

HTTP LIVE STREAMING

WITH CMAF CONTAINER

COGICOM



Clement Duval

PLAYLIST vs SEGMENTS

Playlist/Manifest

HLS or DASH

Variant_1: http://init_1 http://segment_1 http://segment_2 ...

Variant_2: http://init_2 http://segment_1 http://segment_2 ...

Variant_3: http://init_3 http://segment_1 http://segment_2 ...

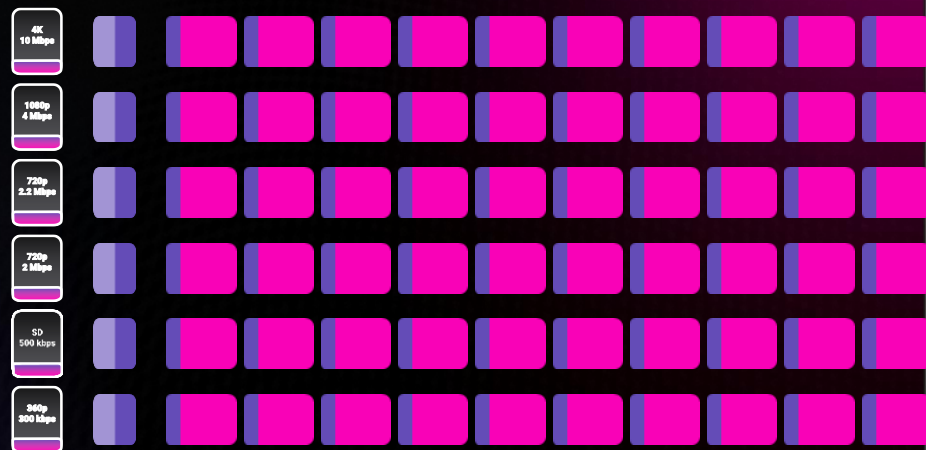
Variant_4: http://init_4 http://segment_1 http://segment_2 ...

Variant_5: http://init_5 http://segment_1 http://segment_2 ...

Variant_6: http://init_6 http://segment_1 http://segment_2 ...

Media containers

ISOBMFF/CMAF



MANIFEST vs MEDIA CONTAINERS

MANIFEST



MEDIA CONTAINER

MPEG
Transport Stream



ISOBMFF & CMAF



APPLE'S HTTP LIVE STREAMING

- PRIMARILY DEFINES THE **FORMAT OF PLAYLIST**
- **THE MOST POPULAR** STREAMING PROTOCOL

APPLE'S HTTP LIVE STREAMING

- PRIMARILY DEFINES THE **FORMAT OF PLAYLIST**
- **THE MOST POPULAR** STREAMING PROTOCOL



Apple



iPhone 3G S

2009

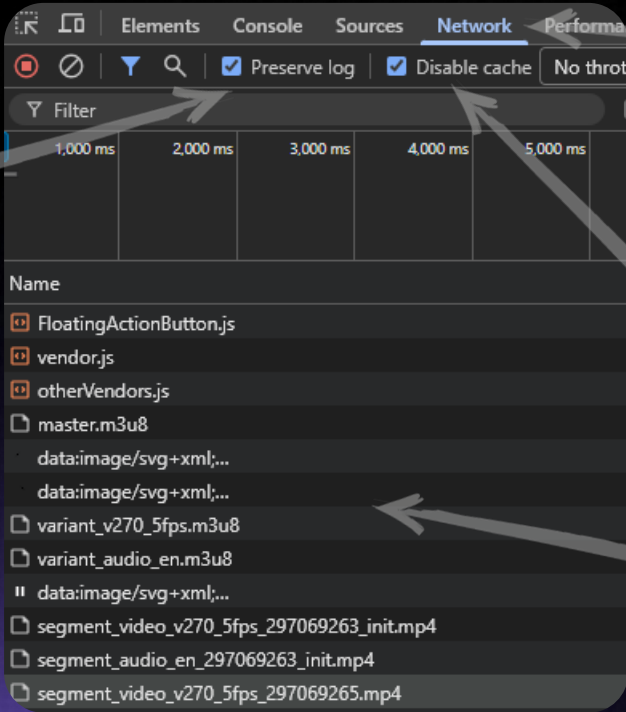
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BEFORE WE START

TOOLS TO ANALYZE THE HTTP TRAFFIC

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VIEWING HTTP PACKETS WITH THE BROWSER'S CONSOLE



The screenshot shows a browser's developer tools with the **Network** tab selected. The **Filter** dropdown is set to **All**. The **Preserve log** and **Disable cache** checkboxes are checked. The **Timeline** view shows a list of network requests. The first request is **FloatingActionButton.js**. The second request is **vendor.js**. The third request is **otherVendors.js**. The fourth request is **master.m3u8**. The fifth request is **data:image/svg+xml;...**. The sixth request is **variant_v270_5fps.m3u8**. The seventh request is **variant_audio_en.m3u8**. The eighth request is **data:image/svg+xml;...**. The ninth request is **segment_video_v270_5fps_297069263_init.mp4**. The tenth request is **segment_audio_en_297069263_init.mp4**. The eleventh request is **segment_video_v270_5fps_297069265.mp4**.

Annotations:

- Network tab**: Points to the **Network** tab in the developer tools.
- Preserve log**: Points to the **Preserve log** checkbox.
- Disable cache**: Points to the **Disable cache** checkbox.
- F12**: A pink text label.
- You should receive m3u8/mp4 files**: Points to the **variant_v270_5fps.m3u8** request.
- audio/video should play**: A text label.

LANGUAGE SELECTION

ENGLISH

LOAD STREAM

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BEFORE WE START

HLS PLAYLIST OVERVIEW

MASTER & VARIANT PLAYLISTS

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HLS PLAYLIST HIERARCHY

MASTER PLAYLIST

http://master_playlist.m3u8

```
Variant_1 <bandwidth>  
Variant_2 <bandwidth>  
Variant_3 <bandwidth>
```

Provides **URL of variant playlists**
& associated bandwidth values

VARIANT 1

VARIANT 2

VARIANT 3

```
Init  
Segment1  
Segment2  
Segment3
```

```
Init  
Segment1  
Segment2  
Segment3
```

```
Init  
Segment1  
Segment2  
Segment3
```

Provides **URL of media segments** for each variant

 init

 Segment 1

 Segment 2

 Segment 3

 init

 Segment 1

 Segment 2

 Segment 3

 init

 Segment 1

 Segment 2

 Segment 3

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HLS PLAYLIST OVERVIEW

MASTER vs VARIANT PLAYLIST

MASTER PLAYLIST

Provides **URL of variant playlists**
& associated bandwidth values

Downloaded
only once

VARIANT PLAYLISTS

Provides **URL of media segments** for each variant

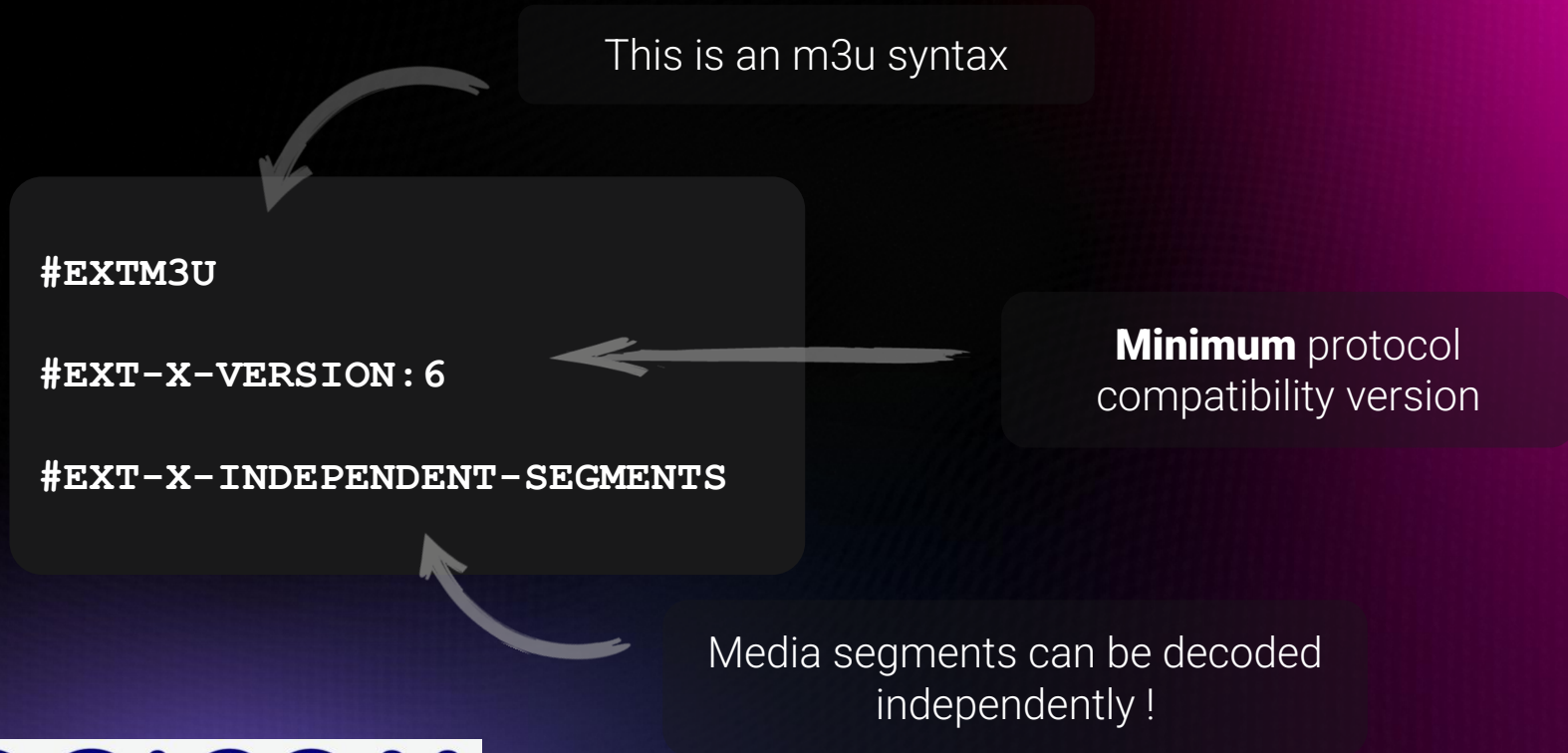
Reloaded
periodically

MASTER PLAYLIST

ANATOMY

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TOP OF THE MASTER PLAYLIST



#EXT-X-STREAM-INF:

```
RESOLUTION=1280x720  
FRAME-RATE=25  
CODECS="avc1.4D401F,mp4a.40.2"
```

```
BANDWIDTH=550000  
AVERAGE-BANDWIDTH=500000
```

```
AUDIO="track1"
```

```
variant_1.m3u8
```

Definition of the **variant stream**



VARIANT STREAM: WHAT'S IN IT?

