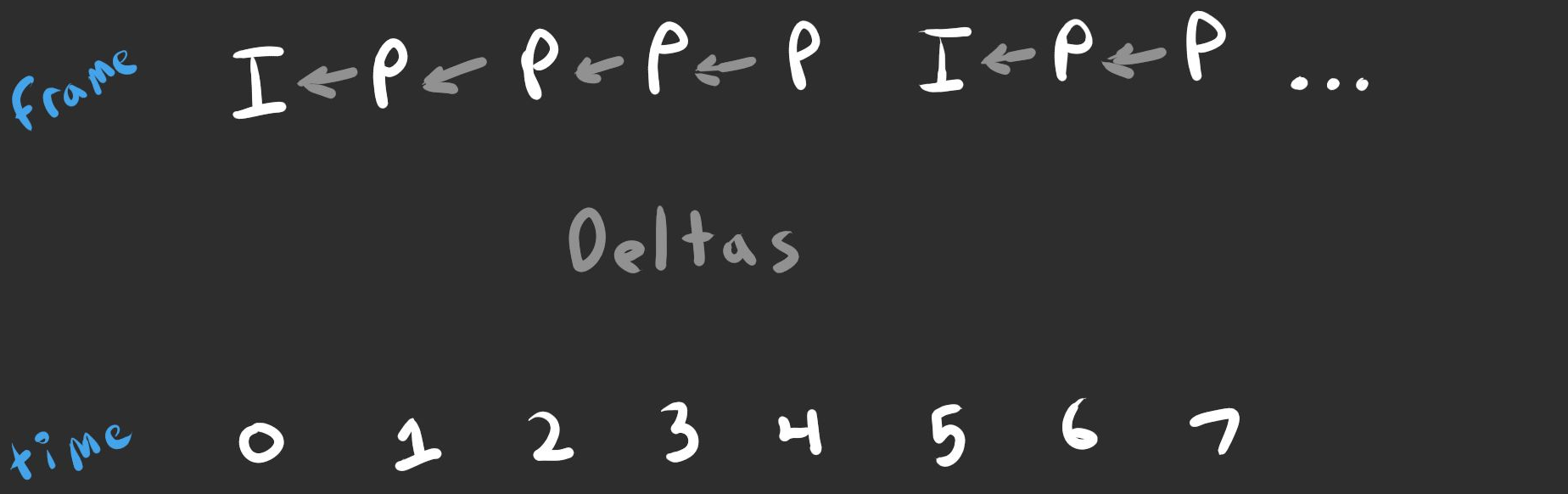
Warp + RUSH + QUICR

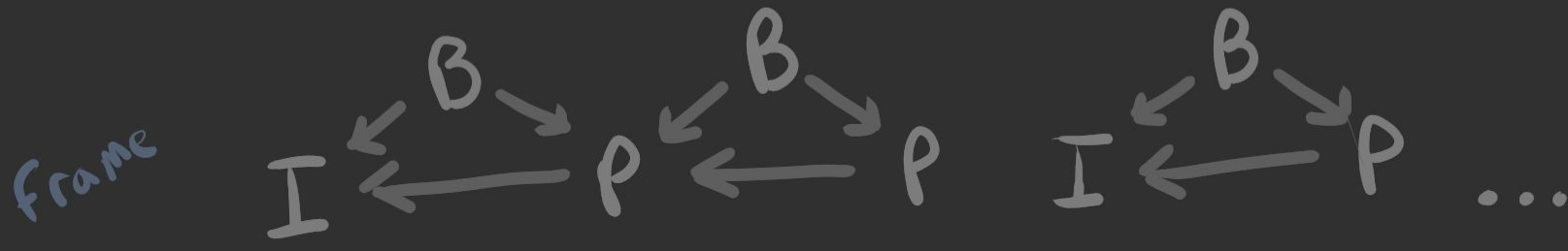
base draft

draft-lcurley-warp-02

Media Encoding



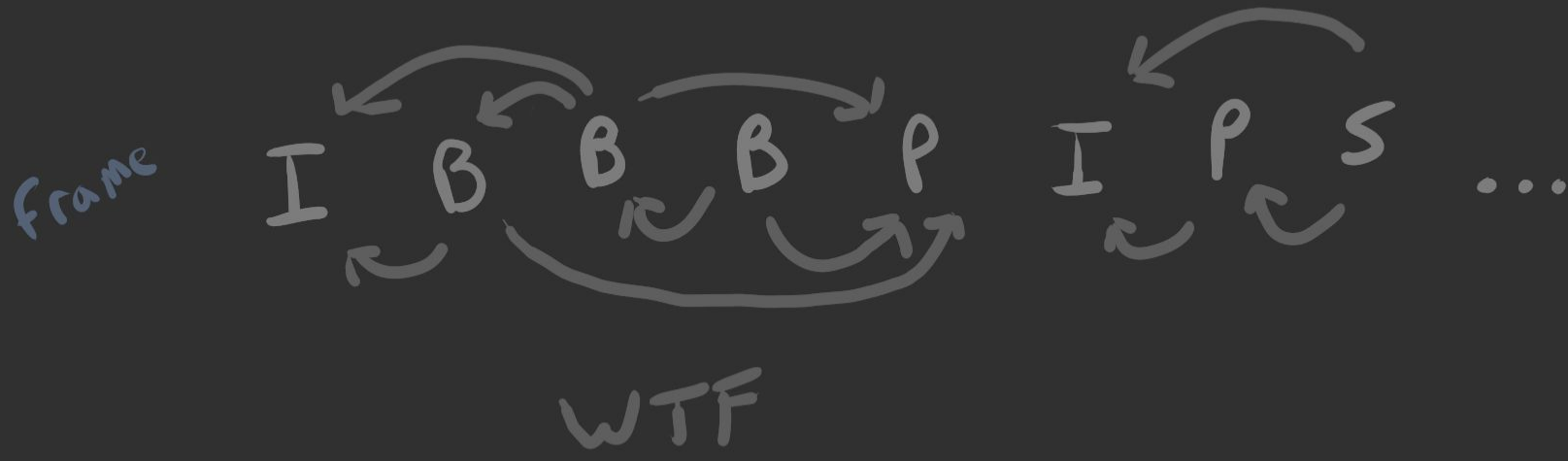
Media Encoding



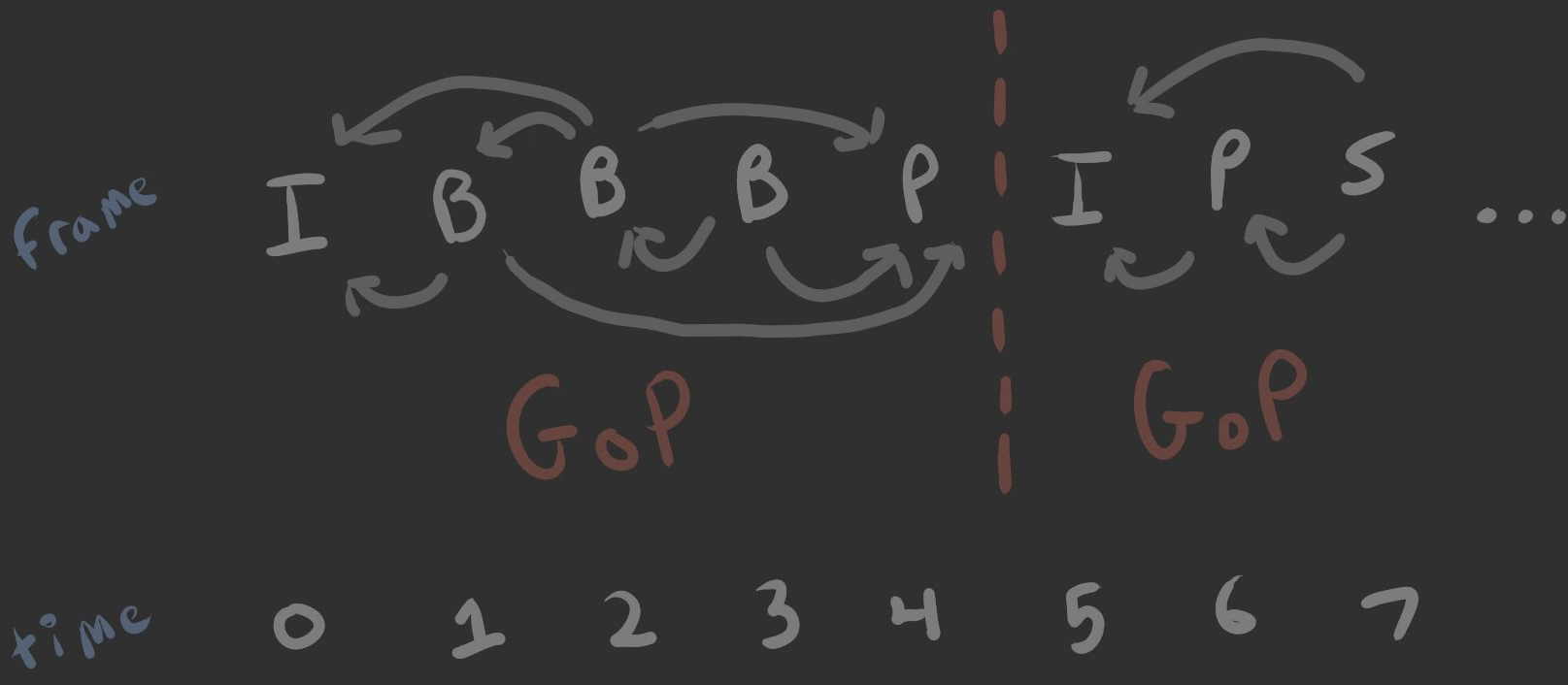
Annoying

time 0 1 2 3 4 5 6 7

Media Encoding



Media Encoding



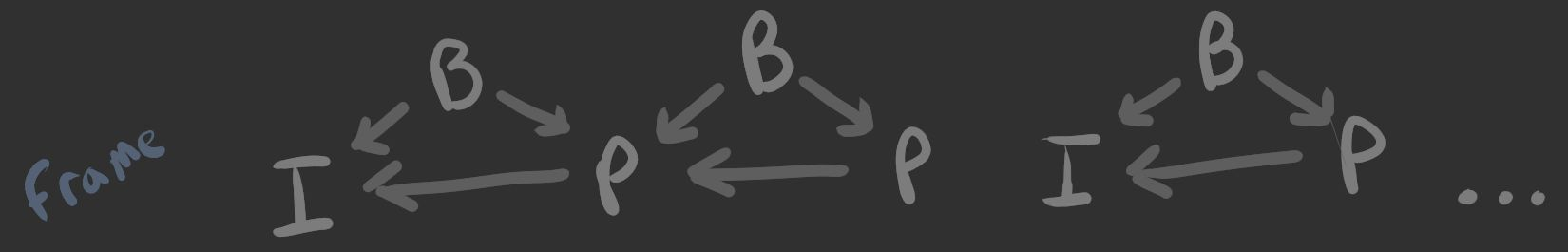
Goals

1. respect encoding over network

2. minimize latency during congestion

3. use QUIC

TCP RTMP HLS/DASH*



how to serialize?

time 0 1 2 3 4 5 6 7

TCP RTMP HLS/DASH*

frame I ← P ← B ← P ← B ← I ← P ← B ...

decode order

time 0 2 1 4 3 5 7 6

TCP

RTMP

HLS/DASH*

Congestion

:(

frame I ← P ← B ← P ← B ← I ← P ← B ...

