



Deploying Dynamic Ad Insertion with DASH

A Broadcasters Architecture

Introduction - ITV

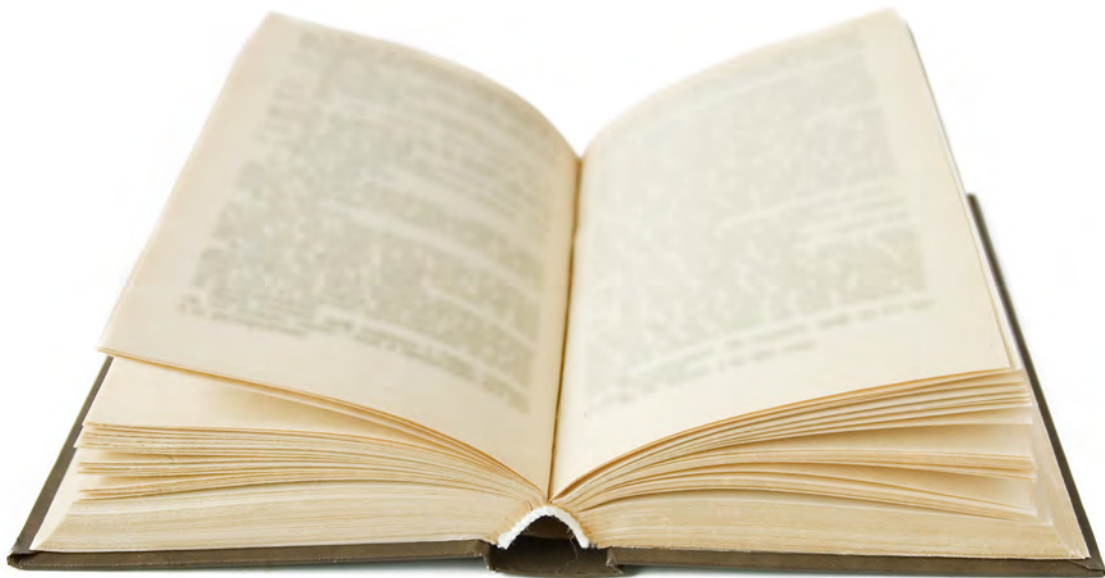
The UK's largest commercial broadcaster

We make, sell and distribute our own content

Operating 6 Free to air broadcast channels

Direct to consumer with The ITV Hub





DASH
■ ■ ■ ■ ■ ■





Through the lens of an end-
to-end project and
architecture

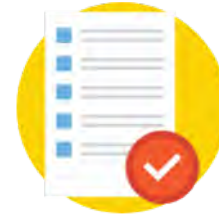


Shaping the direction for
Simulcast






Strategic Themes

-  Content
-  Distribution
-  Revenue Capacity
-  Viewer Experience



Project Goals

-  Replace Flash
-  Further productise SSAI
-  Move Web to SSAI

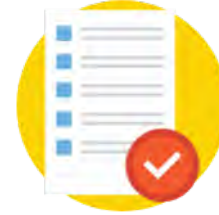


Shaping the direction for
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- ✔ Distribution
- ✔ Revenue Capacity
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Shaping the direction for
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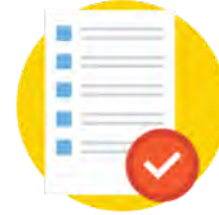
Strategic Themes

 Content

 **Distribution**


 Revenue Capacity


 Viewer Experience



Project Goals

 Replace Flash

 Further productise SSAI





 Move Web to SSAI

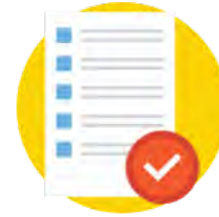


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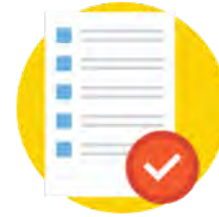
Shaping the direction for
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Strategic Themes

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- Revenue Capacity

Viewer Experience



Project Goals





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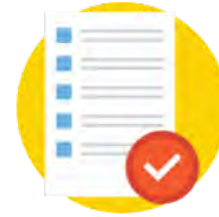


Shaping the direction for
Simulcast






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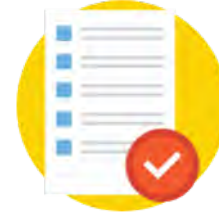


Shaping the direction for
Simulcast



Strategic Themes

- Content
- Distribution
- Revenue Capacity
- Viewer Experience



Project Goals

- Replace Flash
- Further productise SSAI**
- Move Web to SSAI

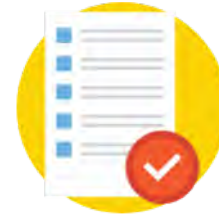


Shaping the direction for
Simulcast



Strategic Themes

- ✓ Content
- ✓ Distribution
- ✓ Revenue Capacity
- ✓ Viewer Experience



Project Goals

- ✓ Replace Flash
- ✓ Further productise SSAI
- ✓ **Move Web to SSAI**

Meanwhile...



**Work begins on Linear
Addressable technology**



Driving Live OTT and
Broadcast Ad Replacement
together



Greater Alignment

- ✓ Standardised signalling
- ✓ Project momentum
- ✓ Converging towards IP



Fewer moving parts

- ✓ Remove out of band signalling of identifiers
- ✓ Remove Miranda cards
- ✓ Greater operational simplicity



Driving Live OTT and
Broadcast Ad Replacement
together



**Greater
Alignment**



Standardised signalling



Project momentum



Converging towards IP



**Fewer moving
parts**



Remove out of band
signalling of identifiers



Remove Miranda cards



Greater operational
simplicity



Driving Live OTT and
Broadcast Ad Replacement
together



**Greater
Alignment**



Standardised signalling



Project momentum



Converging towards IP



**Fewer moving
parts**



Remove out of band
signalling of identifiers



Remove Miranda cards



Greater operational
simplicity



Driving Live OTT and
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Driving Live OTT and
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**Greater
Alignment**

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**Fewer moving
parts**

- ✓ **Remove out of band
signalling of identifiers**
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Driving Live OTT and
Broadcast Ad Replacement
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**Greater
Alignment**

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**Fewer moving
parts**

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Driving Live OTT and
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Greater Alignment

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- ✓ Project momentum
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Fewer moving parts

- ✓ Remove out of band signalling of identifiers
- ✓ Remove Miranda cards
- ✓ **Greater operational simplicity**

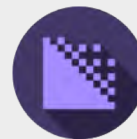
Core platform enhancements



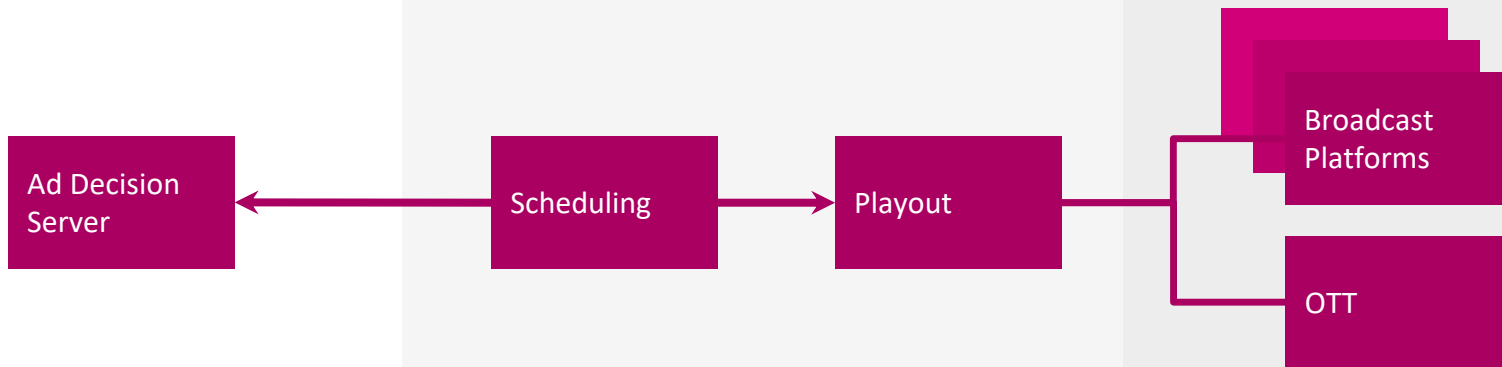
Commercial Systems



Broadcast Systems



Encoding Platform(s)