#EXT-X-STREAM-INF:

```
RESOLUTION=1280x720  
FRAME-RATE=25  
CODECS="avc1.4D401F,mp4a.40.2"
```

```
BANDWIDTH=550000  
AVERAGE-BANDWIDTH=500000
```

```
AUDIO="track1"
```

```
variant_1.m3u8
```

Player needs to know if it is capable to decode it

Indicates the exact **codec configuration** used (encoding complexity)



MASTER PLAYLIST

PROVIDES METADATA ON THE STREAM TO PLAY

SO THAT PLAYERS:

- **DON'T NEED TO DOWNLOAD & PARSE THE INIT SEGMENT**
- **CAN EASILY SKIP STREAM CONFIGURATION THEY DON'T SUPPORT**

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VARIANT STEAM: WHAT'S IN IT?

#EXT-X-STREAM-INF:

```
RESOLUTION=1280x720  
FRAME-RATE=25  
CODECS="avc1.4D401F,mp4a.40.2"
```

```
BANDWIDTH=550000  
AVERAGE-BANDWIDTH=500000
```

```
AUDIO="track1"
```

```
variant_1.m3u8
```

Coming up next!



Live Demo

- ▶ Master playlist
- ▶ Variant declaration & metadata



MASTER PLAYLIST

THE BANDWIDTH ATTRIBUTE

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THE BANDWIDTH LADDER

#EXT-X-STREAM-INF:

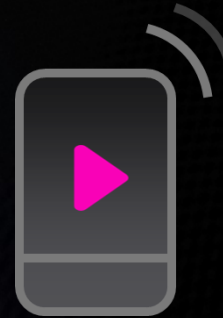
AVERAGE-BANDWIDTH=1500000
variant_1.m3u8

#EXT-X-STREAM-INF:

AVERAGE-BANDWIDTH=1000000
variant_2.m3u8

#EXT-X-STREAM-INF:

AVERAGE-BANDWIDTH=500000
variant_3.m3u8



THE BANDWIDTH LADDER

Variant #3

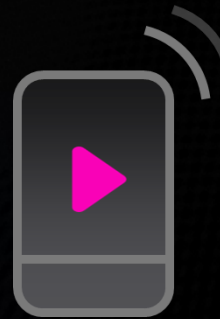
1.5 Mbps

Variant #2

1 Mbps

Variant #1

500 kbps



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THE BANDWIDTH ATTRIBUTE

THE BANDWIDTH LADDER

Variant #3

Bandwidth must be **at least**

1.5 Mbps

Variant #2

Bandwidth must be **at least**

1 Mbps

Variant #1

Bandwidth must be **at least**

500 kbps



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THE BANDWIDTH ATTRIBUTE

Live Demo

- ▶ Master playlist
- ▶ Bandwidth attribute



THROUGHPUT vs BANDWIDTH

HOW PLAYERS CHOOSE THE VARIANT

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HOW PLAYERS COMPUTE THROUGHPUT

In bit per second

In bytes

$$\text{THROUGHPUT} = \frac{\text{MEDIA SEGMENT SIZE}}{\text{DOWNLOAD TIME}}$$

In seconds

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HOW PLAYERS COMPUTE THE BANDWIDTH

$$\text{THROUGHPUT} = \frac{100 \text{ kBytes}}{200 \text{ ms}} = 4 \text{ Mbps}$$

BANDWIDTH vs THROUGHPUT: THE WATER PIPE ANALOGY

Bandwidth:

The **capacity** of the water pipe

Throughput:

The **amount of water** flowing into the pipe



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BANDWIDTH vs THROUGHPUT IN HLS TERMS

Bandwidth:

Fixed value provided by the
origin packager

MASTER PLAYLIST

```
Variant_1 <average-bandwidth>  
Variant_2 <average-bandwidth>  
Variant_3 <average-bandwidth>
```

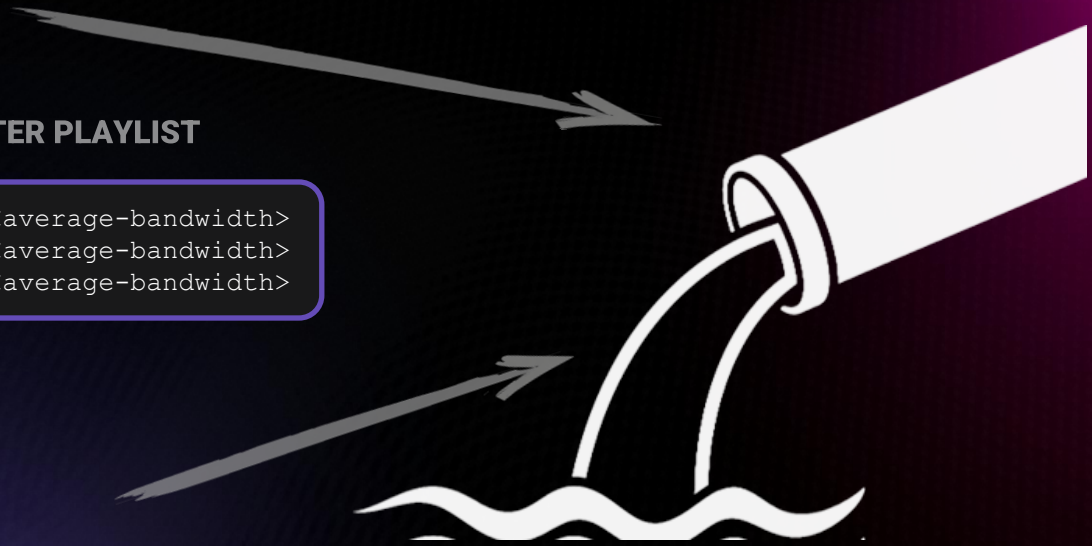
Throughput:

Computed dynamically
by the player



Computed
Throughput

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AVERAGE-BANDWIDTH:

- **MAXIMUM DATA CAPACITY OF A NETWORK LINK**
- **TO PLAY THIS VARIANT SMOOTHLY, YOU NEED A PIPE THAT CAN HANDLE AT LEAST THIS BANDWIDTH**
- **STATIC VALUE INDICATED IN THE MASTER PLAYLIST AND ASSOCIATED TO EACH VARIANT**

THROUGHPUT:

- THE **ACTUAL AMOUNT OF DATA** THAT TRAVELS THROUGH IT IN REAL-TIME.
- **COMPUTED BY THE PLAYER** EVERY TIME A NEW MEDIA SEGMENT IS DOWNLOADED

Quiz 1

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MASTER PLAYLIST

AUDIO RENDITION GROUPS

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VARIANT HIGH-LEVEL INFO:

#EXT-X-MEDIA: TYPE=AUDIO

GROUP-ID="track1"

CHANNELS="2"

NAME="English"

LANGUAGE="eng"

DEFAULT=YES

URI="audio1.m3u8"

Not a variant (not subject to bitrate switching)



VARIANT HIGH-LEVEL INFO:

#EXT-X-MEDIA: TYPE=AUDIO

GROUP-ID="track1"

CHANNELS="2"

NAME="English"

LANGUAGE="eng"

DEFAULT=YES

URI="audio1.m3u8"

Every video variant associated with this **GROUP-ID** should use this audio group

An audio group is a collection of one or more audio renditions



DEFAULT & AUTO-SELECT AUDIO

```
#EXT-X-MEDIA: TYPE=AUDIO
```

```
  GROUP-ID="track1"
```

```
  NAME="English"
```

```
  LANGUAGE="eng"
```

```
  DEFAULT=YES
```

```
  URI="audio_en.m3u8"
```

```
#EXT-X-MEDIA: TYPE=AUDIO
```

```
  GROUP-ID="track1"
```

```
  NAME="Francais"
```

```
  LANGUAGE="fra"
```

```
  DEFAULT=NO
```

```
  URI="audio_fr.m3u8"
```

Every video variant that include **GROUP-ID track1** should use one of the audio stream in this group

VARIANT HIGH-LEVEL INFO:

#EXT-X-MEDIA: TYPE=AUDIO

GROUP-ID="track1"

CHANNELS="2"

NAME="English"

LANGUAGE="eng"

DEFAULT=YES

URI="audio1.m3u8"

- ▶ Audio is stereo
- ▶ Displayed as English by the player
- ▶ Language code is English



VARIANT HIGH-LEVEL INFO:

#EXT-X-MEDIA: TYPE=AUDIO

GROUP-ID="track1"

CHANNELS="2"

NAME="English"

LANGUAGE="eng"

DEFAULT=YES

URI="audio1.m3u8"



DEFAULT AUDIO TRACK

```
#EXT-X-MEDIA: TYPE=AUDIO  
GROUP-ID="track1"  
NAME="English"  
LANGUAGE="eng"  
DEFAULT=YES  
URI="audio_en.m3u8"
```

```
#EXT-X-MEDIA: TYPE=AUDIO  
GROUP-ID="track1"  
NAME="Francais"  
LANGUAGE="fra"  
DEFAULT=NO  
URI="audio_fr.m3u8"
```

The player plays the default language first
whatever the system language is set on the playing device