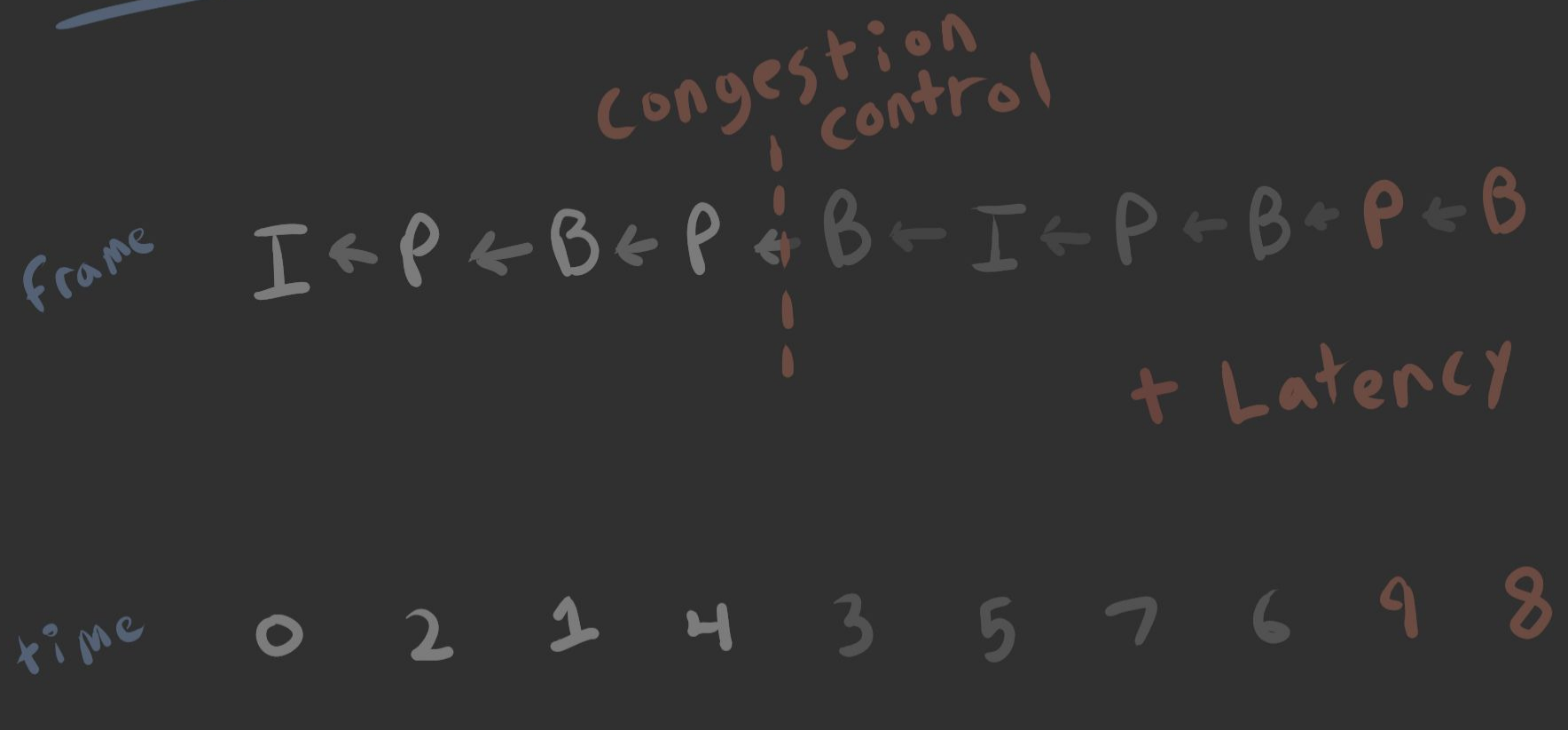
What to queue?

time 0 2 1 4 3 5 7 6

TCP

RTMP

HLS/DASH*



Rule 1

don't introduce dependencies

RTP

RTP

congestion !!

frame  ...

what to drop?

time 0 1 2 3 4 5 6 7

RTP

Best Case :D

RTP

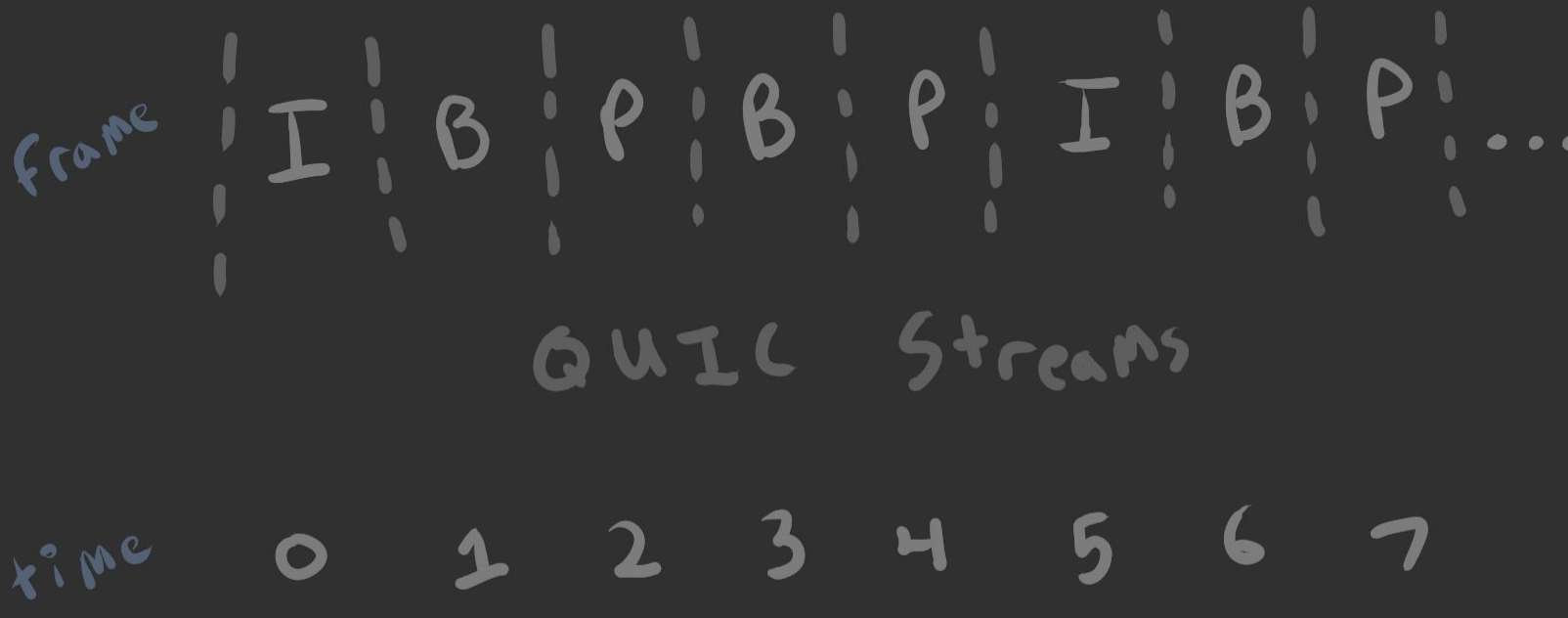
Worst case :(

Rule 2

don't drop partial frames*

* slices

RUSH



RUSH

congestion
=(

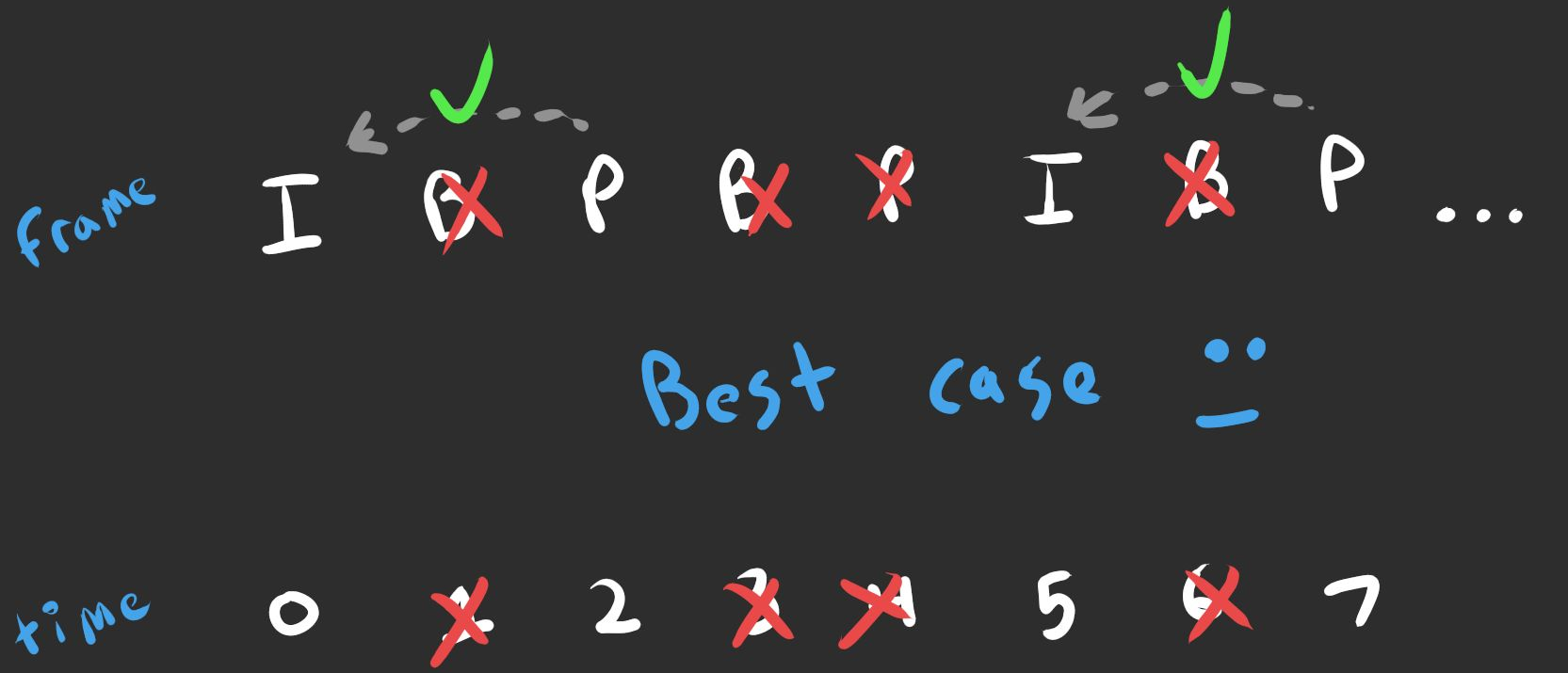
frame I B P B P I B P ...

