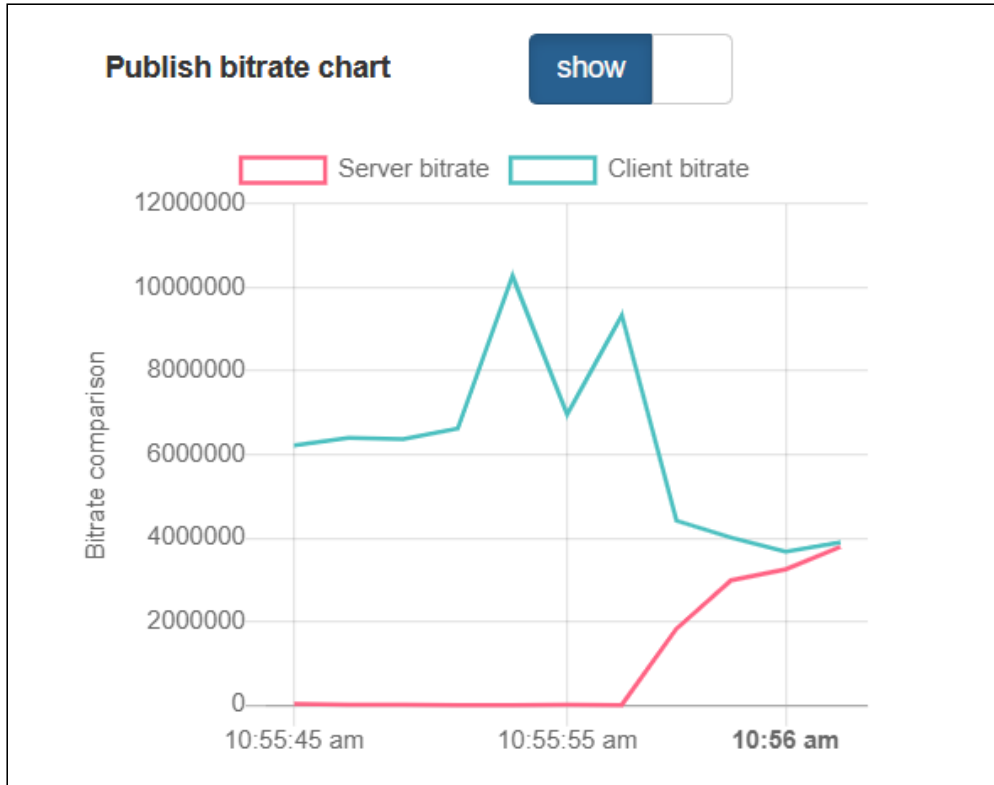
PUBLISHING

The **PERFECT** value changes to **BAD** for publisher.

Publishing bitrate graph looks as follows



9. Stop bandwidth shaping, check publishing bitrate graphs



After the graphs converge again, the **PERFECT** publisher channel quality value is displayed

10. Shape incoming traffic to 768 kbps

Player

1280x720

test
Stop

PLAYING

Video stats

- Codec:** H264
- Codec Rate:** 90000
- Fir Count:** 0
- Pli Count:** 81
- Nack Count:** 0
- Packets Received:** 266189
- Bytes Received:** 271314911
- Packets Lost:** 0
- Height:** 720
- Width:** 1280
- Bitrate:** 145864

Audio stats

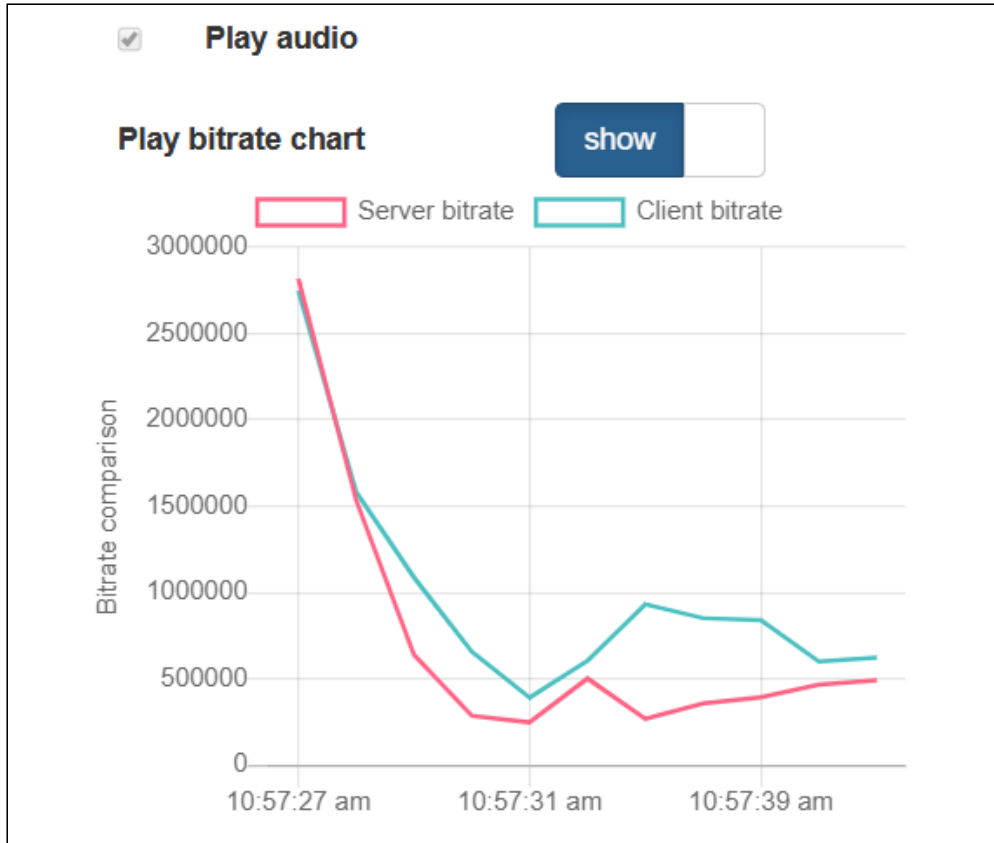
- Codec:** opus
- Codec Rate:** 48000
- Packets Received:** 33312
- Bytes Received:** 2967388
- Packets Lost:** 0
- Bitrate:** 31032