AUDIO RENDITION GROUP

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HLS PATH NAVIGATION

RELATIVE PATHS TO SAVE SPACE

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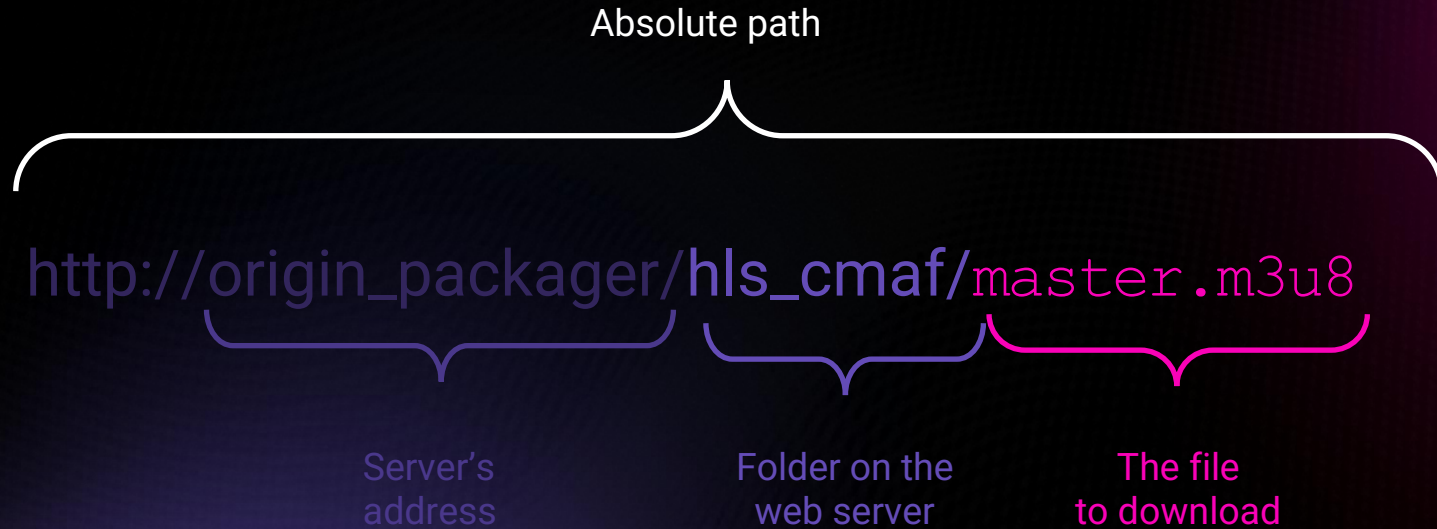
ANATOMY OF AN HTTP URL

Absolute path



`http://origin_packager/hls_cmaf/master.m3u8`

ANATOMY OF AN HTTP URL



THE MASTER PLAYLIST

IS ALWAYS DOWNLOADED USING AN ABSOLUTE HTTP URL

**OTHER COMPONENTS' URL ARE USUALLY INDICATED USING
RELATIVE PATH TO SAVE ON PLAYLIST SIZE**

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ANATOMY OF AN HTTP URL

`http://origin_packager/hls_cmaf/master.m3u8`

In its simplest form,
all files are in the same directory
on the web server

`media_segment.mp4`

`init_segment.mp4`

`variant_1.m3u8`

`variant_2.m3u8`

`variant_3.m3u8`

`audio_en.m3u8`

#EXT-X-STREAM-INF:

...

variant_1.m3u8

http://origin_packager/hls_cmaf/master.m3u8

http://origin_packager/hls_cmaf/variant_1.m3u8

#EXT-X-STREAM-INF:

...

variant_2.m3u8

http://origin_packager/hls_cmaf/variant_2.m3u8

#EXT-X-STREAM-INF:

...

variant_3.m3u8

http://origin_packager/hls_cmaf/variant_3.m3u8

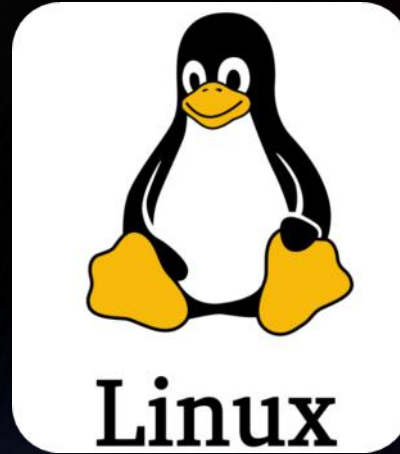
#EXT-X-MEDIA: TYPE=AUDIO,

URI="audio_en.m3u8"

http://origin_packager/hls_cmaf/audio_en.m3u8



PATH NAVIGATION



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PATH NAVIGATION



- `./file` or `file:` → File is in the current directory
- `./sub/file` → File is in the subdirectory of the current directory
- `../file` → File is in the parent directory (1 level up)
- `../../file` → File is in the parent directory (2 levels up)
- `/file` → File is in the root directory
- `http://other_webserver/file` → File is on a different web server's root directory

#EXT-X-STREAM-INF:

...

../720p/variant_1.m3u8

http://origin_packager/hls_cmaf/master.m3u8

#EXT-X-STREAM-INF:

...

../360p/variant_2.m3u8

http://origin_packager/720p/variant_1.m3u8

#EXT-X-STREAM-INF:

...

../270p/variant_3.m3u8

http://origin_packager/360p/variant_2.m3u8

#EXT-X-MEDIA: TYPE=AUDIO,

URI="../audio/audio_en.m3u8"

http://origin_packager/270p/variant_3.m3u8

http://origin_packager/audio/audio_en.m3u8

Live Demo

- ▶ Relative path in master playlist



VARIANT PLAYLIST

PROVIDING MEDIA SEGMENT URLS

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HLS PLAYLIST HIERARCHY

MASTER PLAYLIST

http://master_playlist.m3u8

```
Variant_1 <bandwidth>  
Variant_2 <bandwidth>  
Variant_3 <bandwidth>
```

Provides **URL of variant playlists**
& associated bandwidth values

VARIANT 1

VARIANT 2

VARIANT 3

```
Init  
Segment1  
Segment2  
Segment3
```

```
Init  
Segment1  
Segment2  
Segment3
```

```
Init  
Segment1  
Segment2  
Segment3
```

Provides **URL of media segments** for each variant

 init

 Segment 1

 Segment 2

 Segment 3

 init

 Segment 1

 Segment 2

 Segment 3

 init

 Segment 1

 Segment 2

 Segment 3

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HLS PLAYLIST OVERVIEW

HLS PLAYLIST HIERARCHY

MASTER PLAYLIST

http://master_playlist.m3u8

```
Variant_1 <bandwidth>  
Variant_2 <bandwidth>  
Variant_3 <bandwidth>
```

Provides **URL of variant playlists**
& associated bandwidth values

VARIANT 1

VARIANT 2

VARIANT 3

```
Init  
Segment1  
Segment2  
Segment3
```

```
Init  
Segment1  
Segment2  
Segment3
```

```
Init  
Segment1  
Segment2  
Segment3
```

Provides **URL of media segments** for each variant

 init

 Segment 1

 Segment 2

 Segment 3

 init

 Segment 1

 Segment 2

 Segment 3

 init

 Segment 1

 Segment 2

 Segment 3

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HLS PLAYLIST OVERVIEW

MASTER vs VARIANT PLAYLIST

MASTER PLAYLIST

Provides **URL of variant playlists**
& associated bandwidth values

Downloaded
only once

VARIANT PLAYLISTS

Provides **URL of media segments** for each variant

Reloaded
periodically

VARIANT PLAYLIST

VARIANT 1

#EXT-X-VERSION: 6

#EXT-X-TARGETDURATION: 4

#EXT-X-MAP:URI="`init-variant1.mp4`**"**

#EXT-X-PROGRAM-DATE-TIME: 2026-05...

#EXT-X-MEDIA-SEQUENCE: 123



HLS VERSION

VARIANT 1

#EXT-X-VERSION: 6

#EXT-X-TARGETDURATION: 4

#EXT-X-MAP:URI="init-variant1.mp4"

#EXT-X-PROGRAM-DATE-TIME: 2026-05...

#EXT-X-MEDIA-SEQUENCE: 123

Minimum protocol
compatibility version

May be different from the
master playlist's version



MAXIMUM SEGMENT DURATION IN THE VARIANT PLAYLIST

VARIANT 1

#EXT-X-VERSION: 6

#EXT-X-TARGETDURATION: 4

#EXT-X-MAP:URI="init-variant1.mp4"

#EXT-X-PROGRAM-DATE-TIME: 2026-05...

#EXT-X-MEDIA-SEQUENCE: 123



Duration of the **longest segment** in the current playlist

Helps players **manage their buffer**

Players should reload the playlist at minimum **50% of TARGET-DURATION**



SEGMENT DURATION IN THE VARIANT PLAYLIST

```
#EXTINF:4,  
segment1.mp4  
#EXTINF:4,  
segment2.mp4  
#EXTINF:4,  
segment3.mp4
```

Segment 1 is 4-second long



Duration is placed
before the segment's relative path

VARIANT'S INIT SEGMENT

VARIANT 1

```
#EXT-X-VERSION:6  
#EXT-X-TARGETDURATION:4  
#EXT-X-MAP:URI="init-variant1.mp4"  
  
#EXT-X-PROGRAM-DATE-TIME:2026-05...  
#EXT-X-MEDIA-SEQUENCE:123
```

Init segment for this variant

Downloaded only once by the player when switching to the variant for the 1st time

ETYP

MOOV



VARIANT'S TIME & ORDER

VARIANT 1

#EXT-X-VERSION: 6

#EXT-X-TARGETDURATION: 4

#EXT-X-MAP: URI="init-variant1.mp4"

#EXT-X-PROGRAM-DATE-TIME: 2026-05...

#EXT-X-MEDIA-SEQUENCE: 123

Coming up next!



Live Demo

- ▶ Variant playlist attributes
- ▶ Segment durations



LIVE WINDOW SIZE

SLIDING WINDOWS FOR AVAILABLE SEGMENTS

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LIVE WINDOW SIZE

DURATION OF TIME FOR WHICH MEDIA SEGMENTS ARE
AVAILABLE FOR PLAYBACK

INDICATES THE **DEPTH OF THE VARIANT PLAYLISTS**

SETS A LIMIT ON **HOW FAR BACK IN TIME** A PLAYER CAN
REQUEST MEDIA SEGMENTS FOR LIVE PLAYBACK

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SEGMENT DURATION IN THE VARIANT PLAYLIST



```
#EXTINF:4,  
segment1.mp4  
#EXTINF:4,  
segment2.mp4  
#EXTINF:4,  
segment3.mp4
```

Oldest segment in the playlist
Will disappear from the playlist in
4 sec or less

Live window size is
 $3 \times 4 = 12$ seconds

Live edge segment
Most recent segment

Live Demo

- ▶ Live window size
- ▶ Live edge segment



PROGRAM-DATE-TIME

REAL-WORLD WALL-CLOCK SYNC

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EXT-X-PROGRAM-DATE-TIME

**ASSOCIATES SEGMENTS TO WALL-CLOCK TIME,
NECESSARY FOR:**

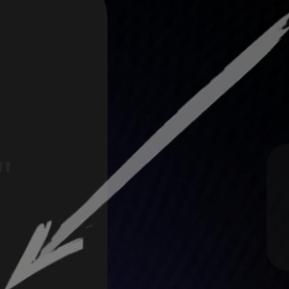
- **SEAMLESS & PRECISE BITRATE SWITCHING**
- **INTERACTIVE DIGITAL VIDEO RECORDED**
- **DYNAMIC AD INSERTION**
- **MULTI-CAM SYNCHRONIZATION**

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PROGRAM-DATE-TIME: SYNC'ING VARIANTS

