



Dynamic Track Switching for MOQT relays

<https://github.com/wilaw/dts4moq>

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What is Dynamic Track Switching?

Dynamic Track Switching (DTS) allows a relay to dynamically switch which groups are forwarded from among a set of subscriptions.

The primary use-case is server-side Adaptive Bitrate Switching among media tracks.

Why not just call it ABR? - because

- a) MOQT is agnostic about payload and cannot assume media
- b) The same mechanism can be extended to switch on other metrics besides throughput (such as activity in a security camera). ABR is a subset of DTS. We want to keep it flexible for future applications.

General approach

The approach is:

1. Define two new parameters - SWITCHING-SET-ASSIGNMENT parameter and the DTS-ACTIVATION parameter
2. Subscribe to each of the tracks you wish to switch between and allocate them to the same switching set.
3. Activate switching on that set.

SWITCHING-SET-ASSIGNMENT parameter (0x41)

May only accompany SUBSCRIBE or REQUEST_UPDATE messages.

Assigns the accompanying subscription to a DTS switching set and specifies a waiting time-limit.

```
SWITCHING-SET-ASSIGNMENT {  
    Switching set ID (vi64) ,  
    [Throughput threshold (vi64) ,  
    Selection time limit (vi64)]  
}
```

- **Switching set ID** - an integer specifying a switching set. The value zero is reserved to indicate no switching set.
- **Throughput threshold** - the minimum throughput, expressed in integer kilobits per second, necessary to select this subscription. This value **MUST** be omitted if the Switching set ID is zero.
- **Selection time limit** - the maximum amount of time, in milliseconds, which a relay **MUST** wait after the arrival of the first candidate group in a switching group, before this subscription is disqualified as the preferred selection. This value **MUST** be omitted if the Switching set ID is zero.

DTS-ACTIVATION parameter (0x43)

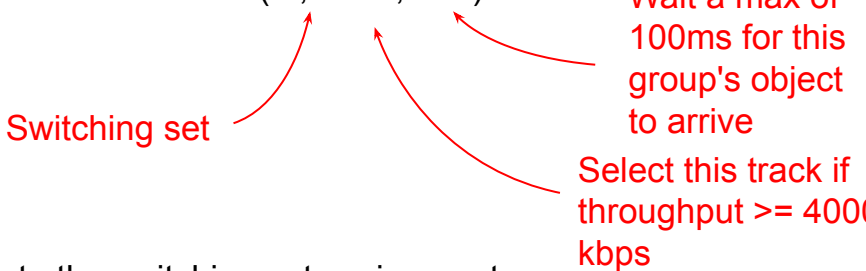
May only accompany SUBSCRIBE or REQUEST_UPDATE messages.
Enables or disables dynamic track switching for a specified switching set

```
DTS-ACTIVATION {  
    Switching set ID (vi64) ,  
    State (1)  
}
```

- **Switching set ID** - an integer referencing a previously defined switching set.
- **State** - a value of 1 activates dynamic switching for the specified switching set and a value of 0 deactivates it

Example

The original publisher produces 3 video tracks, all under the same name-space, with names "high" (3Mbps), "medium" (2Mbps) and "low" (1Mbps).