Replaceable
adverts are
scheduled

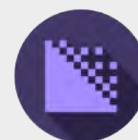
Core platform enhancements



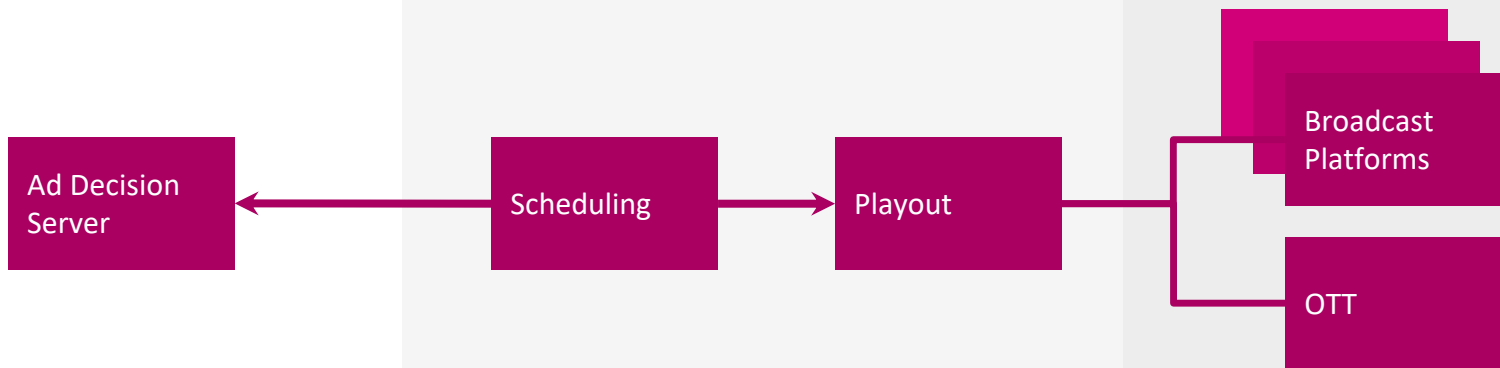
Commercial Systems



Broadcast Systems



Encoding Platform(s)



Spot and break IDs are minted

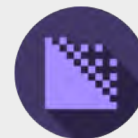
Core platform enhancements



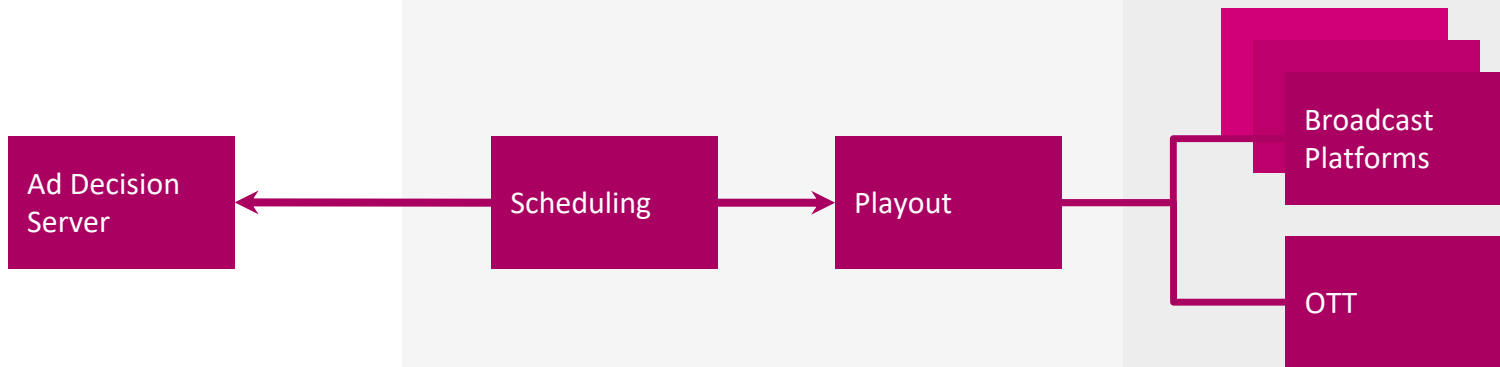
Commercial Systems



Broadcast Systems



Encoding Platform(s)



BXF carries schedule and SCTE-104 inserted in ICE'S

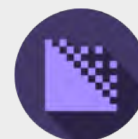
Core platform enhancements



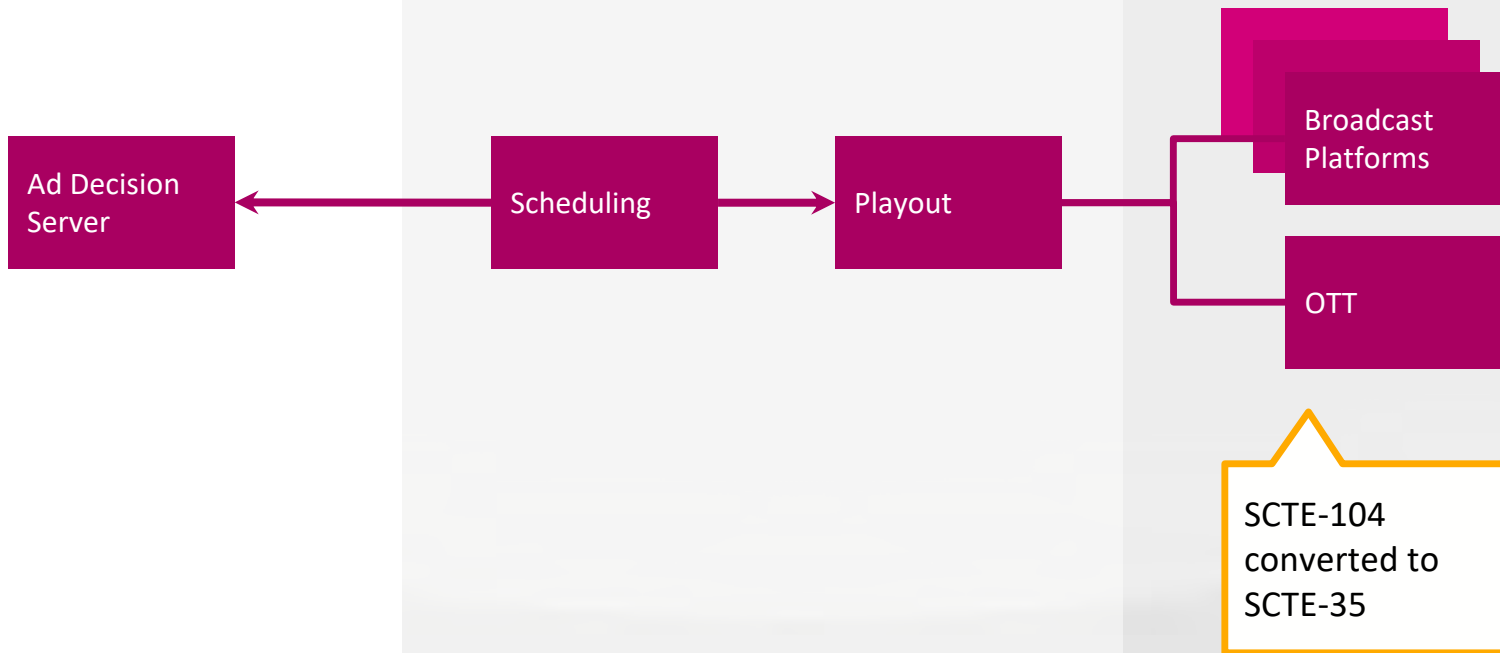
**Commercial
Systems**



Broadcast Systems



**Encoding
Platform(s)**





ITV SCTE specifications are
available to view



View on Github

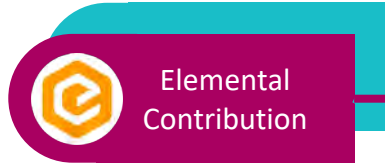
<https://github.com/ITV/SCTE-Signalling>