what to reset?

time 0 1 2 3 4 5 6 7

RUSH

RESET_STREAM

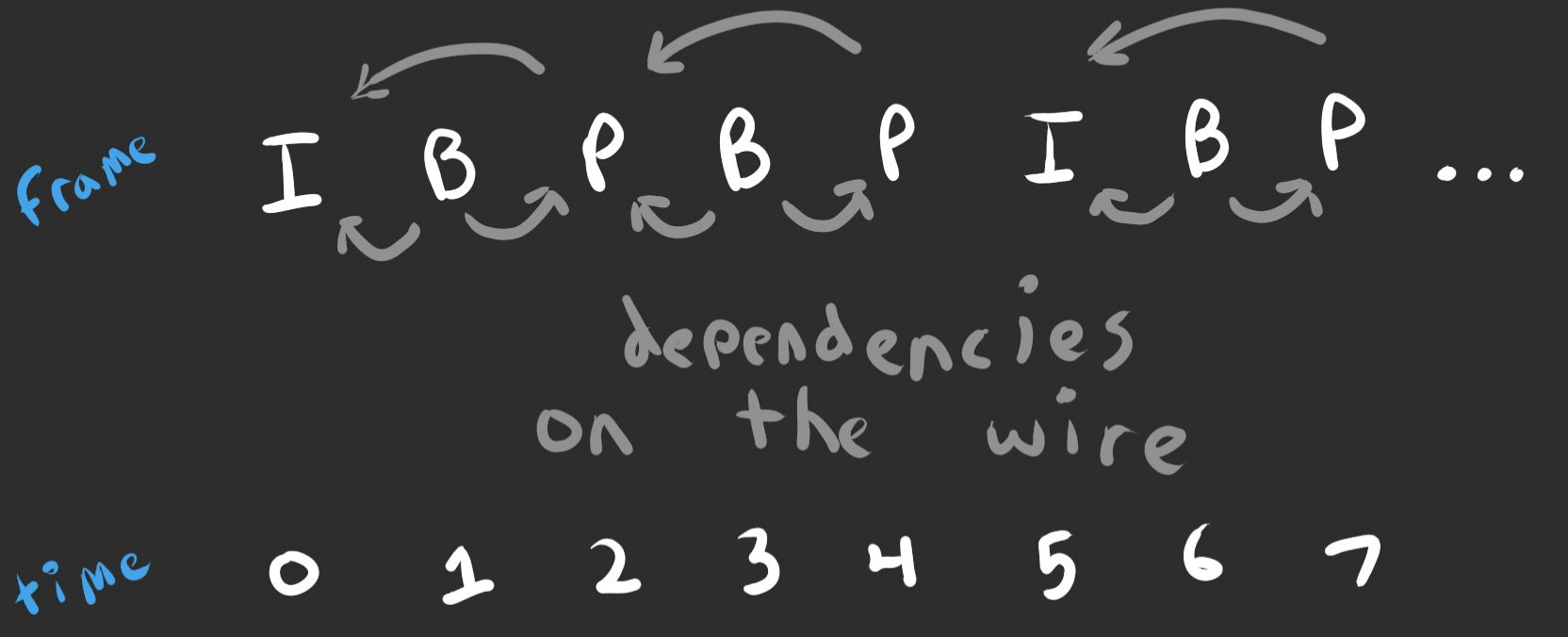


Best case :)