VARIANT 1

```
#EXT-X-VERSION: 6  
#EXT-X-TARGETDURATION: 4  
#EXT-X-MAP: URI="init-variant1.mp4"  
  
#EXT-X-PROGRAM-DATE-TIME: 2026-05...  
#EXT-X-MEDIA-SEQUENCE: 123
```



Wall-clock time of the
segment that follows

Associates the segment's **start time**

There may be one per variant playlist
or one per segment



COMPUTING SEGMENTS' WALL-CLOCK TIMES

```
#EXT-X-PROGRAM-DATE-TIME:2026-01-03T21:00:00.0Z
```

```
#EXTINF:4,
```

```
segment1.mp4 2026-01-03T21:00:00.0Z
```

```
#EXTINF:4,
```

```
segment2.mp4 21:00:04.0Z
```

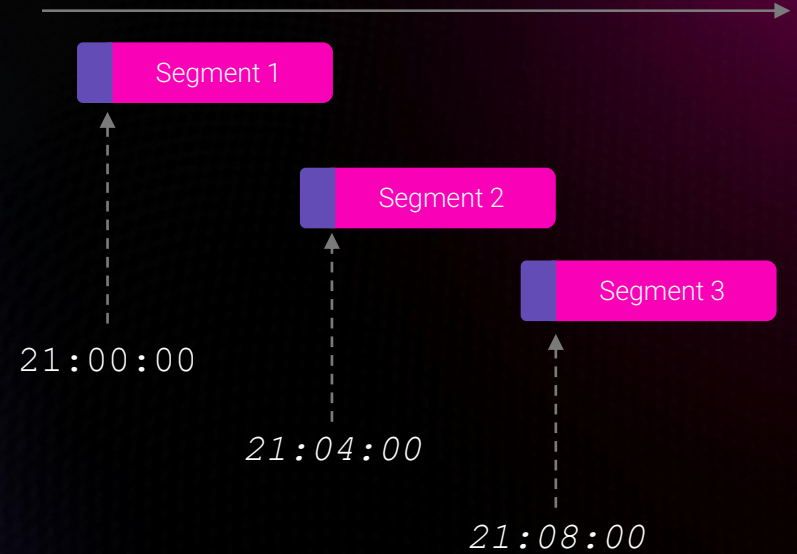


```
#EXTINF:4,
```

```
segment3.mp4 21:00:08.0Z
```



Decode
Timeline



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RELOADING THE VARIANT PLAYLIST

```
#EXT-X-PROGRAM-DATE-TIME:2026-01-03T21:00:00.0Z
```

```
#EXTINF:4,
```

```
segment1.mp4 2026-01-03T21:00:00.0Z
```

```
#EXTINF:4,
```

```
segment2.mp4
```

```
#EXTINF:4,
```

```
segment3.mp4
```

Reloading The variant playlist

Decode
Timeline

Segment 1

Segment 2

Segment 3

21:00:00

21:04:00

21:08:00

COGICOM

RELOADING THE VARIANT PLAYLIST

```
#EXT-X-PROGRAM-DATE-TIME: 2026-01-03T21:00:00.0Z
```

```
#EXTINF: 4,
```

```
segment1.mp4 2026-01-03T21:00:00.0Z
```

```
#EXTINF: 4,
```

```
segment2.mp4 21:00:04.0Z
```



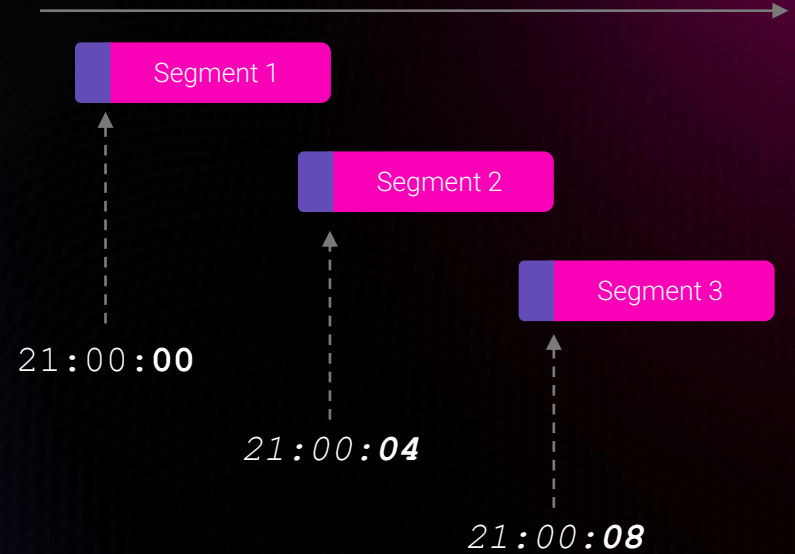
```
#EXTINF: 4,
```

```
segment3.mp4 21:00:08.0Z
```



COGICOM

Decode
Timeline



RELOADING THE VARIANT PLAYLIST

```
#EXT-X-PROGRAM-DATE-TIME: 2026-01-03T21:00:04.0Z
```

```
#EXTINF: 4,
```

```
segment2.mp4 2026-01-03T21:00:04.0Z
```

```
#EXTINF: 4,
```

```
segment3.mp4 21:00:08.0Z
```



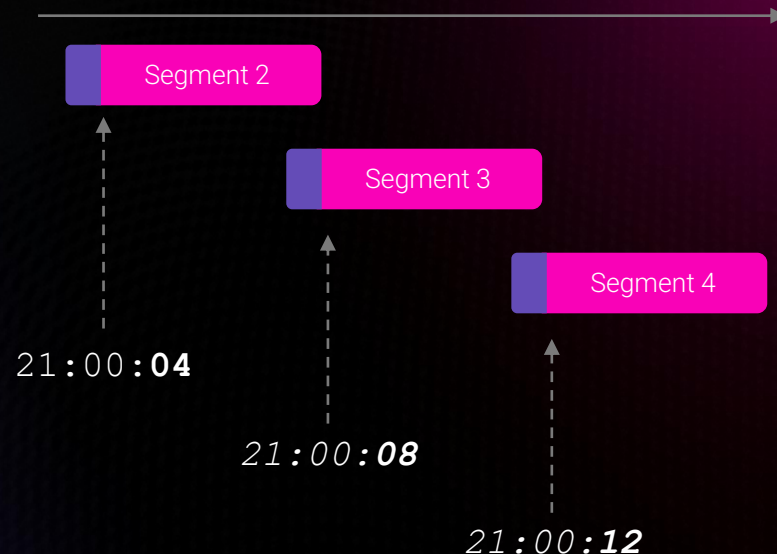
```
#EXTINF: 4,
```

```
segment4.mp4 21:00:12.0Z
```



COGICOM

Decode
Timeline



Live Demo

- ▶ Program date time in variant playlist



MEDIA SEQUENCE NUMBER

PLAY SEGMENTS IN THE CORRECT ORDER

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MEDIA SEQUENCE: ENSURING CONTINUITY

VARIANT 1

```
#EXT-X-VERSION: 6  
#EXT-X-TARGETDURATION: 4  
#EXT-X-MAP: URI="init-variant1.mp4"  
  
#EXT-X-PROGRAM-DATE-TIME: 2026-05-01T00:00:00.000Z  
#EXT-X-MEDIA-SEQUENCE: 123
```