OTT encoding platform



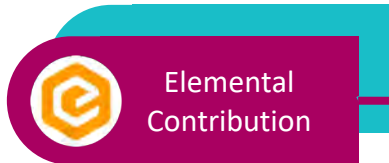
Contribution Encoding

DC site 1



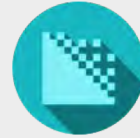
Elemental Contribution

DC site 2



Elemental Contribution

SCTE-35 carried in a 15 mbps HD TS stream



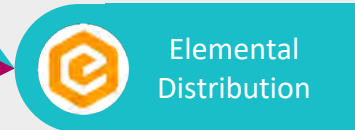
Distribution Encoding

DC site 3



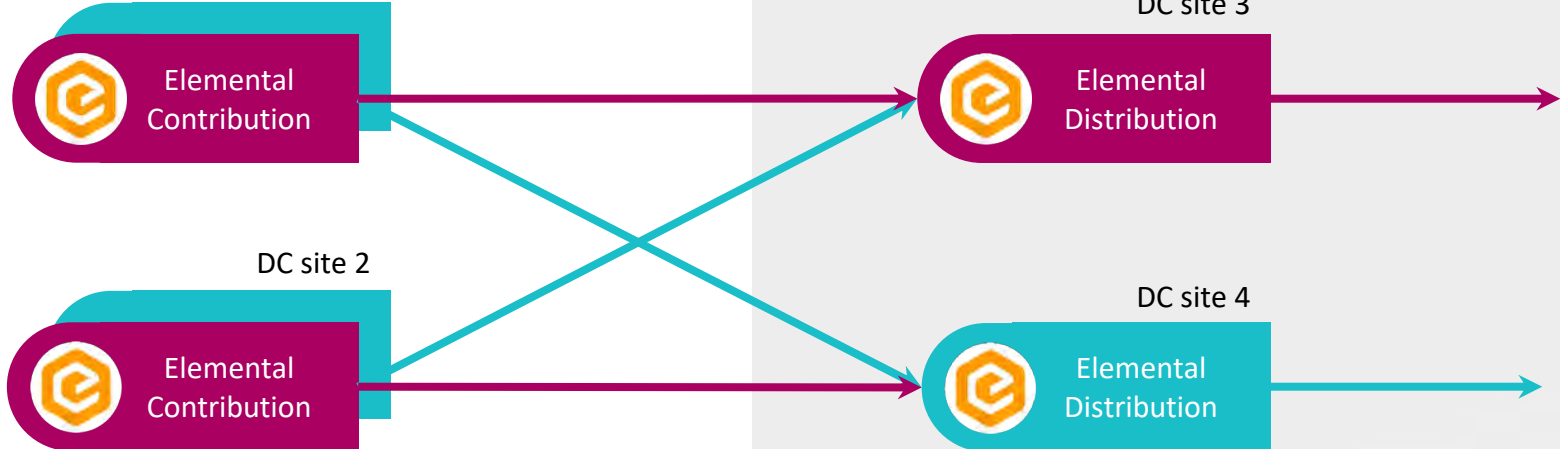
Elemental Distribution

DC site 4



Elemental Distribution

Outputted as fMP4 ABR set



OTT distribution platform



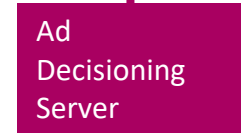
**Distribution
Encoding**



Packaging and DRM



Ad Replacement



Firmware
upgrade to
v2.11.7



OTT distribution platform



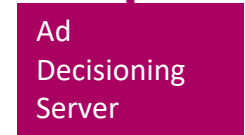
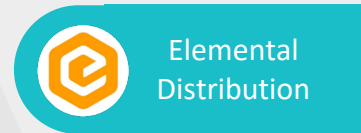
Distribution
Encoding



Packaging and DRM



Ad Replacement



10gbps
AWS
DirectConnect



OTT distribution platform



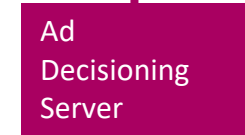
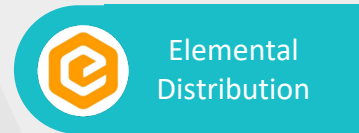
Distribution
Encoding



Packaging and DRM



Ad Replacement



Support for
Cablelabs ESAM
spec





Standardising packager
contribution format



View on Github

<https://github.com/unifiedstreaming/fmp4-ingest>

OTT distribution platform



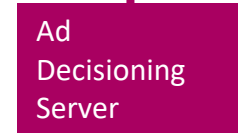
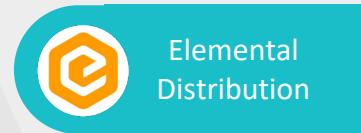
Distribution
Encoding



