

# Unifying Real-Time Communications and Content Delivery with Media-over-QUIC Transport

Media over QUIC

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**Ali C. Begen, PhD**

<https://ali.begen.net>

## Earlier Research Has Shown That

- For timely delivery, QUIC may perform better than TCP in congested environments
  - We still need a custom application-layer protocol to reap all the benefits QUIC provides
- Existing adaptive streaming methods
  - have been highly tuned for HTTP/1.1 and 2 running on top of TCP
  - do not give remarkably better results with H3 running over QUIC

Unless the streaming application is aware of QUIC's unique features, the improvements will be limited

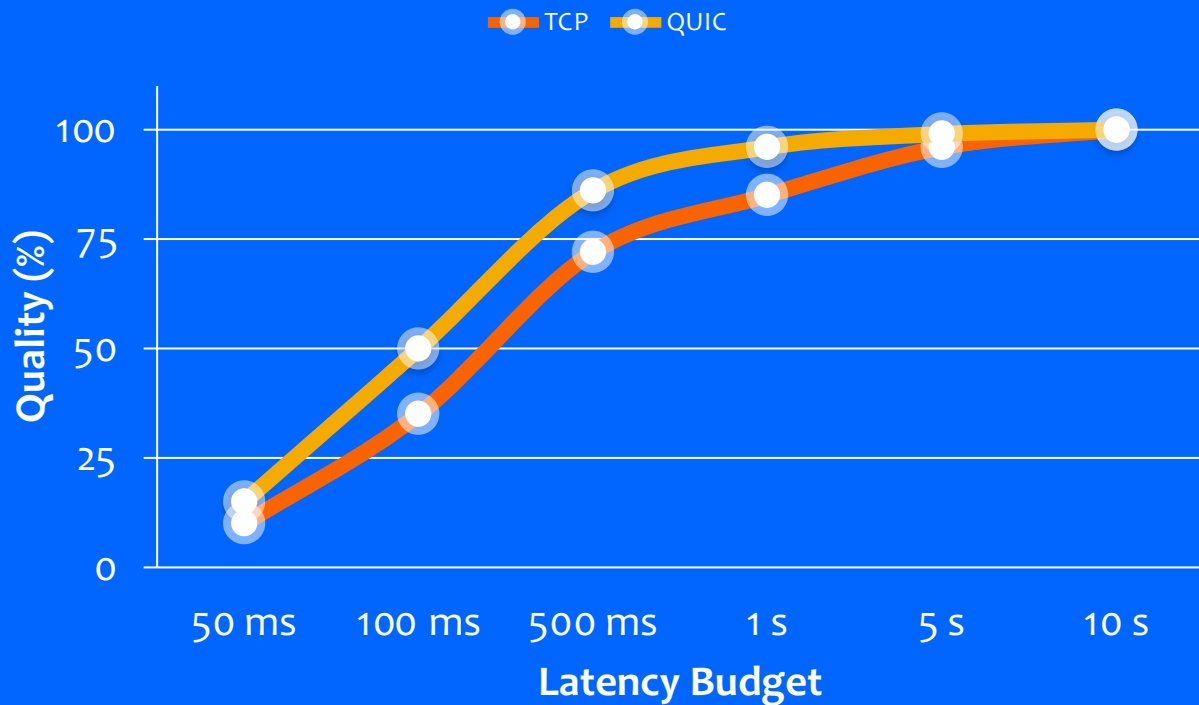


Reading: Quickly starting media streams using QUIC – ACM Packet Video'18

Take the red pill for H3 and see how deep the rabbit hole goes – ACM MHV'22

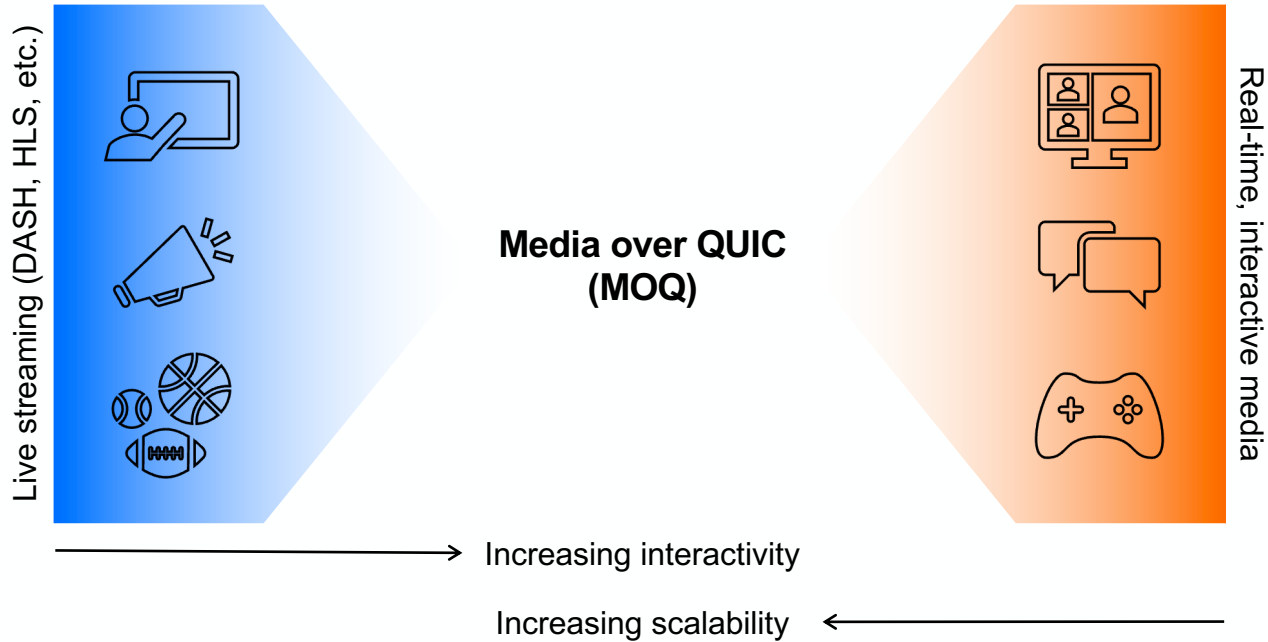
Toward one-second latency: evolution of live media streaming (<https://arxiv.org/abs/2310.03256>)