Indicates the sequence number of the oldest segment in the playlist

Players compute the other sequences



RELOADING THE VARIANT PLAYLIST

##EXT-X-MEDIA-SEQUENCE: 123

#EXTINF: 4 ,

segment1.mp4 123

#EXTINF: 4 ,

segment2.mp4 124

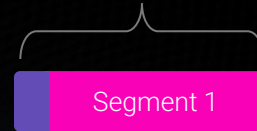


#EXTINF: 4 ,

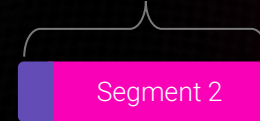
segment3.mp4 125



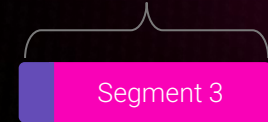
123



124



125



COGICOM

RELOADING THE VARIANT PLAYLIST

##EXT-X-MEDIA-SEQUENCE: 124

#EXTINF: 4,

segment2.mp4 124

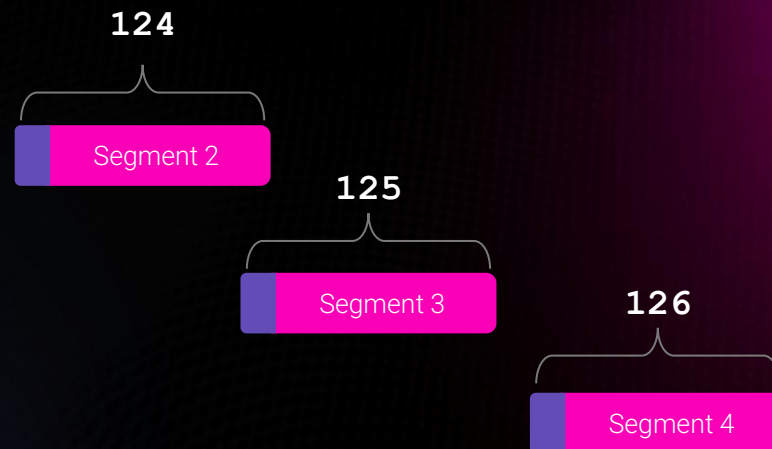
#EXTINF: 4,

segment3.mp4 125



#EXTINF: 4,

segment4.mp4 126



COGICOM

MEDIA-SEQUENCE

**ACTS AS A TRACKING ID TO SEE IF THE PLAYLIST HAS NEW
SEGMENT AVAILABLE**

THESE SEQUENCES SHOULD MATCH ACROSS VARIANTS

COGICOM

Live Demo

- ▶ Media sequence number in variant playlist



Quiz 2

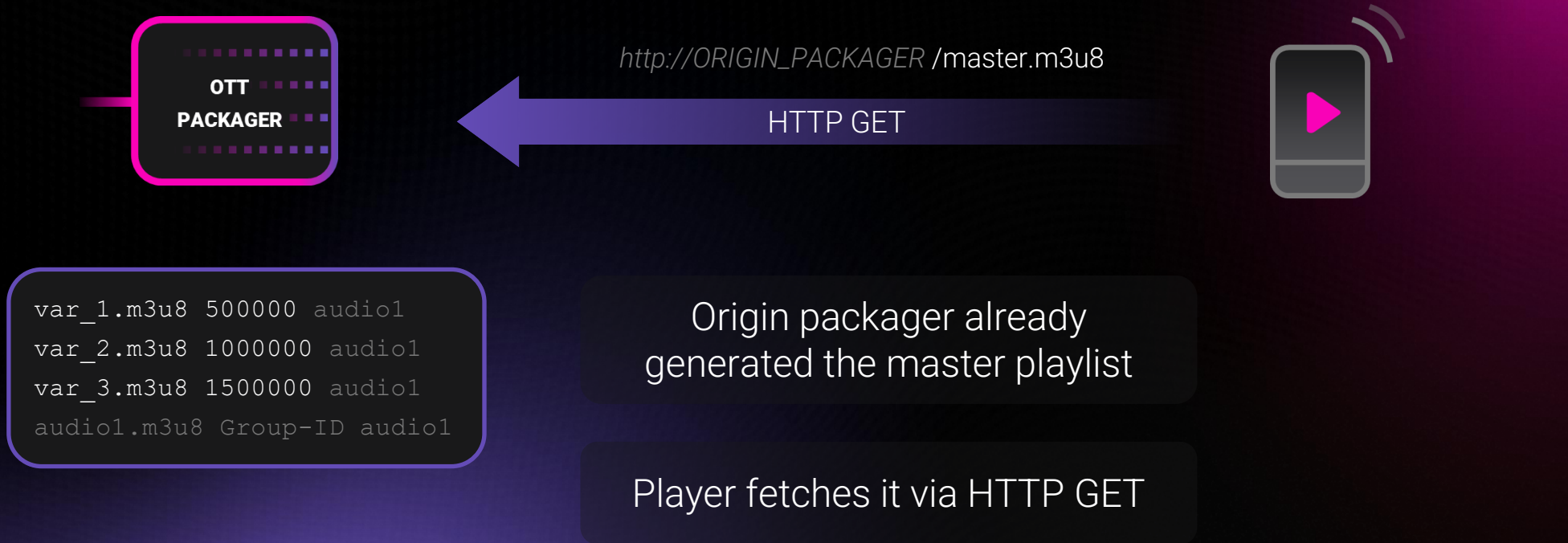
COGICOM

FROM PLAYLIST TO MEDIA SEGMENTS

LET'S SUMMARIZE

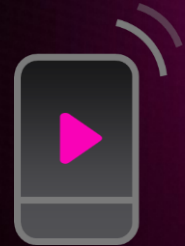
COGICOM

FETCHING THE MASTER PLAYLIST



FROM PLAYLIST TO MEDIA SEGMENTS

DOWNLOADING THE MASTER PLAYLIST



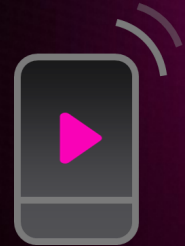
Player decides
which variant to start with

Lowest variant is usually a good choice

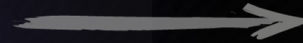
`var_1.m3u8 500000 audio1`
`var_2.m3u8 1000000 audio1`
`var_3.m3u8 1500000 audio1`
`audio1.m3u8 Group-ID audio1`

FROM PLAYLIST TO MEDIA SEGMENTS

DOWNLOADING THE MASTER PLAYLIST



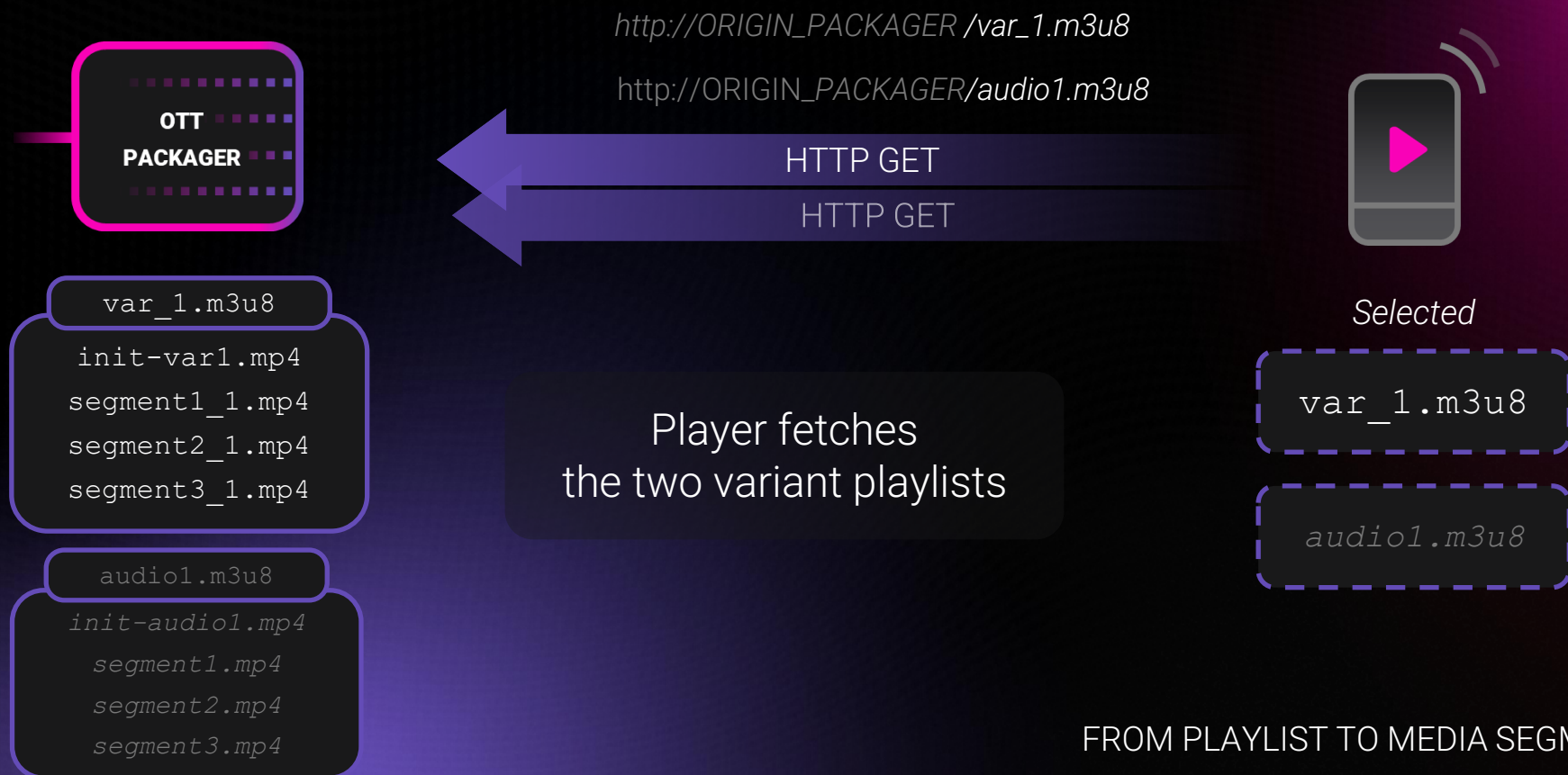
Player picks the audio to be played
along the video



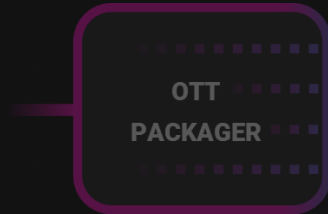
```
var_1.m3u8 500000 audio1  
var_2.m3u8 1000000 audio1  
var_3.m3u8 1500000 audio1  
audio1.m3u8 Group-ID audio1
```