Packaging and DRM

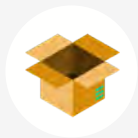


Ad Replacement

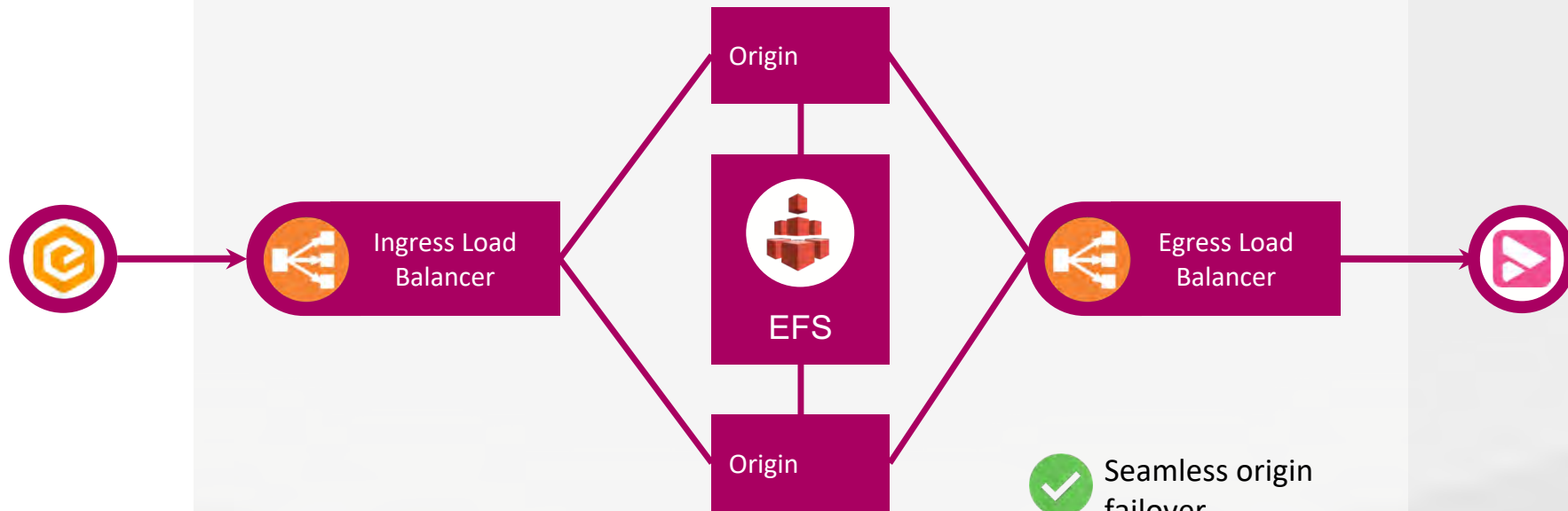


2 entirely
isolated and
active packager
chains

Origin storage options - EFS



Within Each Packaging and
DRM chain



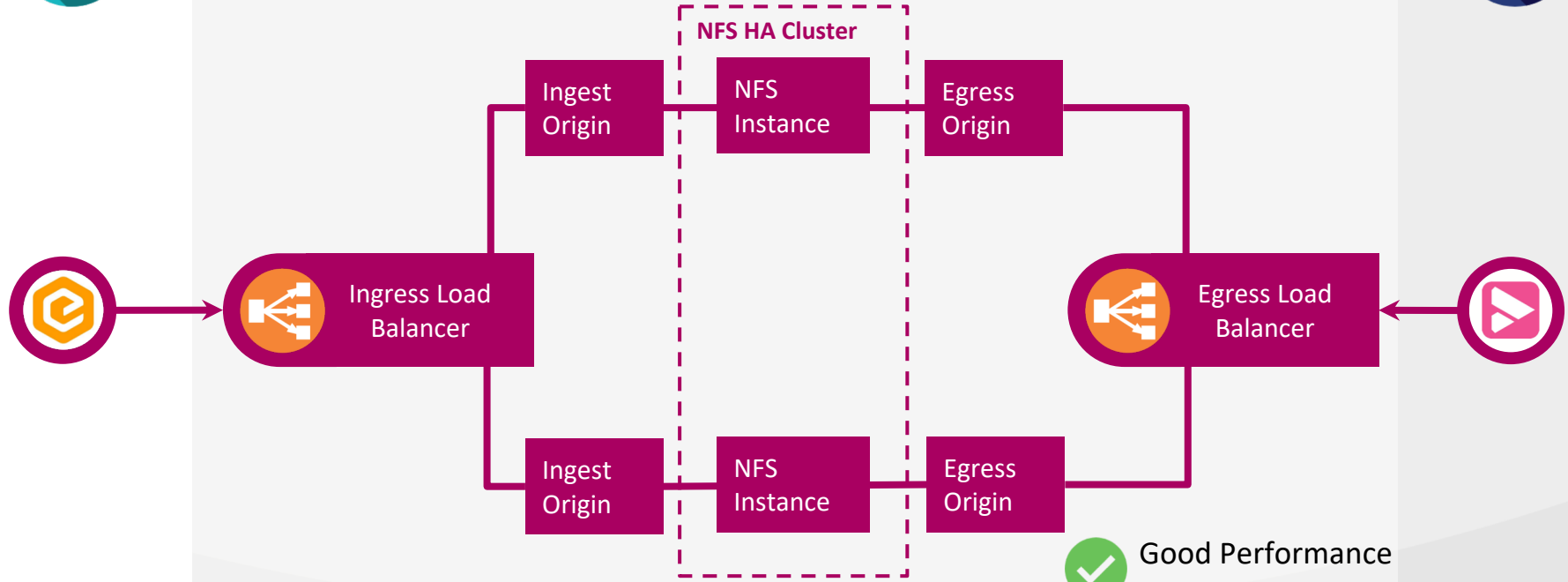
✓ Seamless origin failover

✗ Issues for low latency

Origin storage options - NFS



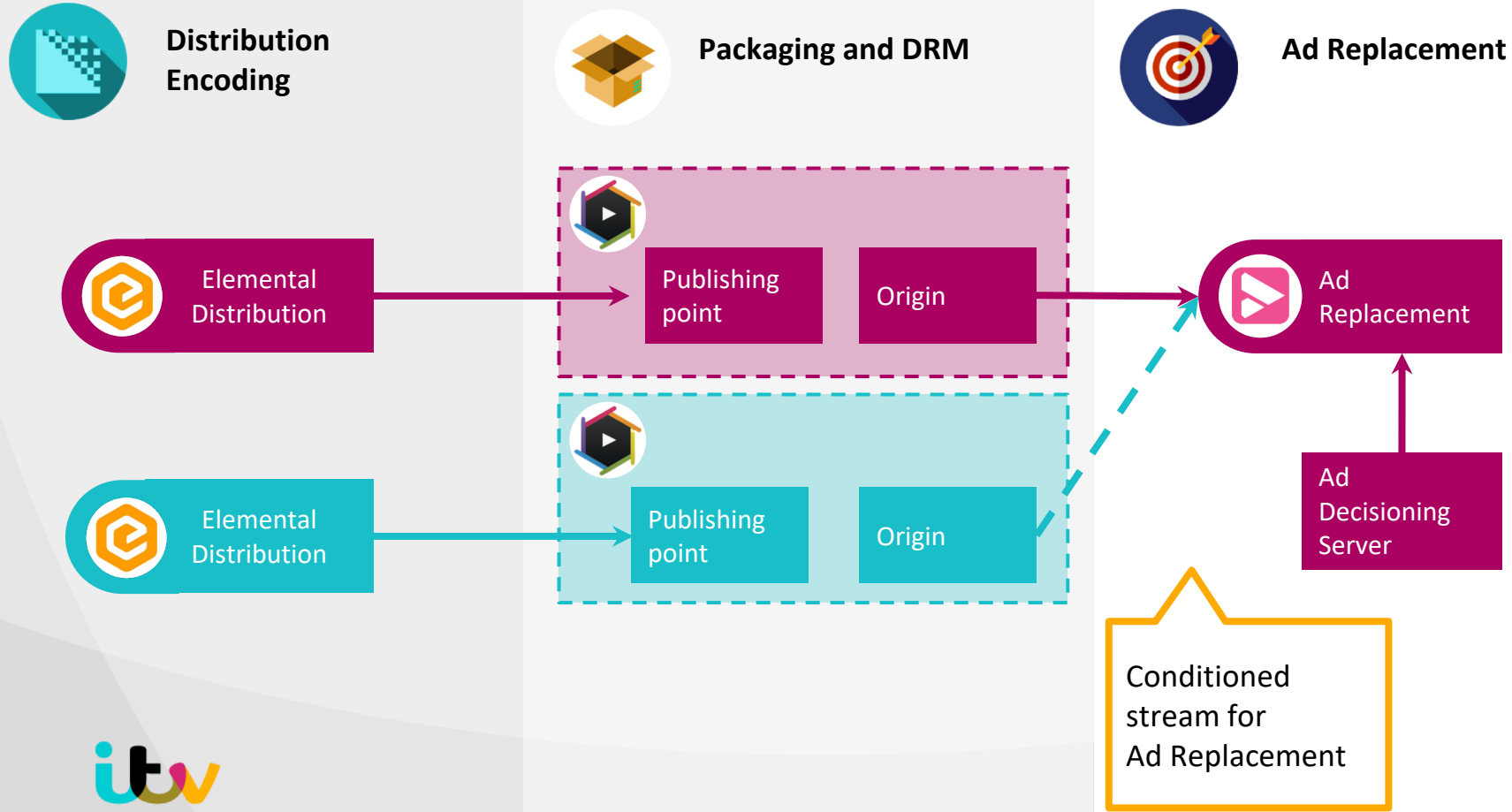
Within Each Packaging and DRM chain



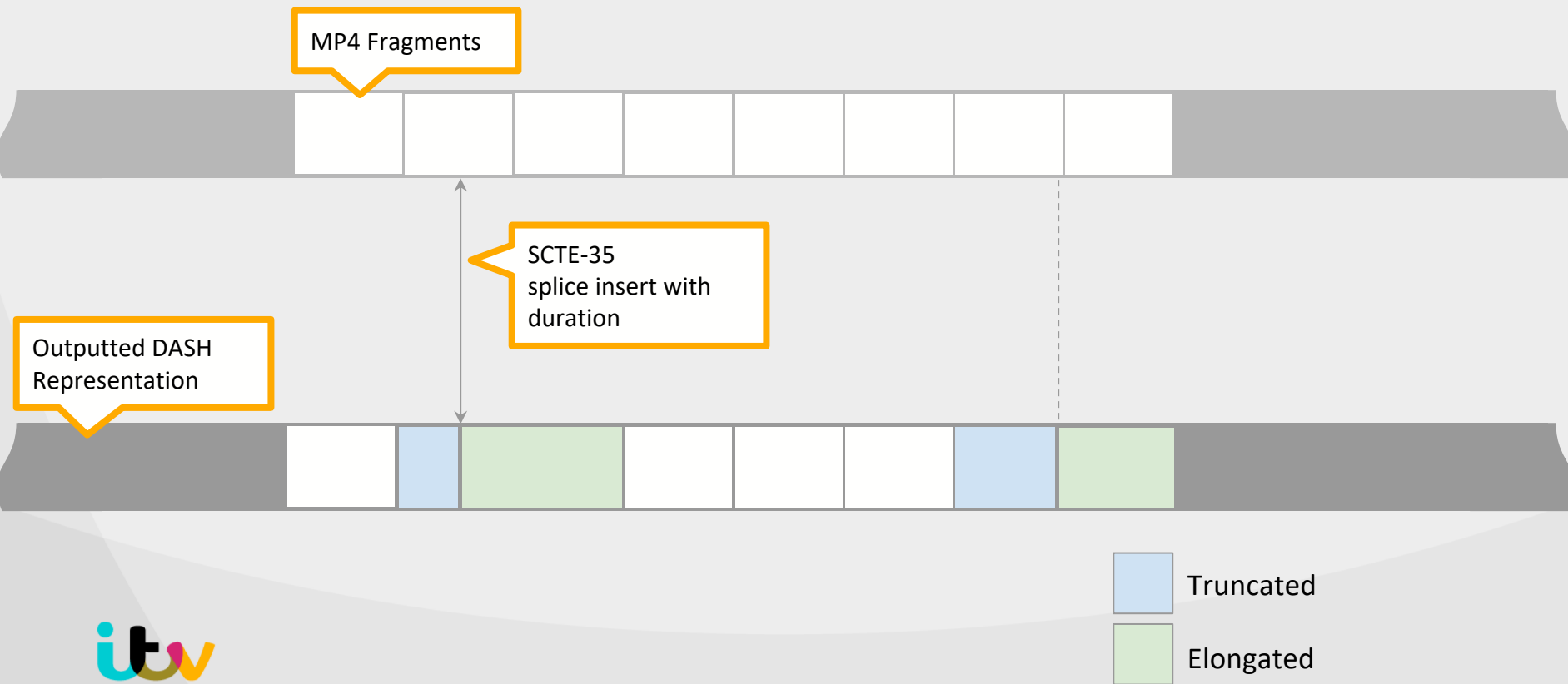
✓ Good Performance

? Not active/active

Ad Replacement - Contribution



Ad Replacement - Segment splicing

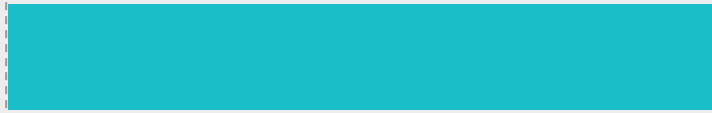
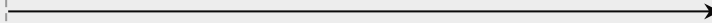


In-band Ad Markers - Spots & Breaks

Programme part



Ad Break



Ad Spot



Simplified example of origin output



Contribution to Ad Replacement



Event for break marker



Events for spot markers



Single Period



Use of messageData



```
<MPD>
  <Period>
    <EventStream
      schemeIdUri="urn:scte:scte35:2014:bin"
      timescale="1000000">
      <Event
        presentationTime="1525867839000000"
        duration="240000000"
        id="3808275760"
        messageData="/DA1AAAAA4QAP/wFAUeWX2Bf+/+QkwjIP4BSZcAxBQCAgAA+QrgZQ==" />
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        duration="40000000"
        id="3632990444"
        messageData="/DA1AAAAA4QAP/wFAUDQp06f+/+Qm7WAP4ANu6ABBQCCAAAt/CvSg==" />
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        duration="40000000"
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        messageData="/DA1AAAAA4QAP/wFAUDQp07f+/+QqXEgP4ANu6ABBQDCAAA0XbxgQ==" />
      <Event
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        duration="30000000"
        id="3810505184"
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        presentationTime="1525867979000000"
        duration="30000000"
        id="3798062637"