Connection

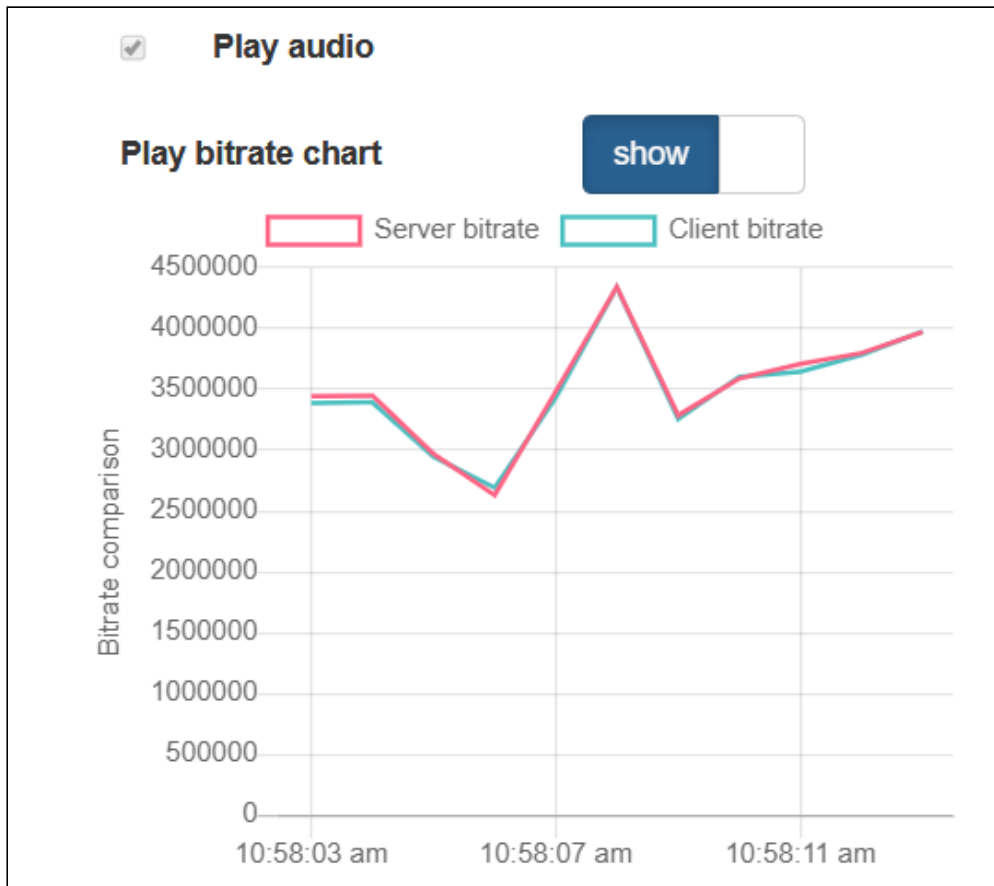
- Quality:** BAD

The **PERFECT** value changes to **BAD** for subscriber, picture freeze and artifacts are

observed. Playing bitrate graph looks as follows



11. Stop bandwidth shaping, check playing bitrate graphs



After the graphs converge again, the **PERFECT** subscriber channel quality value is displayed, picture is restored

Recommendations to publishers

If channel quality is displayed as **PERFECT** or **GOOD**, it means channel bandwidth is enough to publish a stream with a current resolution and bitrate.

If channel quality is changed steadily to **BAD**, it means channel bandwidth is not enough, and subscribers are viewing a problems. It is recommended to lower publishing bitrate and/or resolution if possible.

If channel quality is changed steadily to **UNKNOWN**, video frames can not reach the server. It is recommended to republish stream.

Recommendations to subscribers

If channel quality is displayed as **PERFECT** or **GOOD**, it means channel bandwidth is enough to play a stream with a current resolution and bitrate. If a problems occur while playing stream in this case, the reason of the problems is probably on publisher side.

If channel quality is changed steadily to **BAD**, it means channel bandwidth is not enough, picture freeze and artefacts are observed. It is recommended to request the stream with lower bitrate and/or resolution if possible.

If channel quality is changed steadily to **UNKNOWN**, video frames can not be received from the server. It is recommended to reconnect and restart the stream playback.