FROM PLAYLIST TO MEDIA SEGMENTS

SELECTING THE STARTING THE VARIANT



SELECTING THE STARTING THE VARIANT



`http://ORIGIN_PACKAGER/var_1.m3u8`

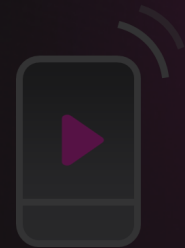
`http://ORIGIN_PACKAGER/audio1.m3u8`

HTTP GET

HTTP GET

**Focusing on
video traffic only**

Player downloads
the two variant playlists



`var_1.m3u8`

`init-var1.mp4`
`segment1_1.mp4`
`segment2_1.mp4`
`segment3_1.mp4`

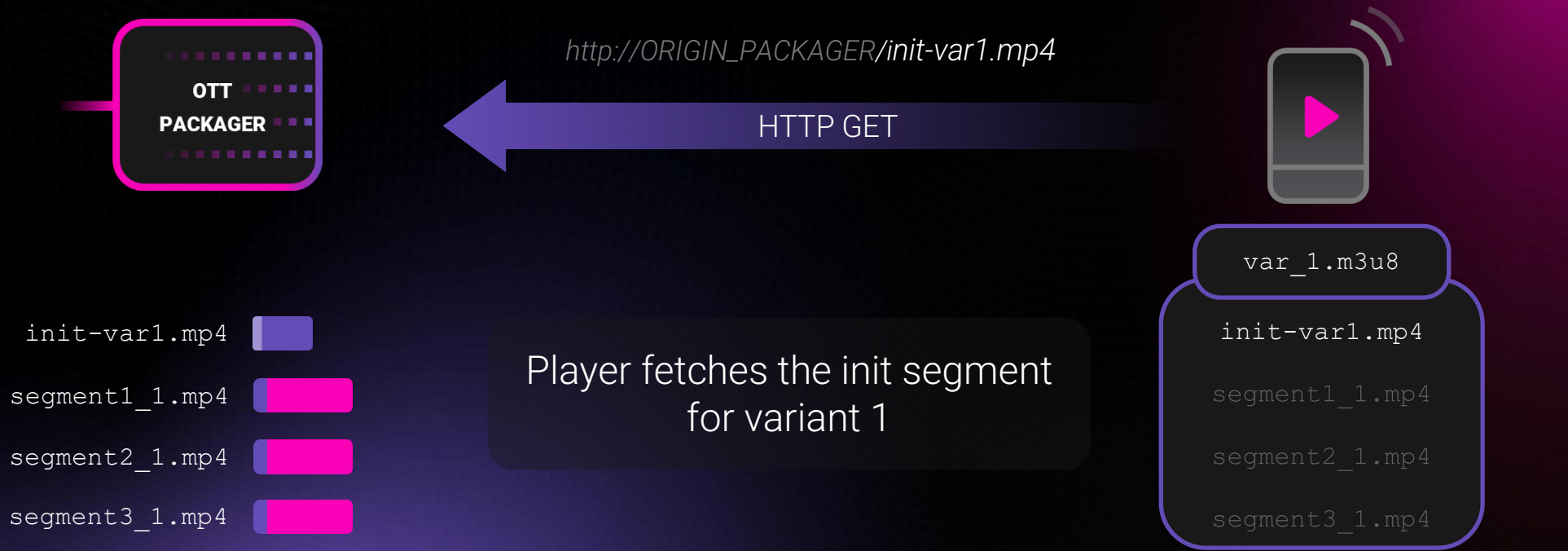
`audio1.m3u8`

`init-audio1.mp4`
`segment1.mp4`
`segment2.mp4`
`segment3.mp4`

FROM PLA

ENTS

FETCHING THE INIT SEGMENT FOR VARIANT 1



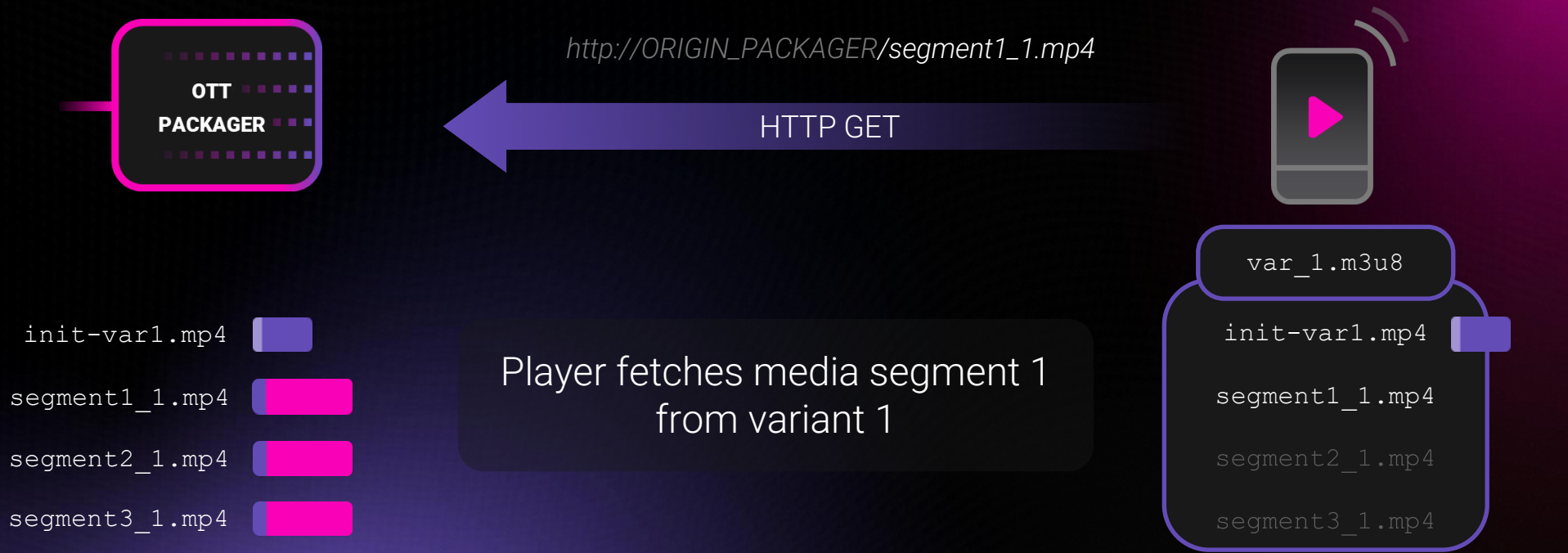
FROM PLAYLIST TO MEDIA SEGMENTS

FETCHING THE INIT SEGMENT FOR VARIANT 1



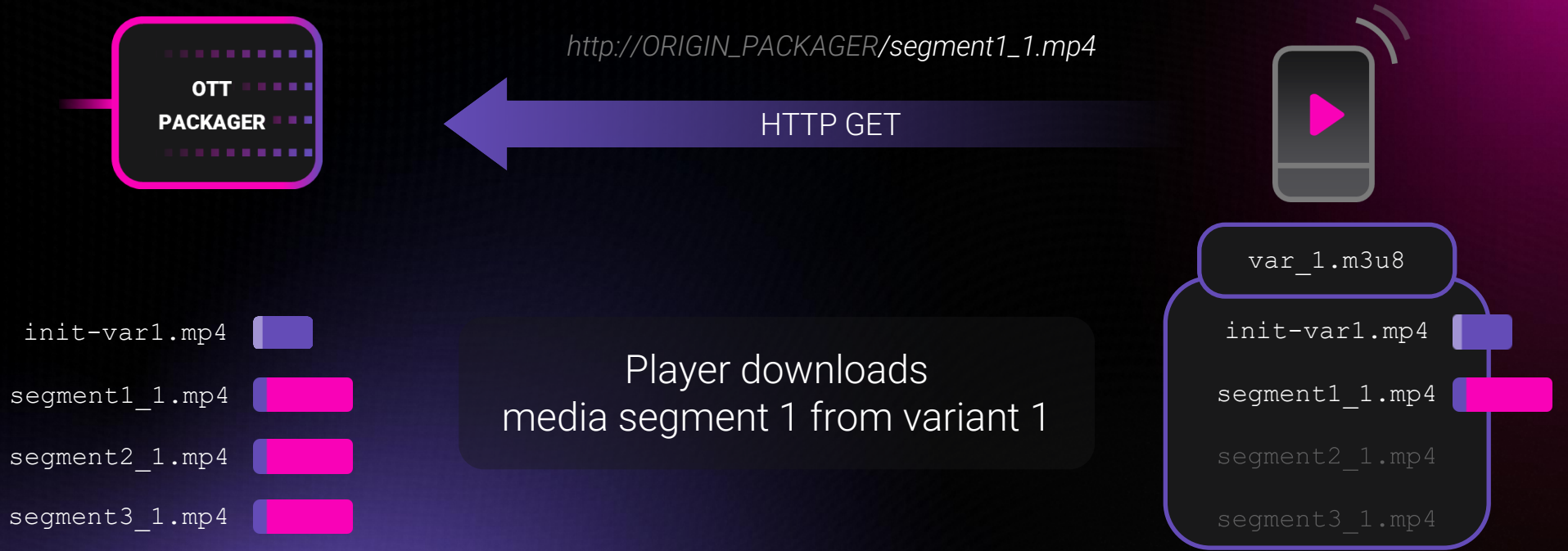
FROM PLAYLIST TO MEDIA SEGMENTS

FETCHING THE INIT SEGMENT FOR VARIANT 1



FROM PLAYLIST TO MEDIA SEGMENTS

DOWNLOADING SEGMENT 1 FROM VARIANT 1



FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER COMPUTE NETWORK THROUGHPUT



Throughput

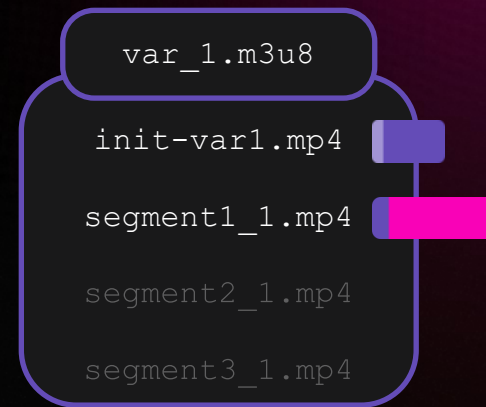
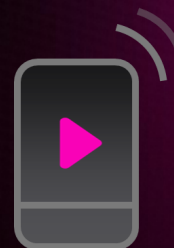


Segment size

Download time



Player computes
network throughput
using segment 1



FROM PLAYLIST TO MEDIA SEGMENTS

COMPUTING NETWORK THROUGHPUT WITH SEGMENT 1



Throughput

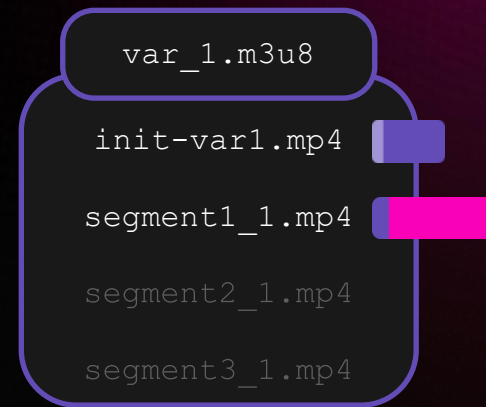
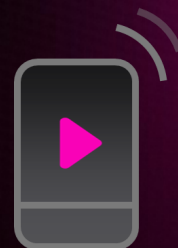


Segment size

Download time

init-var1.mp4 
segment1_1.mp4 
segment2_1.mp4 
segment3_1.mp4 

$$\text{throughput} = \frac{100\text{kBytes}}{400\text{ms}} = \mathbf{2\text{ Mbps}}$$



FROM PLAYLIST TO MEDIA SEGMENTS

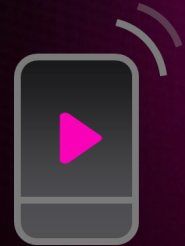
UPGRADING TO A HIGHER VARIANT



Network
throughput
is
2 Mbps

Master playlist

```
var_1.m3u8 500000  
var_2.m3u8 1000000  
var_3.m3u8 1500000
```



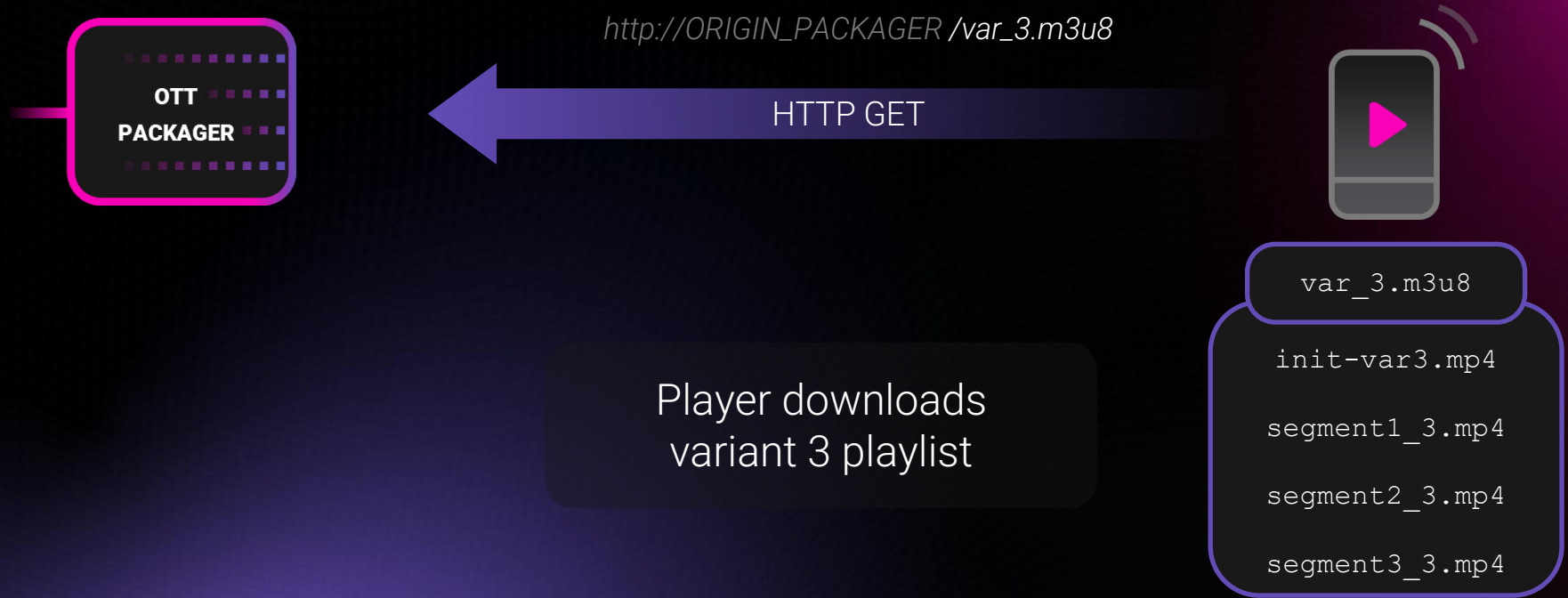
Player upgrades to variant 3,
for which minimum required
bandwidth is 1.5Mbps