        messageData="/DA1AAAAA4QAP/wFAUDQp03f+/+QwXl4P4AKTLgBBQFCAAATd0/Og==" />
    </EventStream>
  </Period>
</MPD>
```

Simplified example of origin output



Contribution to Ad Replacement



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```
<MPD>
  <Period>
    <EventStream
      schemeIdUri="urn:scte:scte35:2014:bin"
      timescale="1000000">
      <Event
        presentationTime="1525867839000000"
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        id="3808275760"
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      <Event
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      <Event
        presentationTime="1525867839000000"
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        duration="300000000"
        id="3810505184"
        messageData="/DA1AAAAA4QAP/wFAUDQp04f+/-+QtyzAP4AKTLgBBQECAAAswM7w==" />
      <Event
        presentationTime="1525867979000000"
        duration="300000000"
        id="3798062637"
        messageData="/DA1AAAAA4QAP/wFAUDQp03f+/-+QwX14P4AKTLgBBQFCAAATd0/Og==" />
    </EventStream>
  </Period>
</MPD>
```

Begins: 12:10:39 PM
Ends: 12:14:39 PM

Simplified example of origin output



Contribution to Ad Replacement



Event for break marker



Events for spot markers



Single Period



Use of messageData



```
<MPD>
  <Period>
    <EventStream
      schemeIdUri="urn:scte:scte35:2014:bin"
      timescale="1000000">
      <Event
        presentationTime="1525867839000000"
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        duration="30000000"
        id="3798062637"
        messageData="/DA\AAAAA4QAP/wFAUDQp09f+/-+Qm7WAP4ANu6ABBQFCAAAtd0/Og==" />
      </EventStream>
    </Period>
  </MPD>
```

Begins: 12:11:49 PM
Ends: 12:12:39 PM

Simplified example of origin output



Contribution to Ad Replacement



Event for break marker



Events for spot markers



Single Period



Use of messageData