RUSH

Worst case ☹

RUSH + QUICR

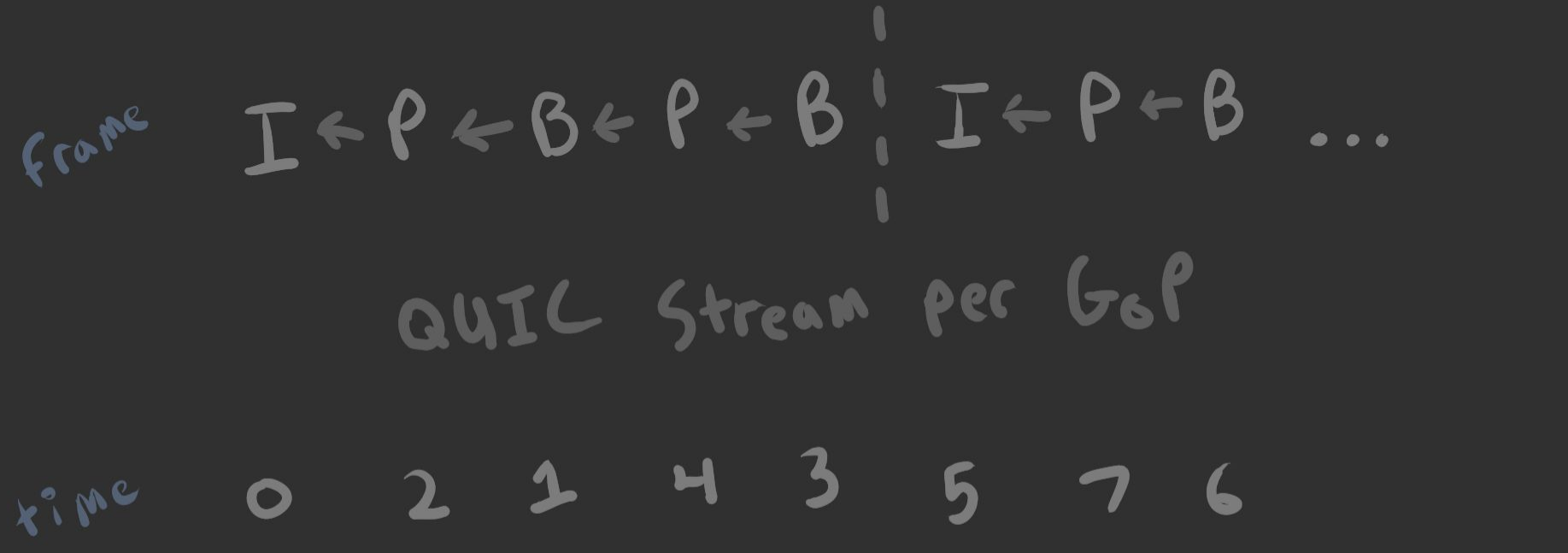


Rule 3

don't drop dependencies

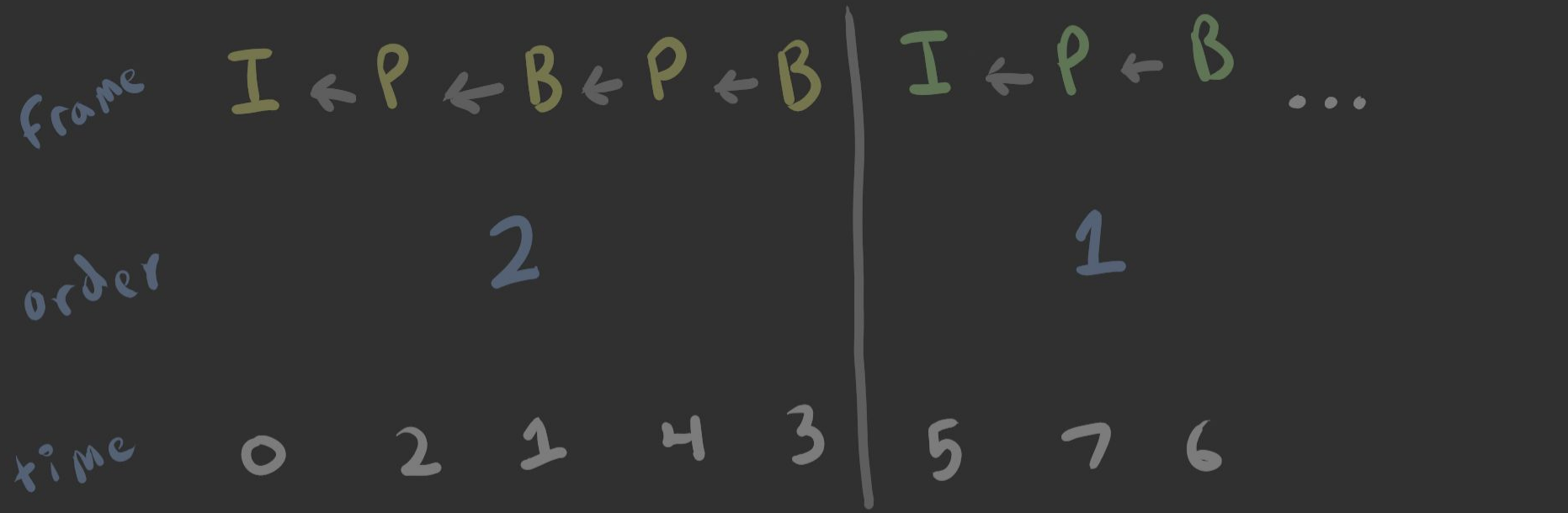
drop leaf nodes first

Warp



Warp

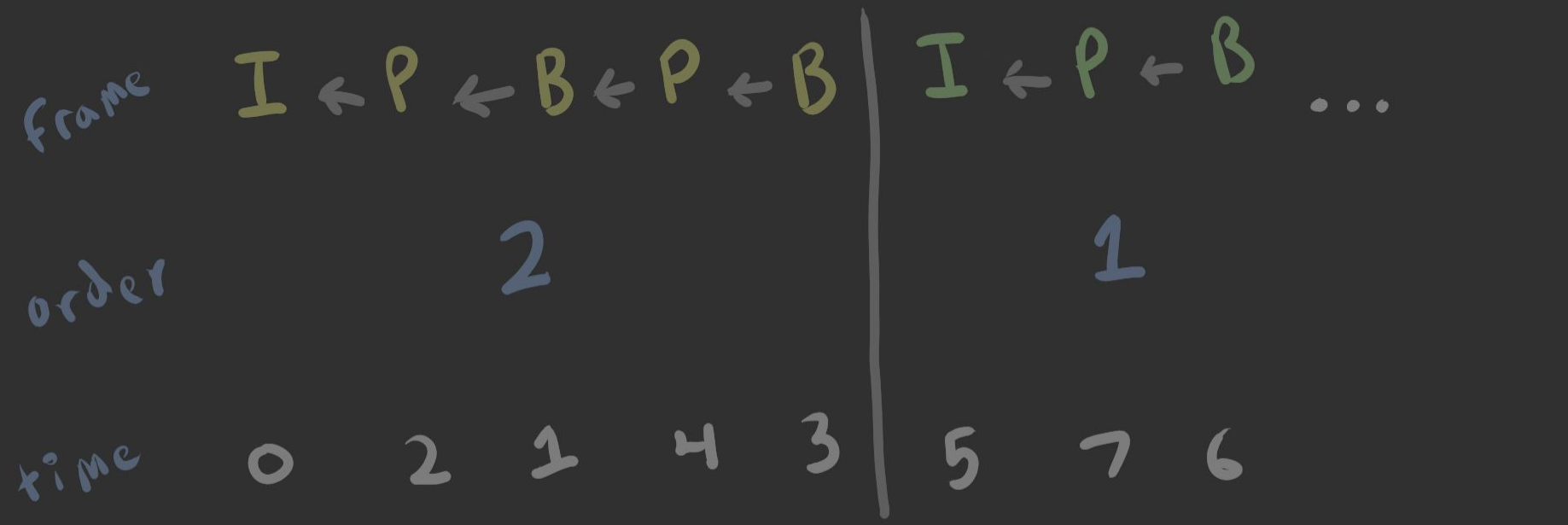
new > old



Warp

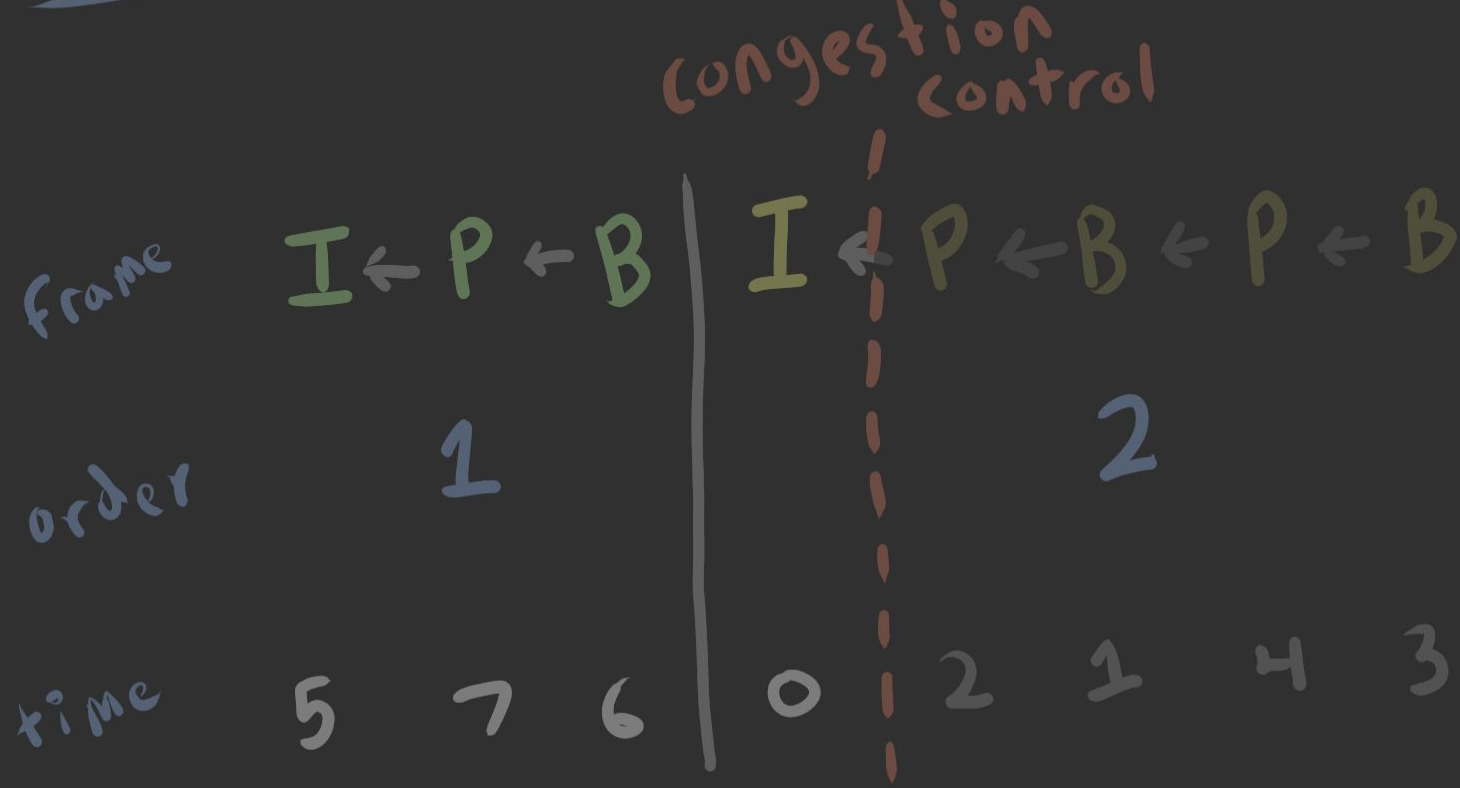
congestion

what to prioritize?