PLAYER FETCHES VARIANT 3 PLAYLIST



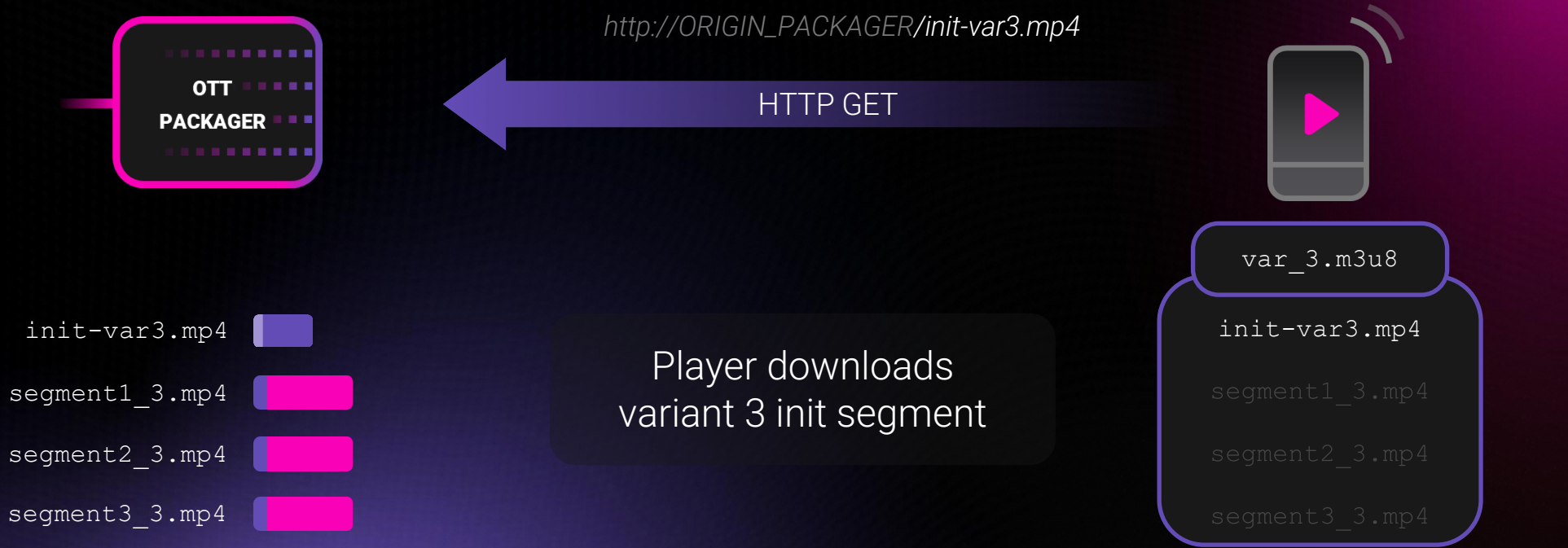
FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



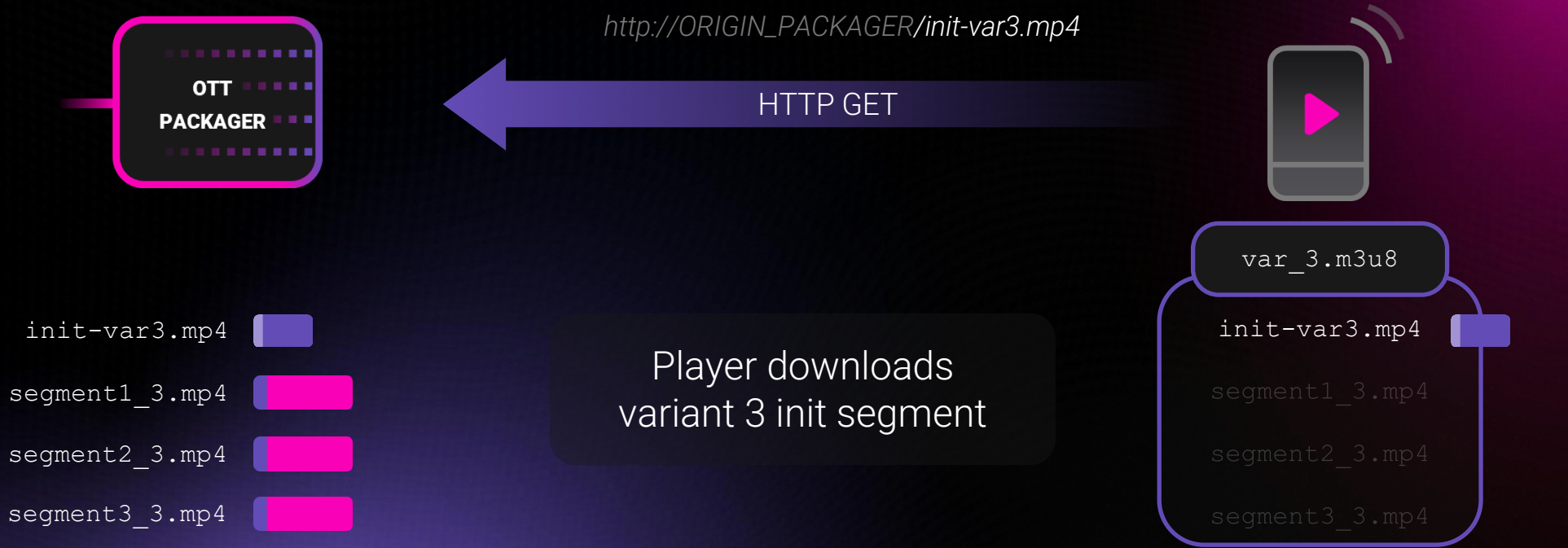
FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



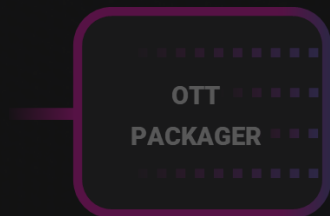
FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST

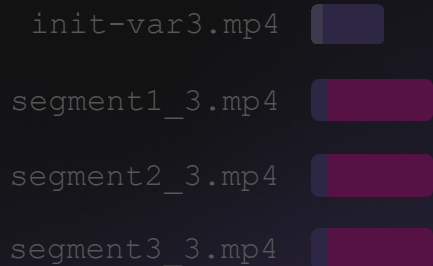


FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



Which segment is downloaded next ?



FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



init-var3.mp4 

segment1_3.mp4 

segment2_3.mp4 

segment3_3.mp4 

Player already downloaded
segment 1 (*var_1*)
it needs **segment 2** (*var_3*)
to ensure continuity



FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



Throughput



Segment size

Download time

init-var3.mp4 

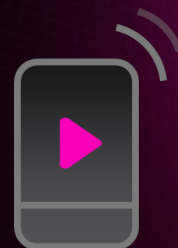
segment1_3.mp4 

segment2_3.mp4 

segment3_3.mp4 

Four lines of text, each followed by a progress bar. The first bar is blue. The others are blue with a red segment.

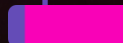
Player computes
network throughput
using segment 2



var_3.m3u8

init-var3.mp4 

segment1_3.mp4

segment2_3.mp4 

segment3_3.mp4

A blue rounded rectangle containing four lines of text, each followed by a progress bar. The first and third bars are blue with a red segment. The others are blue.

FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



Throughput



Segment size

Download time

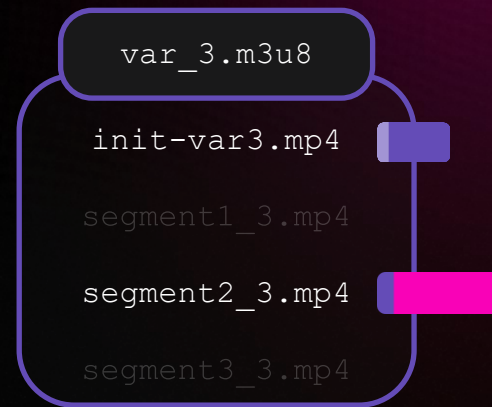
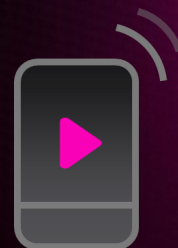
init-var3.mp4 

segment1_3.mp4 

segment2_3.mp4 

segment3_3.mp4 

$$\text{throughput} = \frac{120\text{kBytes}}{480\text{ms}} = \mathbf{2\text{ Mbps}}$$