```
<MPD>
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      schemeIdUri="urn:scte:scte35:2014:bin"
      timescale="1000000">
      <Event
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        id="3808275760"
        messageData="/DA1AAAAA4QAP/wFAUeWX2Bf+/+QkwjIP4BSZcAxBQCAgAA+QrgZQ==" />
      <Event
        presentationTime="1525867869000000"
        duration="40000000"
        id="3632990444"
        messageData="/DA1AAAAA4QAP/wFAUDQp06f+/+Qm7WAP4ANu6ABBQCCAAAt/CvSg==" />
      <Event
        presentationTime="1525867909000000"
        duration="40000000"
        id="128290268"
        messageData="/DA1AAAAA4QAP/wFAUDQp07f+/+QqXEgP4ANu6ABBQDCAAA0XbxgQ==" />
      <Event
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        duration="30000000"
        id="3810505184"
        messageData="/DA1AAAAA4QAP/wFAUDQp04f+/+QtzyAP4AKTLgBBQECAAAA5wM7w==" />
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        duration="30000000"
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        messageData="/DA1AAAAA4QAP/wFAUDQp03f+/+QwXl4P4AKTLgBBQFCAAAtd0/Og==" />
    </EventStream>
  </Period>
</MPD>
```

Simplified example of origin output



Contribution to Ad Replacement



Event for break marker



Events for spot markers



Single Period

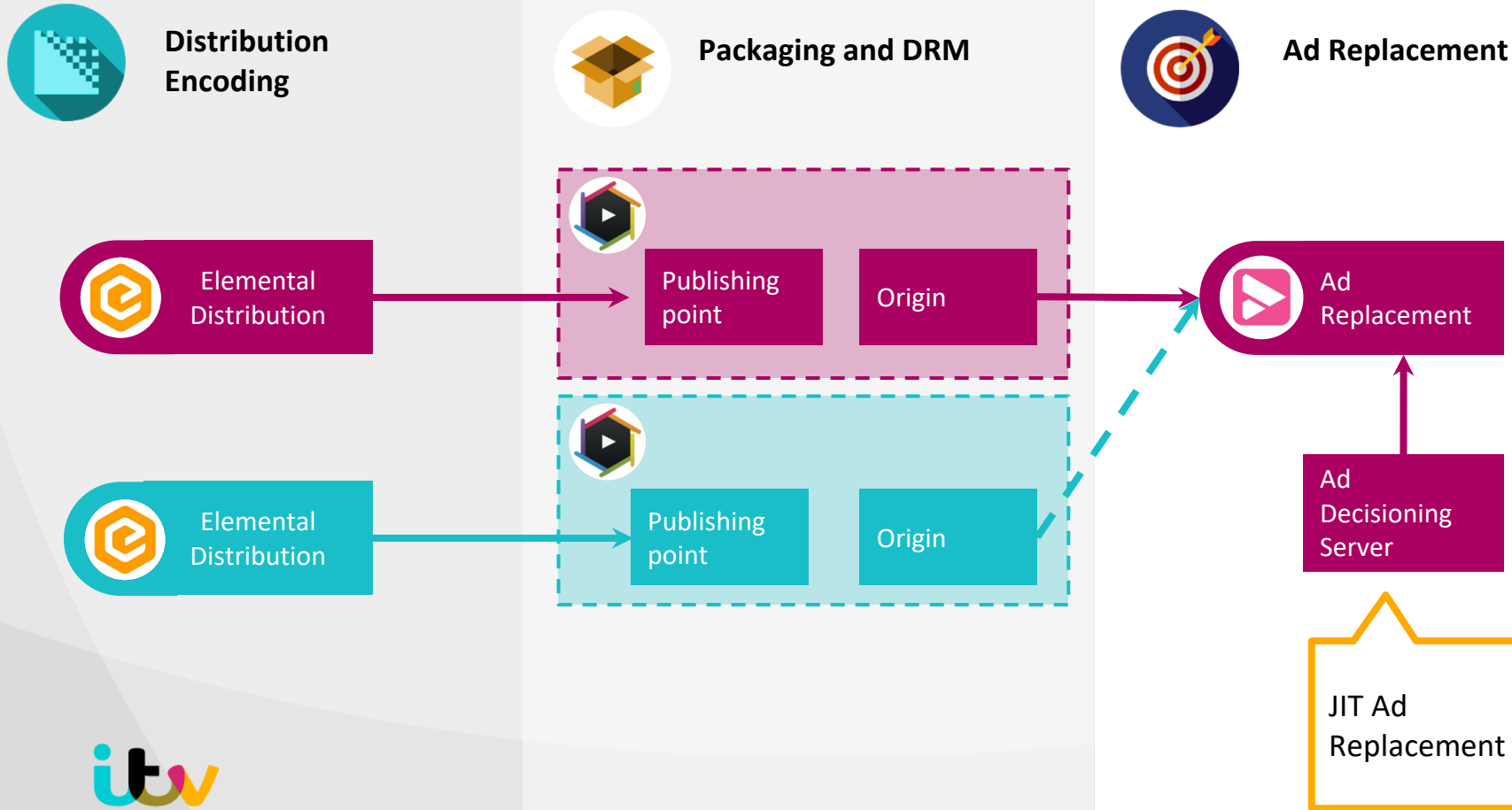


Use of messageData