# Can We Achieve a Better Quality-Latency Tradeoff?

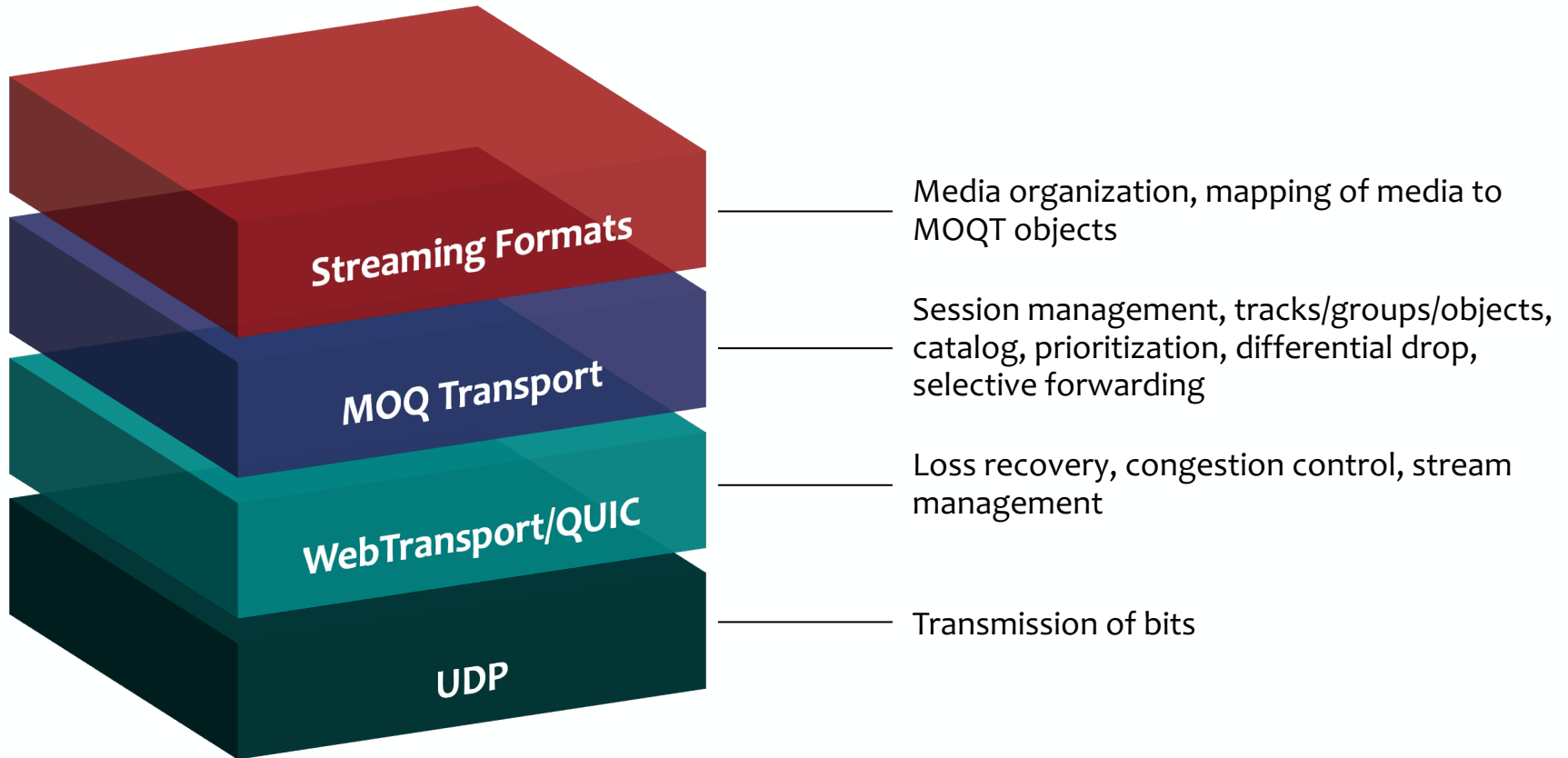


Not to scale, for illustration only

# Unifying Real-Time Communications and Content Delivery

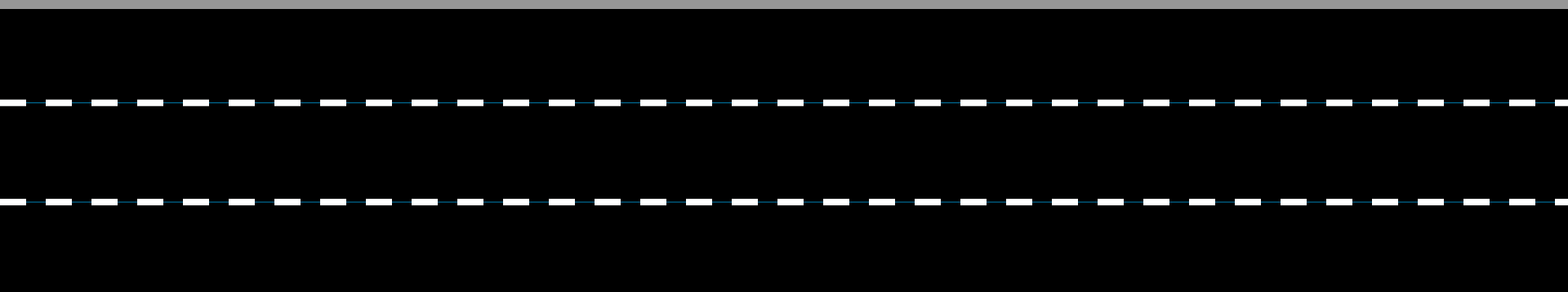


# Protocol Stack



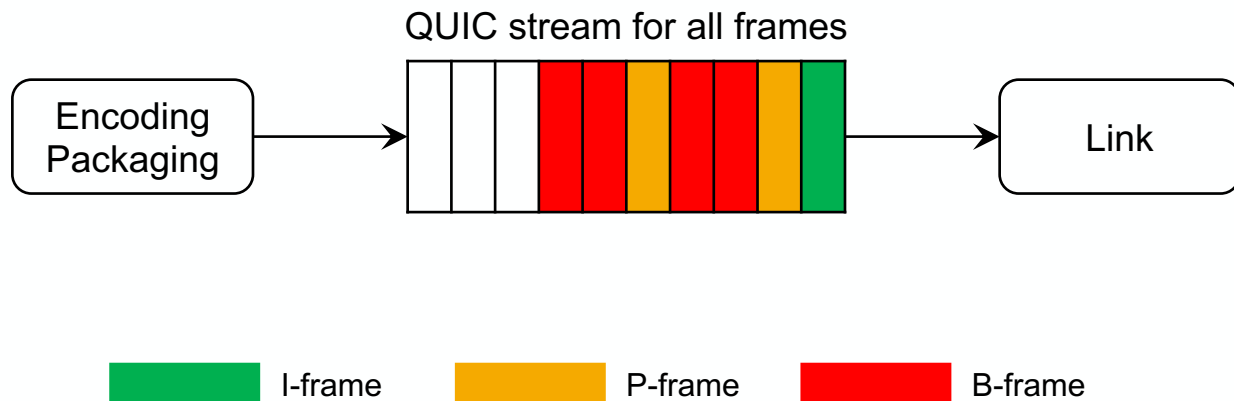