FROM PLAYLIST TO MEDIA SEGMENTS

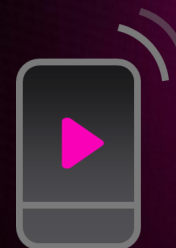
STAYING A VARIANT 3



Network
throughput
remains
2 Mbps

Master playlist

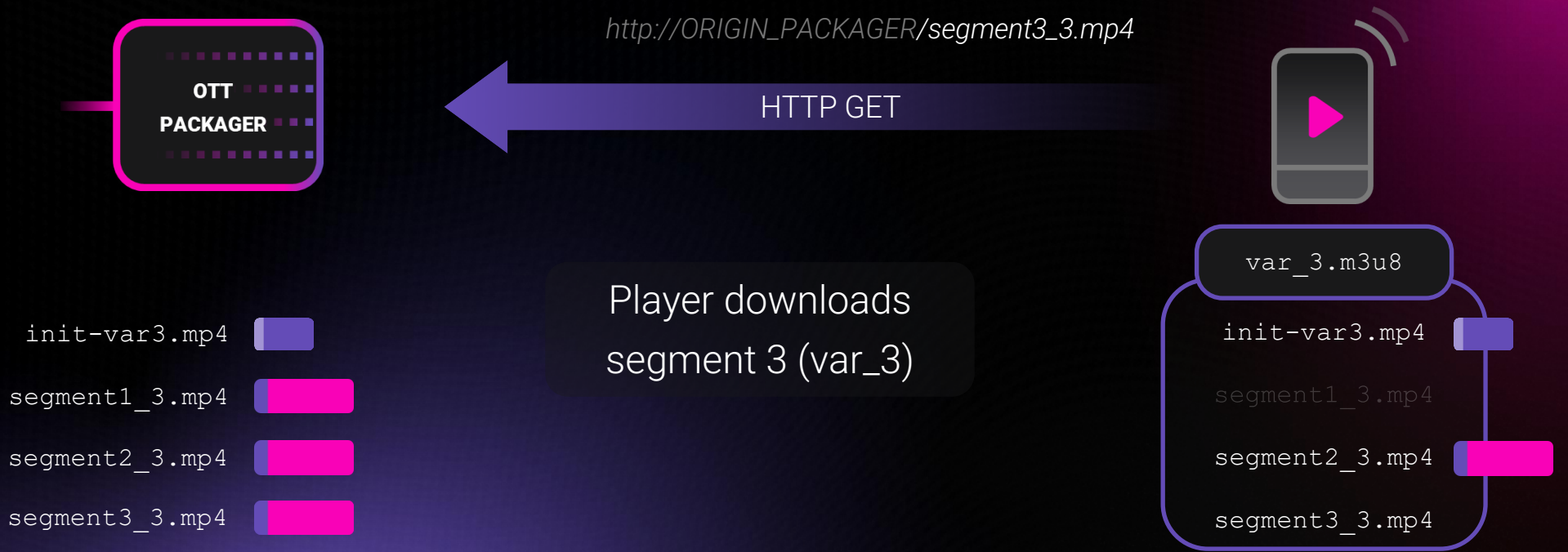
```
var_1.m3u8 500000  
var_2.m3u8 1000000  
var_3.m3u8 1500000
```



Player stays on variant 3

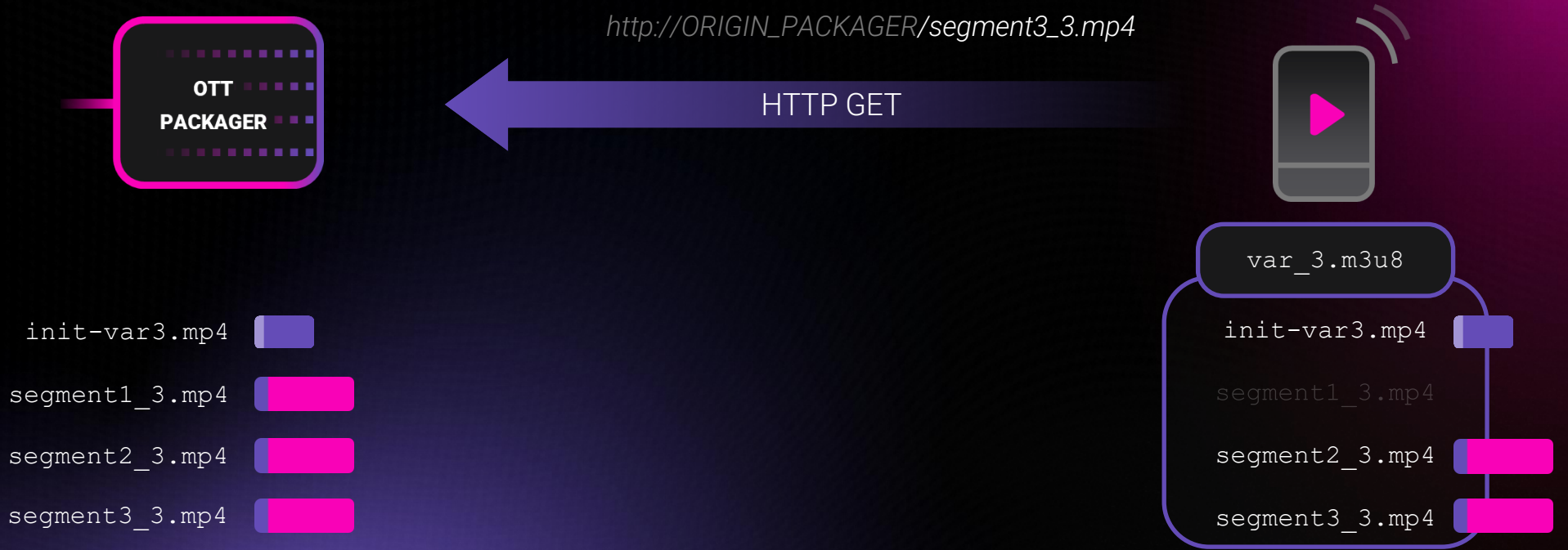
FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



FROM PLAYLIST TO MEDIA SEGMENTS

PLAYER FETCHES VARIANT 3 PLAYLIST



FROM PLAYLIST TO MEDIA SEGMENTS

PROCESS DRIVEN BY THE PLAYER

Start up sequence

Steady state

MASTER
playlist

Starting
variant
m3u8

Starting
variant
init

Starting
variant
segment

Throughput
estimation

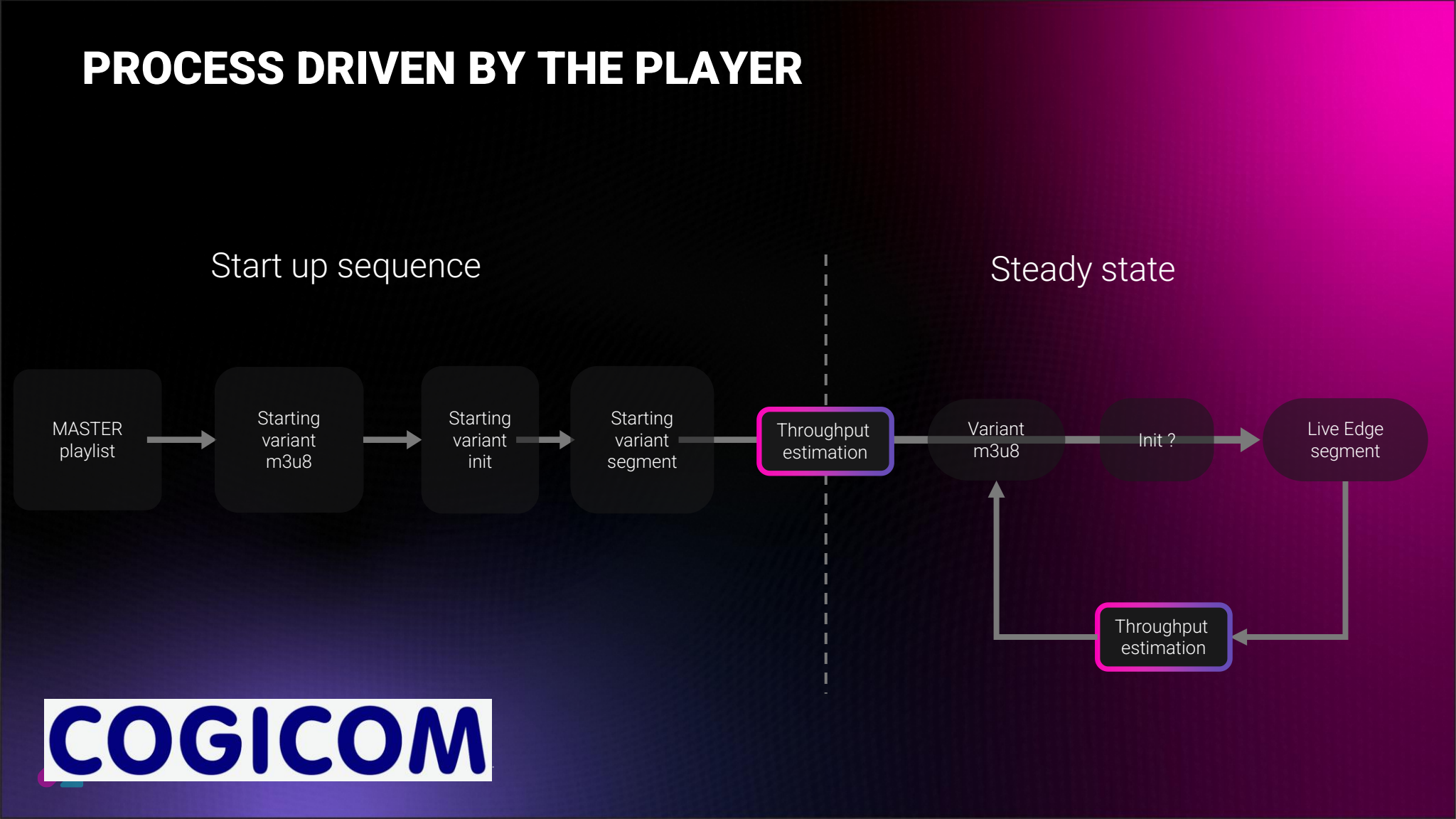
Variant
m3u8

Init ?

Live Edge
segment

Throughput
estimation

COGICOM



var_1.m3u8

init-var1.mp4

segment1.mp4

segment2.mp4

segment3.mp4

var_3.m3u8

init-var3.mp4

segment1.mp4

segment2.mp4

segment3.mp4

**What to expect
visually?**

COGICOM

0-6 seconds: Variant 1
(low quality)



6- 12 seconds: Variant 3
(highest quality)

var_1.m3u8

init-var1.mp4

segment1_1.mp4

segment2_1.mp4

segment3_1.mp4

var_3.m3u8

init-var3.mp4

segment1_3.mp4

segment2_3.mp4

segment3_3.mp4

COGICOM



COGICOM

0-6 seconds: Variant 1
(low quality)



6- 12 seconds: Variant 3
(highest quality)

Live Demo

- ▶ Start up sequence
- ▶ Variant upgrade
- ▶ Steady state



Live Demo

- ▶ Bandwidth throttling in web browser
- ▶ Variant downgrade



Quiz 3

COGICOM

*Hands on
Lab*

COGICOM