```
<MPD>
  <Period>
    <EventStream
      schemeIdUri="urn:scte:scte35:2014:bin"
      timescale="1000000">
      <Event
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        duration="240000000"
        id="3808275760"
        messageData="/DA1AAAAA4QAP/wFAUeWX2Bf+/+QkwjIP4BSZcAxBQCAgAA+QrgZQ==" />
      <Event
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        duration="40000000"
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        messageData="/DA1AAAAA4QAP/wFAUDQp06f+/+Qm7WAP4ANu6ABBQCCAAAt/CvSg==" />
      <Event
        presentationTime="1525867909000000"
        duration="40000000"
        id="128290268"
        messageData="/DA1AAAAA4QAP/wFAUDQp07f+/+QqXEgP4ANu6ABBQDCAAA0XbxgQ==" />
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        duration="30000000"
        id="3798062637"
        messageData="/DA1AAAAA4QAP/wFAUDQp03f+/+QwXl4P4AKTLgBBQFCAAAtd0/Og==" />
    </EventStream>
  </Period>
</MPD>
```

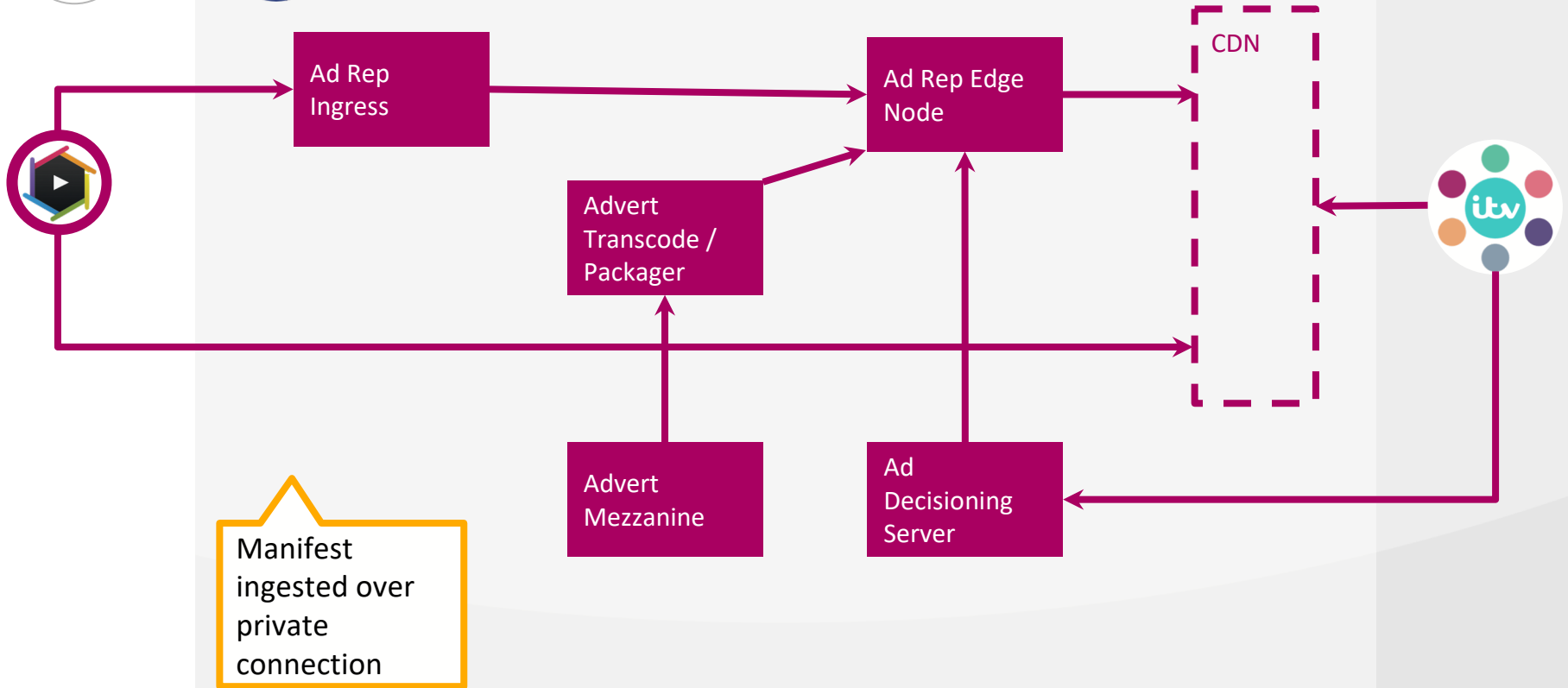
Ad Replacement - Just In Time



JIT Ad Replacement



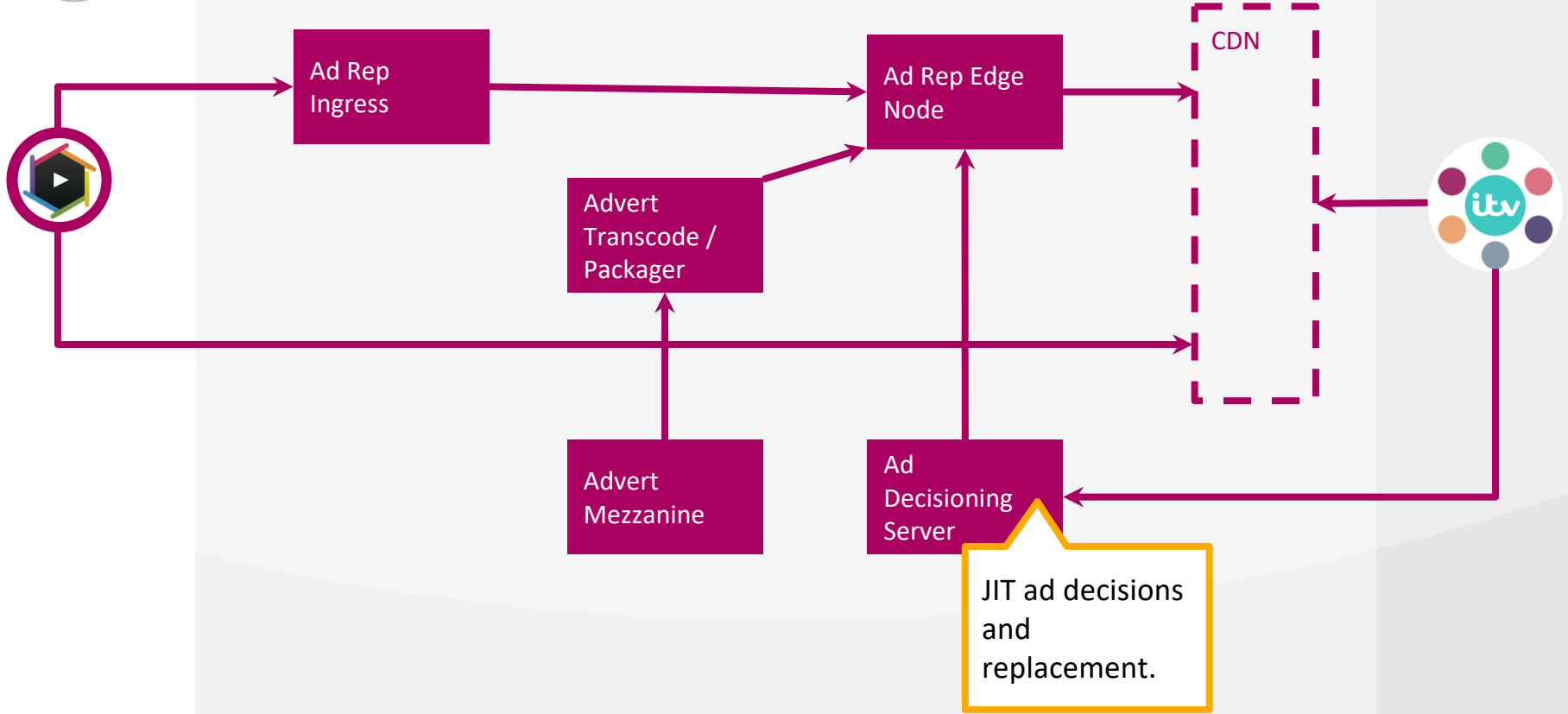
Ad Replacement



JIT Ad Replacement



Ad Replacement





load challenges



Load distributed over segment duration



Breaks down roughly into thirds



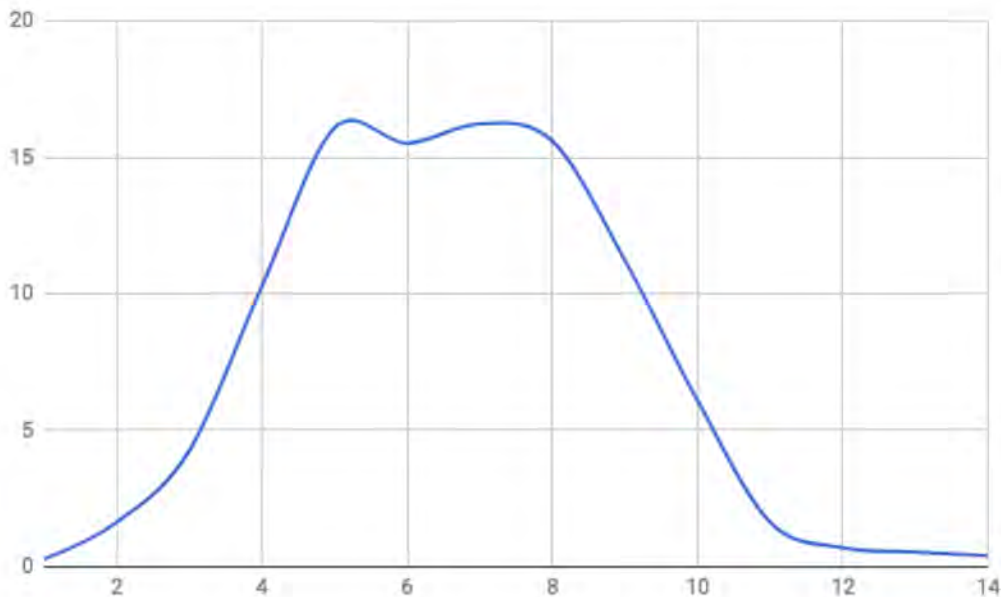
Peak concurrent streams 1.1m



Needs rethink for full rollout and low latency DASH



Ramp up Peak Ramp Down

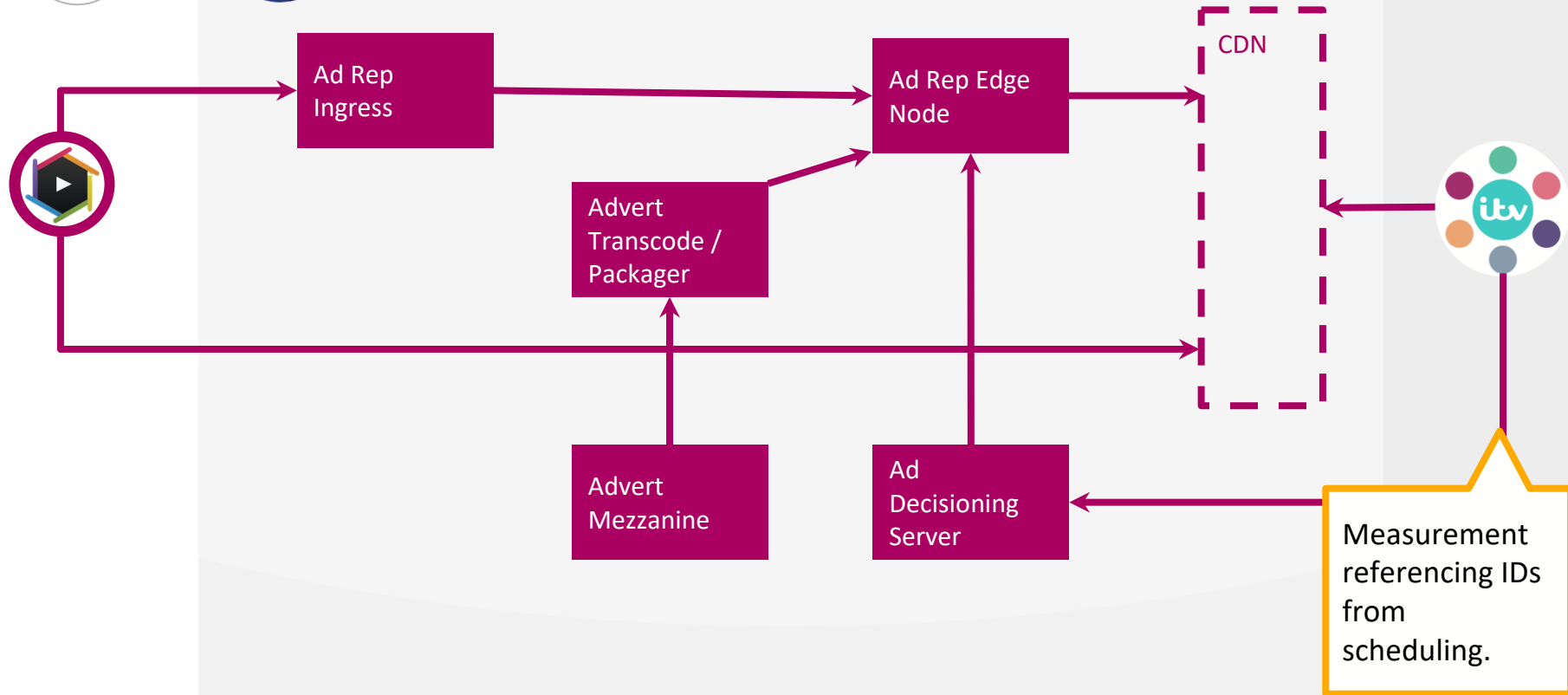


Typical organic advert request distribution

JIT Ad Replacement



Ad Replacement



Simplified example Ad Replacement output

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  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
  <Period start="P0Y0M13DT20H13M9.594S" id="yo-1.1">
    <AdaptationSet mimeType="video/mp4">
      <Representation height="360" width="640" codecs="avc1.4d001f">
        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
            <S r="3" d="36000" t="0" />
            <S d="35600" t="144000" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
    <AdaptationSet mimeType="audio/mp4">
      <Representation audioSamplingRate="48000" codecs="mp4a.40.2">
        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
            <S d="143504" t="0" />
            <S d="144384" t="143504" />
            <S d="143360" t="287888" />
            <S d="144384" t="431248" />
            <S d="143472" t="575632" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
  </Period>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
</MPD>
```