1. Client issues SUBSCRIBE (high) with SWITCHING-SET-ASSIGNMENT (1, 4000, 100)

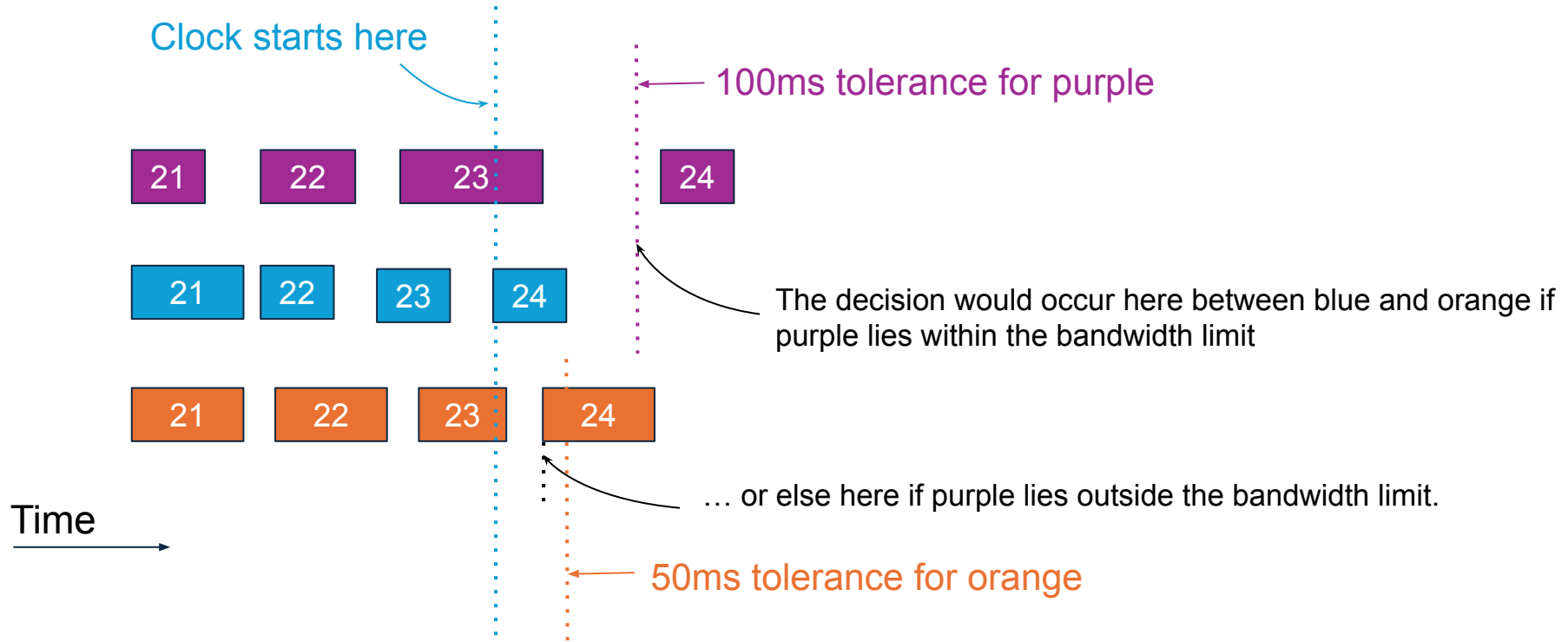
Wait a max of 100ms for this group's object to arrive

Select this track if throughput $\geq$ 4000 kbps

Switching set
2. Relay receives subscription and sets it to forward=0 due to the switching set assignment.
3. Client issues SUBSCRIBE (medium) with SWITCHING-SET-ASSIGNMENT (1, 3000, 50)
4. Relay receives subscription and sets it to forward=0 due to the switching set assignment.
5. Client issues SUBSCRIBE (low) with SWITCHING-SET-ASSIGNMENT (1, 1500, 30) and DTS-ACTIVATION (1, 1) // turn switching set 1 on.
6. All 3 subscriptions are now actively switched, by toggling their 'forward' status. The relay forwards the track with the highest bitrate threshold which is $\leq$ the estimated connection throughput. Decisions are made only when the first Object of a new Group arrives.
7. Client issues REQUEST-UPDATE (1,0) to turn off DTS for that set.
8. Client UNSUBSCRIBES from all 3 tracks when done. If all members of a switching set are unsubscribed, the set is removed from relay memory.

Why the 'waiting' attribute?

Because not all Objects arrive at exactly the same time, even for 'time synchronized' media. We don't want oscillations between tracks because one object arrived 5ms after another one. The "decision" clock starts when the first Group boundary object of a switching set arrives. Consider the process for Group #24:



Extend to a publisher-controlled scheme

We define a reserved Object extension which the publisher can use to define the same information that the SWITCHING-SET-ASSIGNMENT parameter provides.

When a relay sees this extension it MUST implement dynamic track switching on the set.

```
PUBLISHER-DEFINED-SWITCHING{  
    Switching set ID (vi64) ,  
    [Throughput threshold (vi64) ,  
    Selection time limit (vi64) ,  
    Number of tracks in set (vi64)]  
}
```

- **Switching set ID** - an integer specifying a switching set.
- **Throughput threshold** - the minimum throughput, expressed in integer kilobits per second, necessary to select this subscription.
- **Selection time limit** - the maximum amount of time, in milliseconds, which a relay MUST wait after the arrival of the first candidate group in a switching group, before this subscription is disqualified as the preferred selection.
- **Number of tracks** - the size of the set. This tells the relay when it can begin making the switching decision.

Thank you for your time.