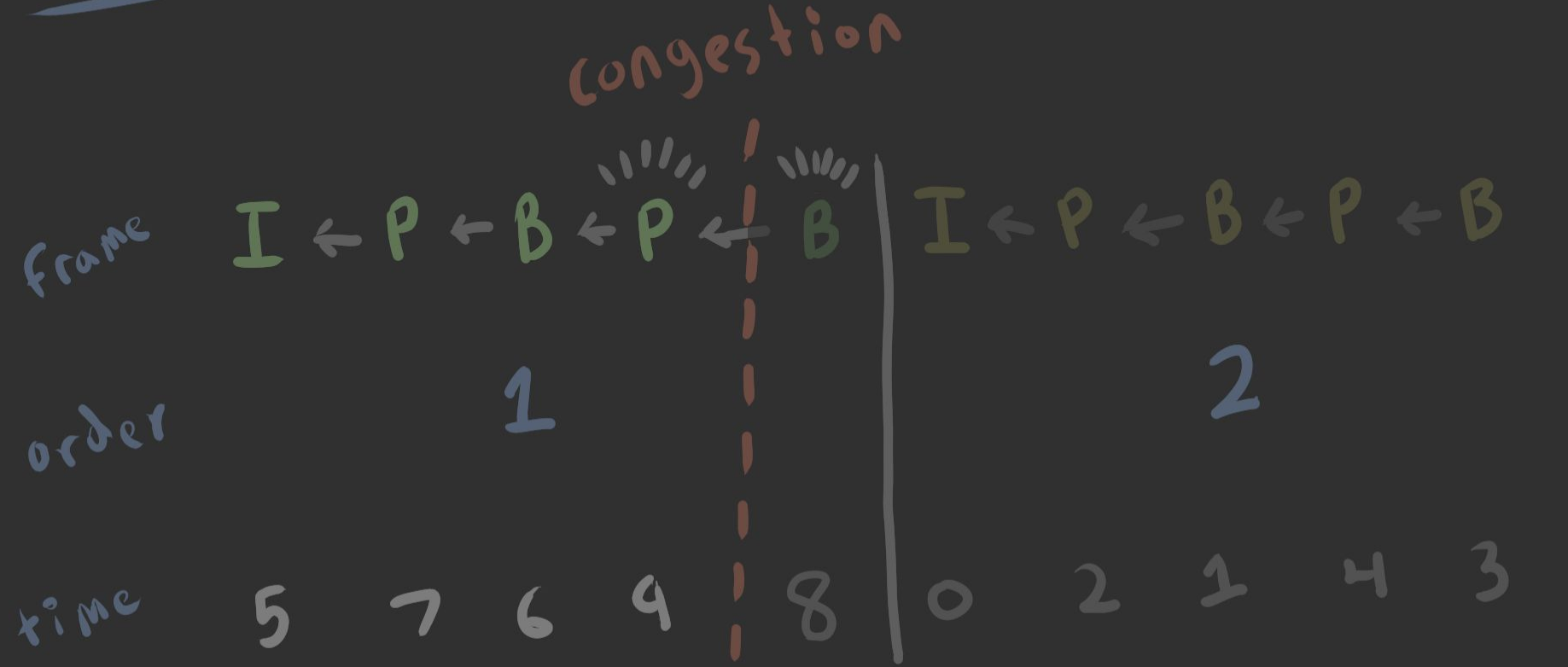
Warp

Starve

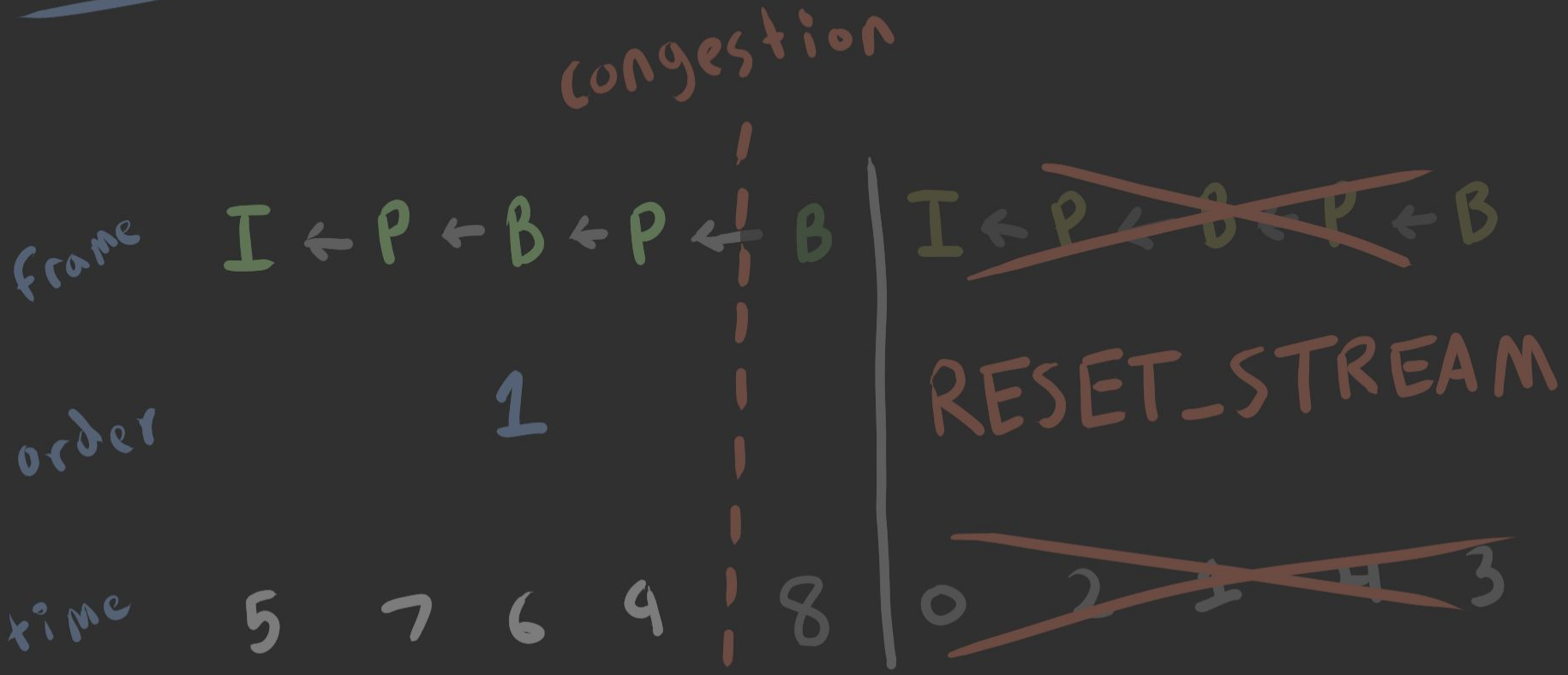


Warp

Skip queue



Warp

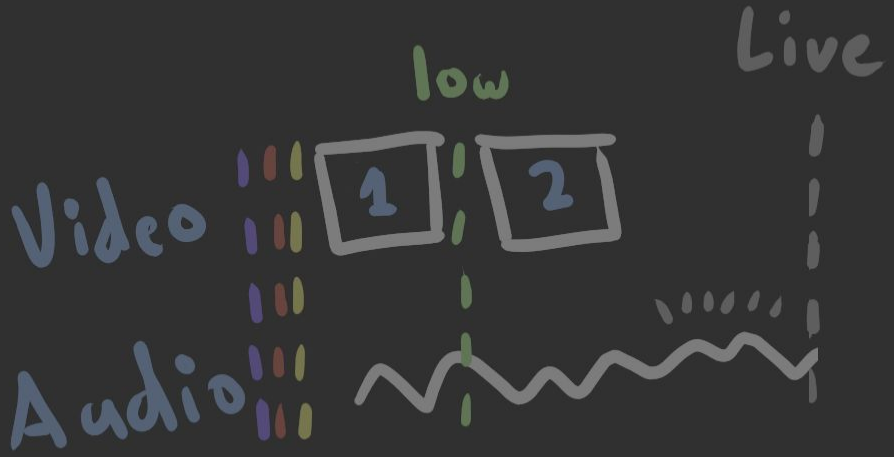

congestion
frame
I ← P ← B ← P ← B
I ← P ← B ← P ← B
order
1
RESET_STREAM
time
5 7 6 9 8
0 2 1 4 3

Why Warp?