**Ad Replacement
output**



Multi-period DASH



**Use of InbandEventStream
and emsg**



Use of SegmentTimeline

Simplified example Ad Replacement output

```
<MPD>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
  <Period start="P0Y0M13DT20H13M9.5945" id="yo-1.1">
    <AdaptationSet mimeType="video/mp4">
      <Representation height="360" width="640" codecs="avc1.4d001f">
        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
            <S r="3" d="36000" t="0" />
            <S d="35600" t="144000" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
    <AdaptationSet mimeType="audio/mp4">
      <Representation audioSamplingRate="48000" codecs="mp4a.40.2">
        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
            <S d="143504" t="0" />
            <S d="144384" t="143504" />
            <S d="143360" t="287888" />
            <S d="144384" t="431248" />
            <S d="143472" t="575632" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
  </Period>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
</MPD>
```



**Ad Replacement
output**



Multi-period DASH



**Use of InbandEventStream
and emsg**



Use of SegmentTimeline

Simplified example Ad Replacement output

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<MPD>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
  <Period start="P0Y0M13DT20H13M9.5945" id="yo-1.1">
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      <Representation height="360" width="640" codecs="avc1.4d001f">
        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
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        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
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            <S d="143504" t="0" />
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            <S d="143360" t="287888" />
            <S d="144384" t="431248" />
            <S d="143472" t="575632" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
  </Period>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
</MPD>
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**Ad Replacement
output**



Multi-period DASH



**Use of InbandEventStream
and emsg**



Use of SegmentTimeline

Simplified example Ad Replacement output

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<MPD>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
  <Period start="P0Y0M13DT20H13M9.5945" id="yo-1.1">
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        <SegmentTemplate>
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        <SegmentTemplate>
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            <S d="143504" t="0" />
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            <S d="143360" t="287888" />
            <S d="144384" t="431248" />
            <S d="143472" t="575632" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
  </Period>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
</MPD>
```



**Ad Replacement
output**



Multi-period DASH



Use of InbandEventStream
and emsg



Use of SegmentTimeline

Simplified example Ad Replacement output

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<MPD>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
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  </Period>
  <Period start="P0Y0M13DT20H13M9.5945" id="yo-1.1">
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        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
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        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
            <S d="143504" t="0" />
            <S d="144384" t="143504" />
            <S d="143360" t="287888" />
            <S d="144384" t="431248" />
            <S d="143472" t="575632" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
  </Period>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
</MPD>
```



**Ad Replacement
output**



Multi-period DASH



**Use of InbandEventStream
and emsg**



Use of SegmentTimeline

Simplified example Ad Replacement output

```
<MPD>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
  <Period start="P0Y0M13DT20H13M9.5945" id="yo-1.1">
    <AdaptationSet mimeType="video/mp4">
      <Representation height="360" width="640" codecs="avc1.4d001f">
        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
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          </SegmentTimeline>
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        <InbandEventStream value="0" schemeIdUri="urn:yospace:a:id3:2016" />
        <SegmentTemplate>
          <SegmentTimeline>
            <S d="143504" t="0" />
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            <S d="143360" t="287888" />
            <S d="144384" t="431248" />
            <S d="143472" t="575632" />
          </SegmentTimeline>
        </SegmentTemplate>
      </Representation>
    </AdaptationSet>
  </Period>
  <Period>
    <AdaptationSet mimeType="video/mp4"/>
    <AdaptationSet mimeType="audio/mp4" />
  </Period>
</MPD>
```



Ad Replacement output



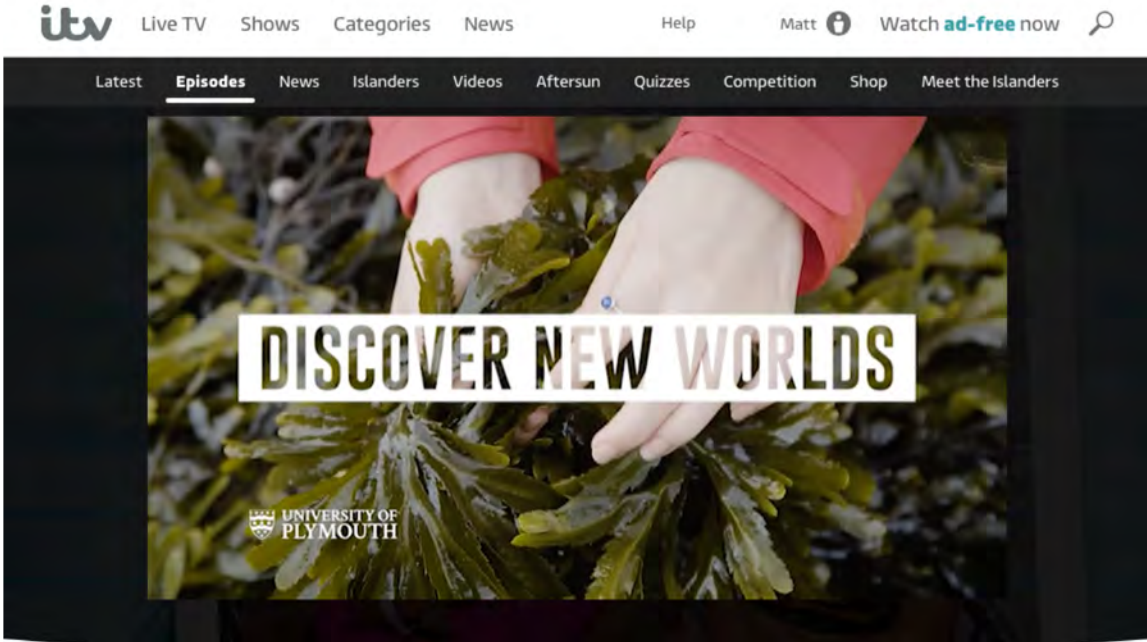
Multi-period DASH



Use of InbandEventStream and emsg



Use of SegmentTimeline



Status of media player



Live with DASH.js without SSAI



Decision to pause on Safari



About to start multi-period testing against solution.



dash.js



Status of media player



Live with DASH.js without SSAI



Decision to pause on Safari



About to start multi-period testing against solution.



dash.js



Status of media player



Live with DASH.js without SSAI



Decision to pause on Safari



About to start multi-period testing against solution.

Work in the Horizontal market



Server Side Ad Replacement on TV



Freeview Play based on HbbTV (like ATSC)



Limited multi-period support.
Mandatory 2019+



Profiled behaviours for near
seamless Ad Transitions



Specifies period-connected as
requirement.



Work in the Horizontal market



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Thank you