Variable latency
&
Relay support

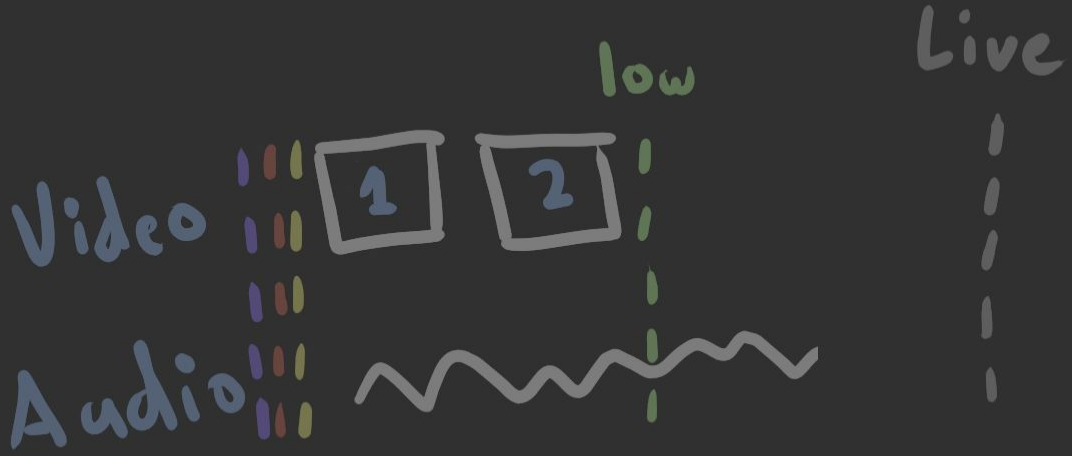
Warp Recieve Buffer

Warp Recieve Buffer

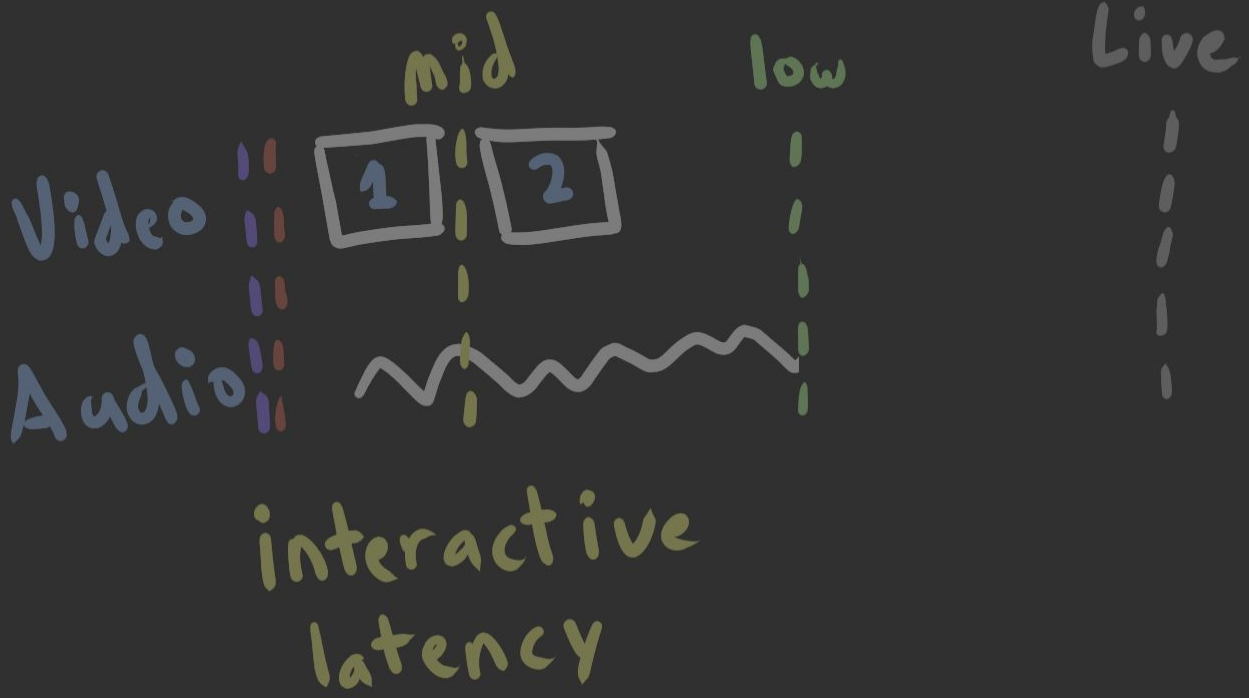


real-time
conferencing

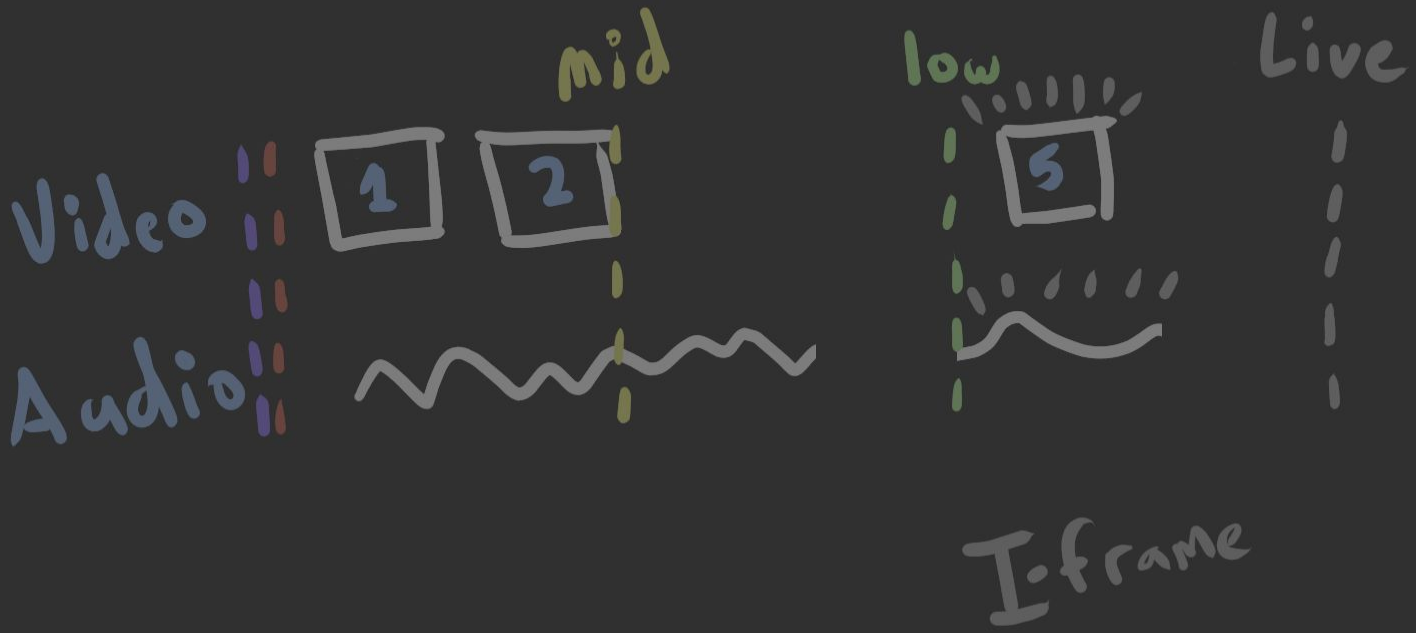
Warp Recieve Buffer



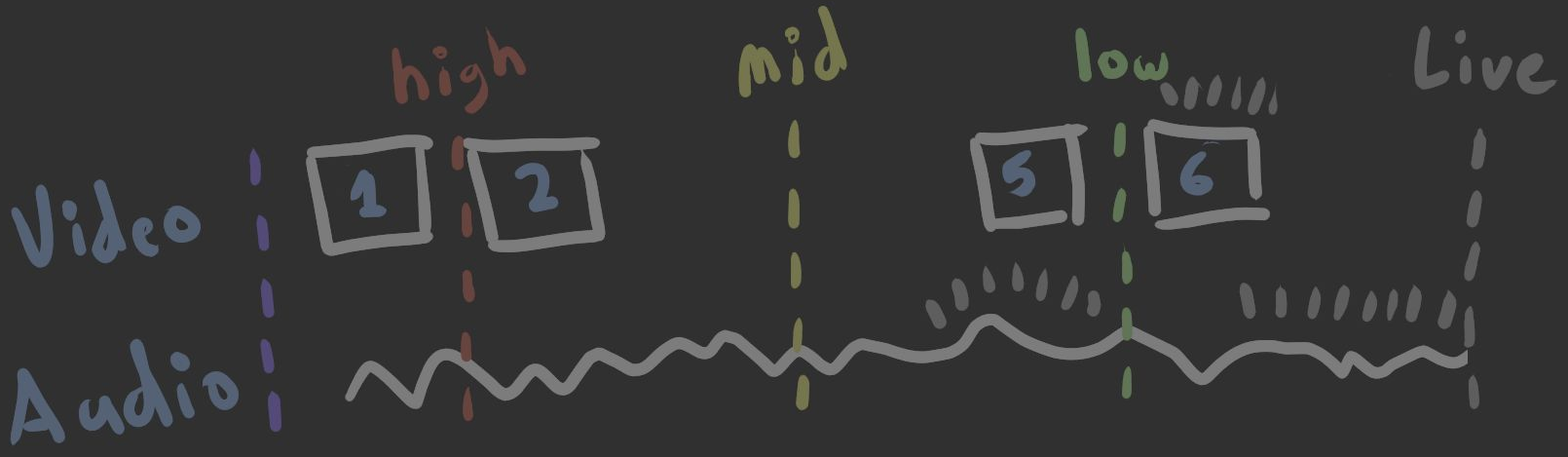
Warp Recieve Buffer



Warp Recieve Buffer



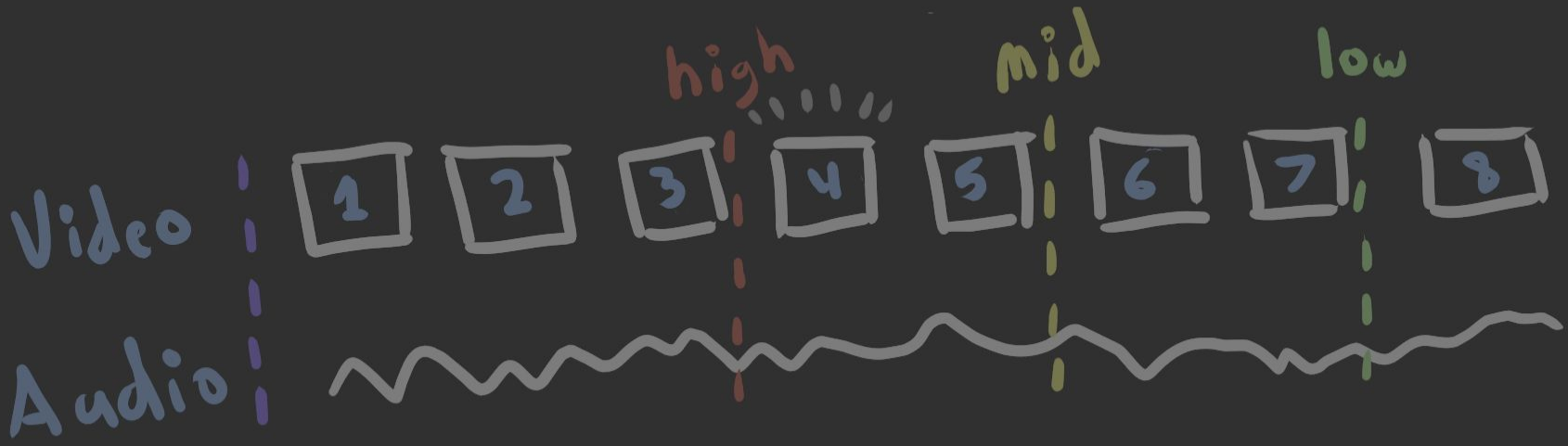
Warp Recieve Buffer



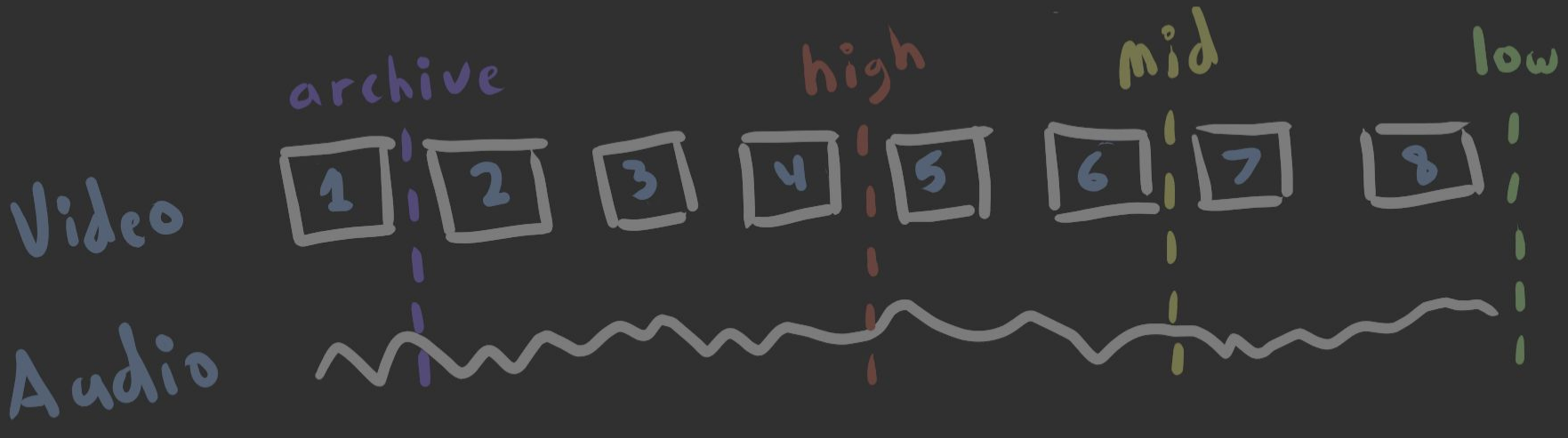
non-interactive latency

Warp Recieve Buffer

Warp Recieve Buffer



Warp Recieve Buffer



flawless upload

Recap

exact same delivery

low +2 latency, -3 video, -1 audio

mid +4 latency, -2 video

high +6 latency

archive +N latency

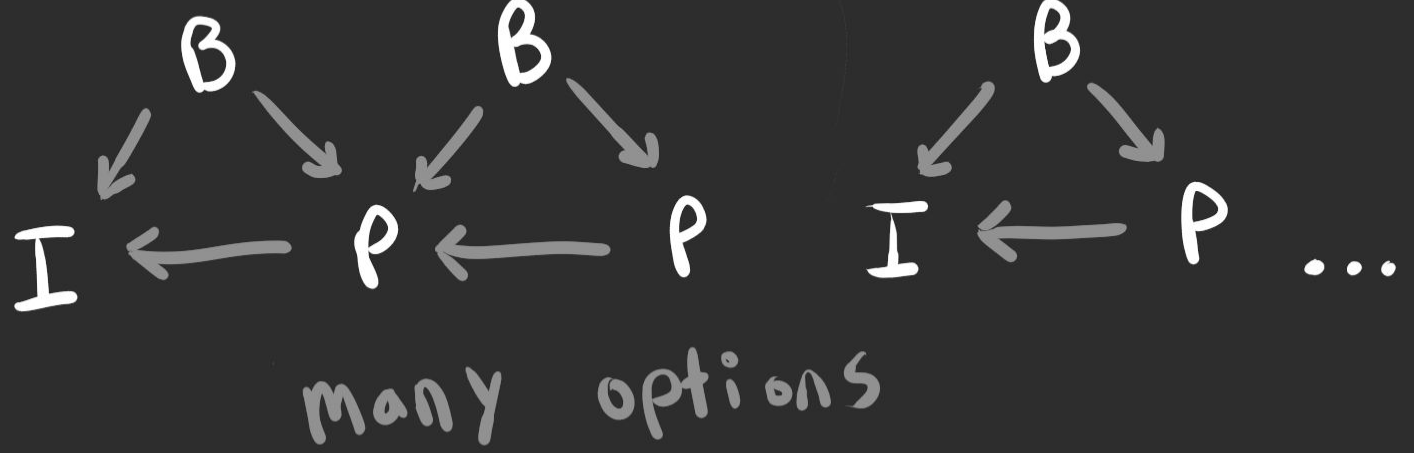
Warp + RUSH + QUICR*

draft-lcurley-warp-02

1. any number of frames per stream = "segment"*

2. delivery order and/or dependencies on wire

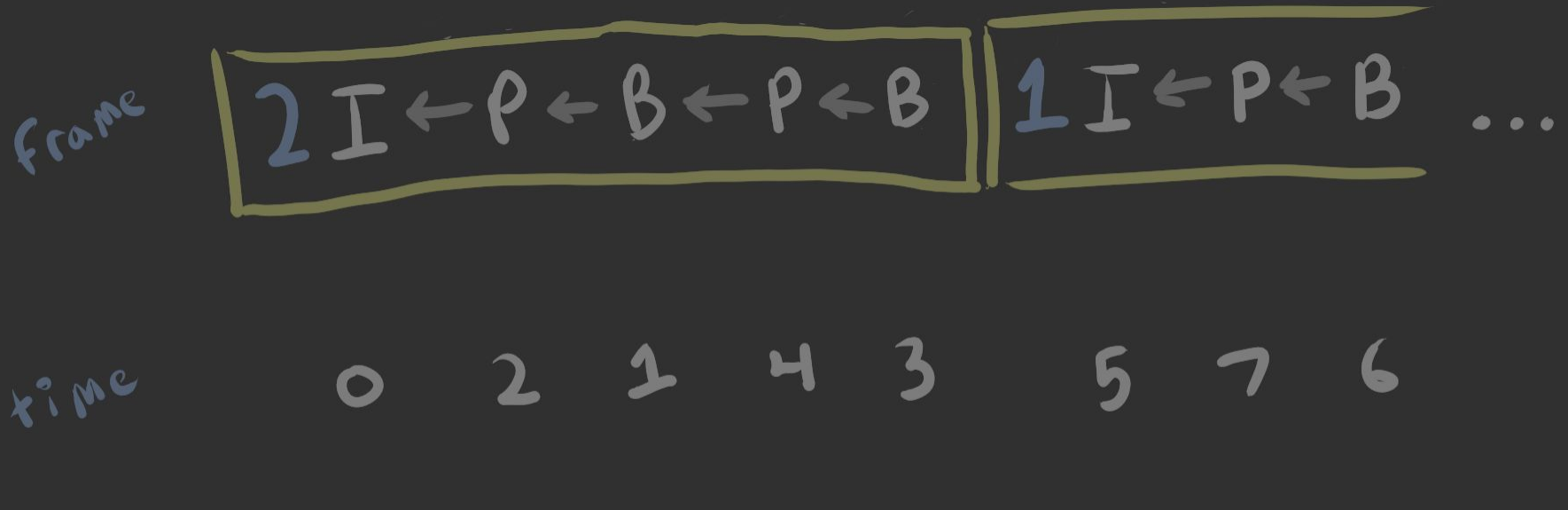
Warp + RUSH + QUICR*



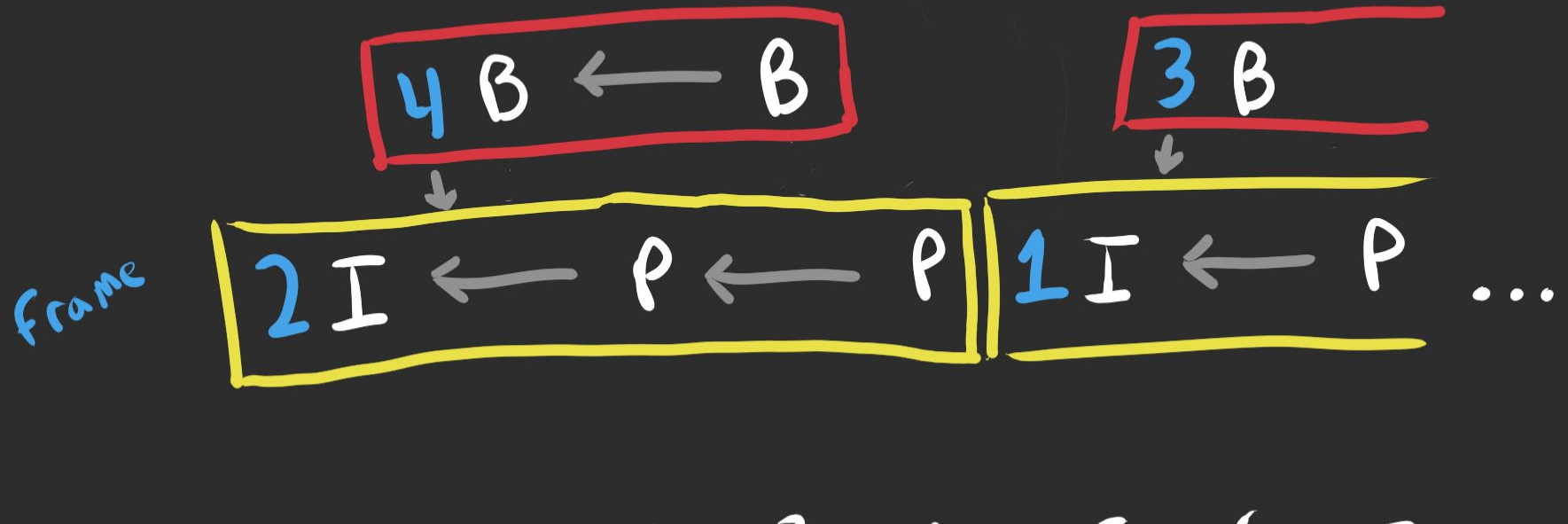
frame

time 0 1 2 3 4 5 6 7

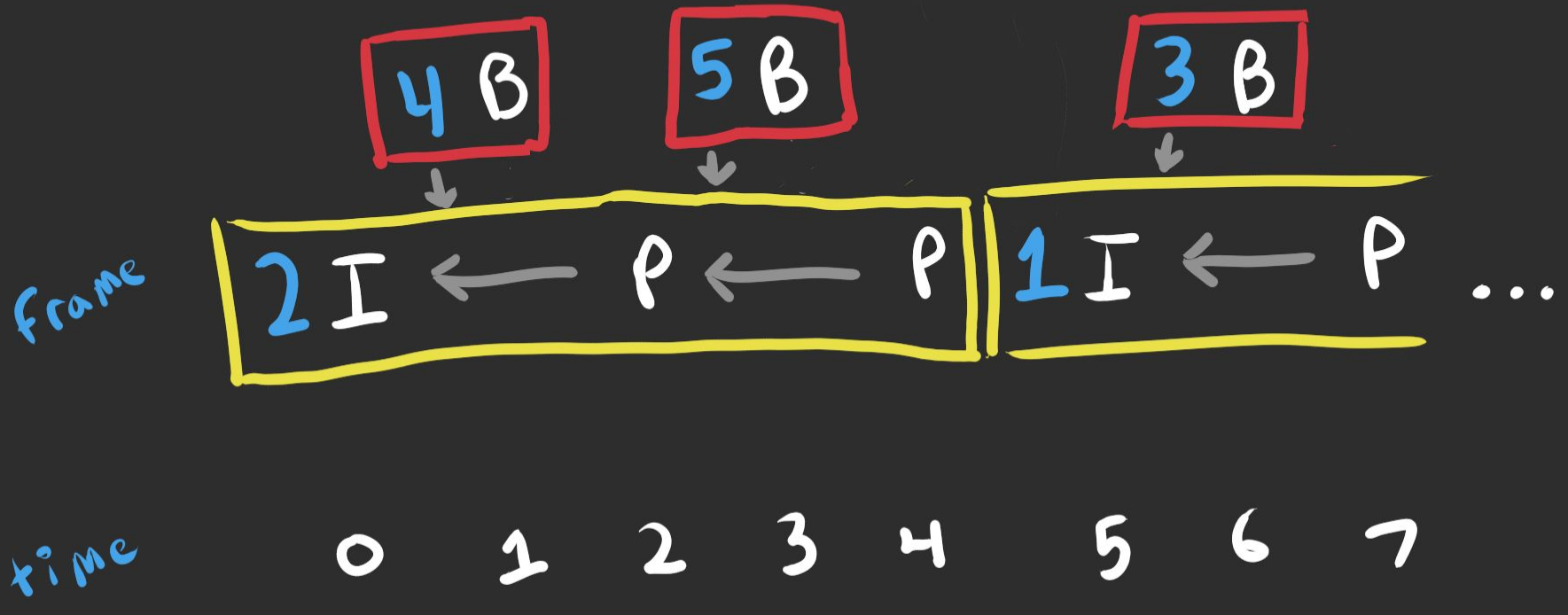
Warp + RUSH + QUICR*



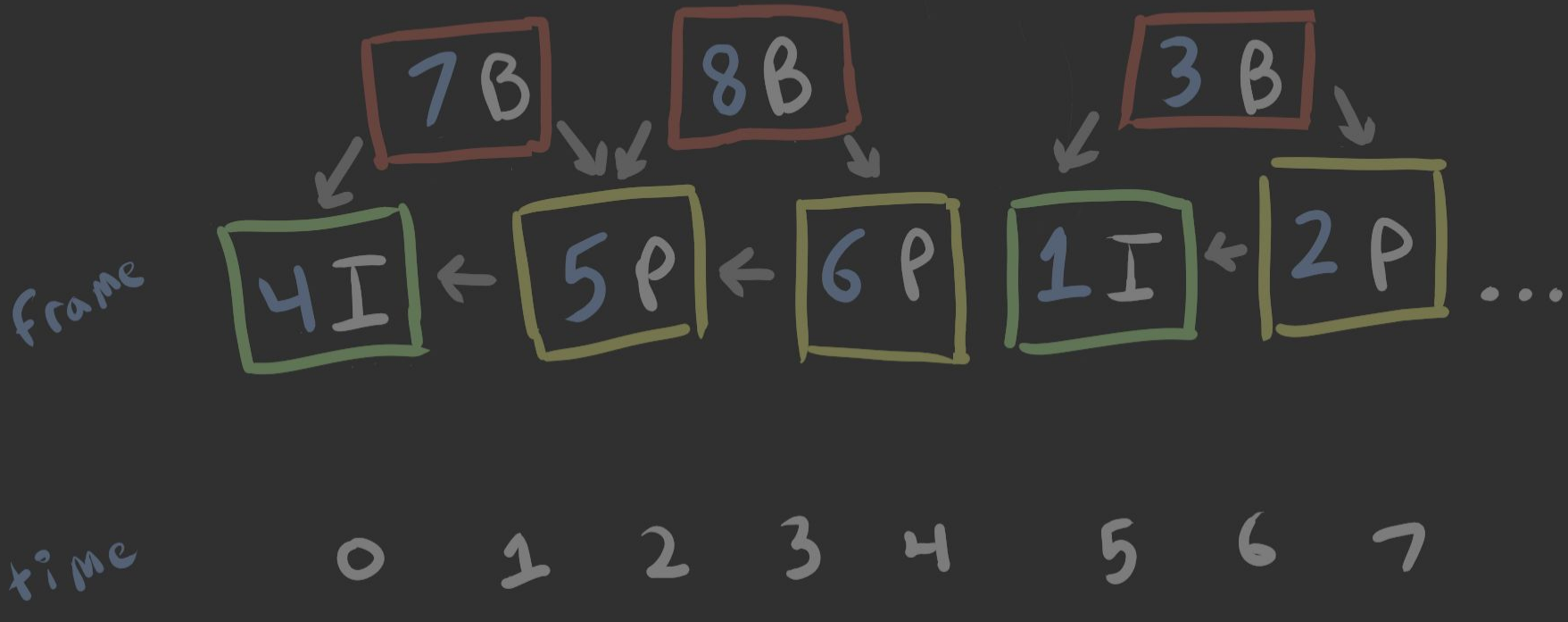
Warp + RUSH + QUICR*



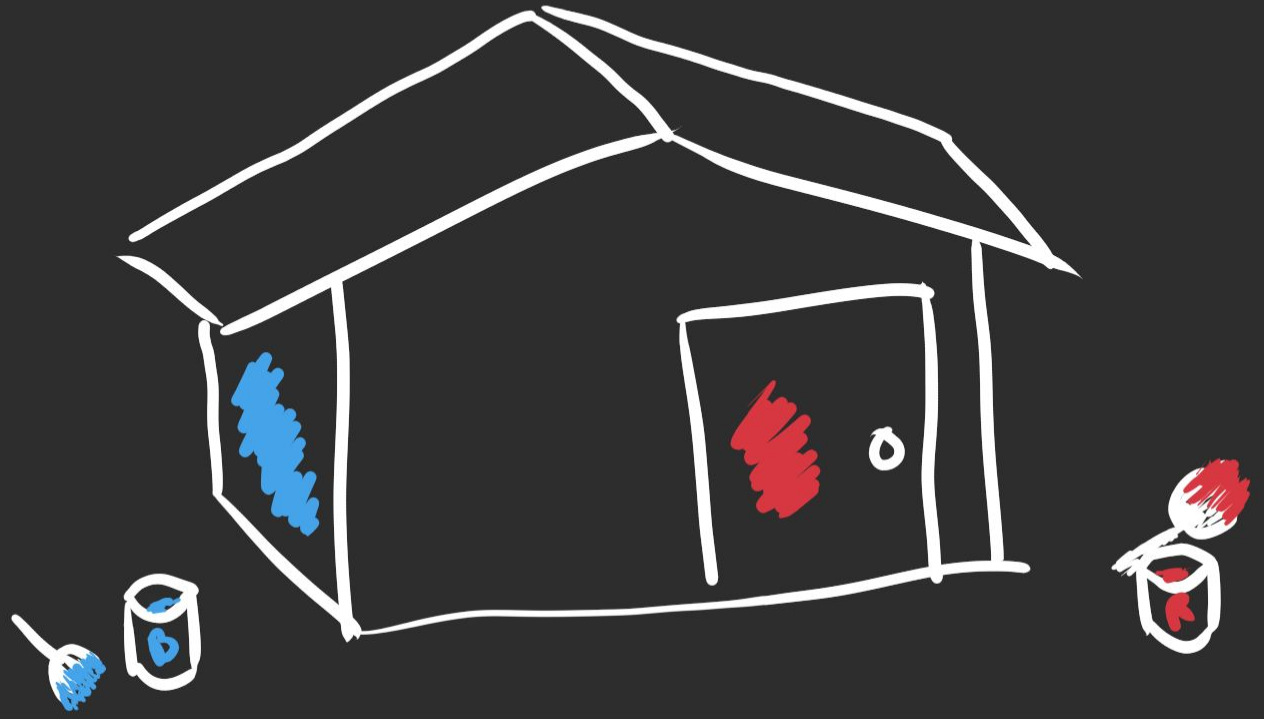
Warp + RUSH + QUICR*



Warp + RUSH + QUICR*



What's next?



What's next?

Names r hard

WARP or RUSH or MOQ or ?

Segments or layers or fragments or chunks or ?

What's next?

kixelated/warp-draft

- Wire format
- CDN support
- media stuff
- adoption?

quic.video/demo

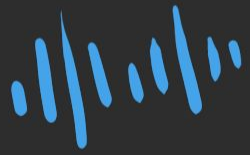
Contributors

Luke

Buck

James

Max



Suhas

Cullen

and you!

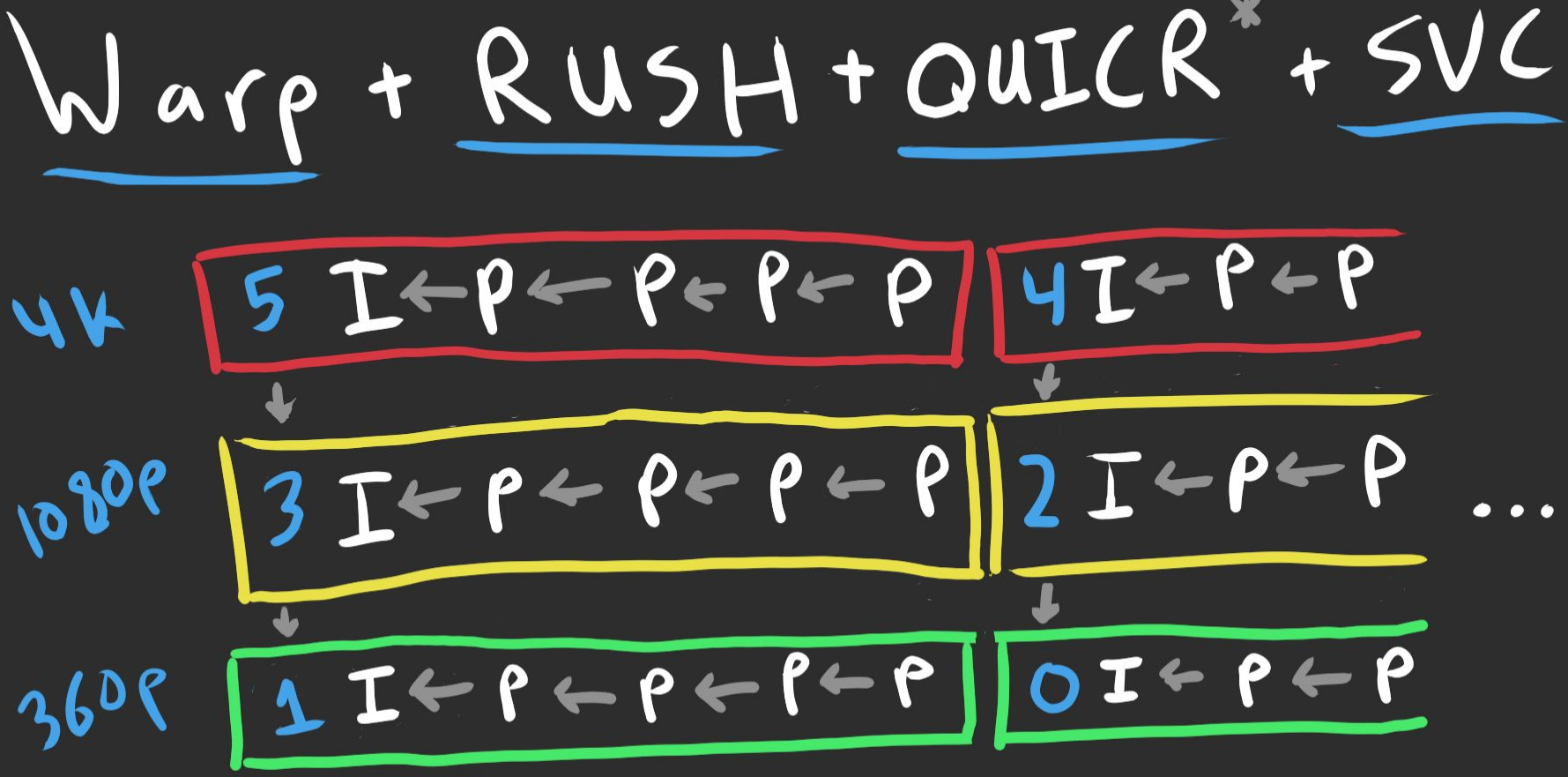
Kirill

Alan

Jordi


Thanks

if someone asks...


Warp + RUSH + QUICR* + SVC
4k
1080p
360p
5 I ← P ← P ← P ← P
4 I ← P ← P
3 I ← P ← P ← P ← P
2 I ← P ← P
...
1 I ← P ← P ← P ← P
0 I ← P ← P
layers!