# When There Is No Congestion

(See the recording for animations)

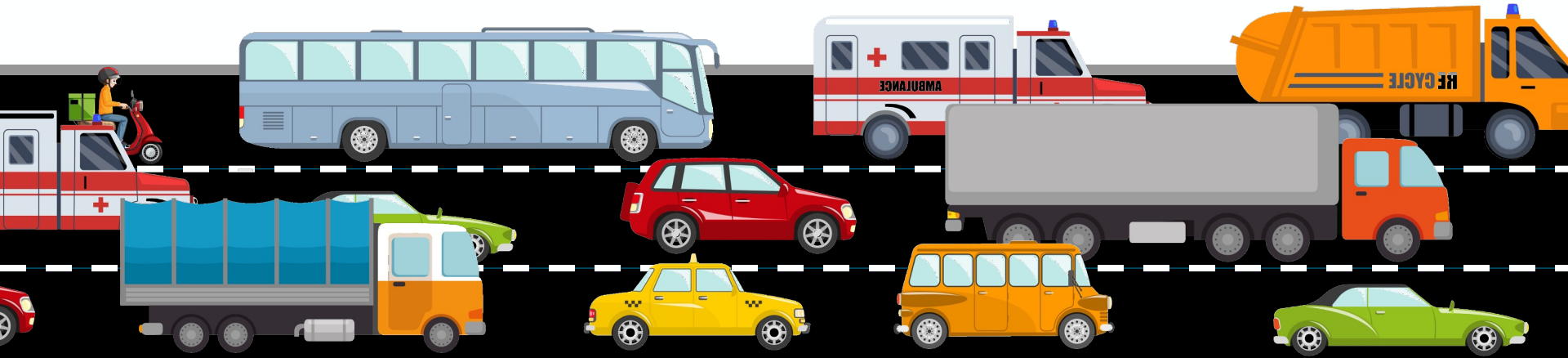


# When There Is No Congestion

*Using single-stream QUIC or TCP with implicit prioritization (first encode, first send) works just fine*



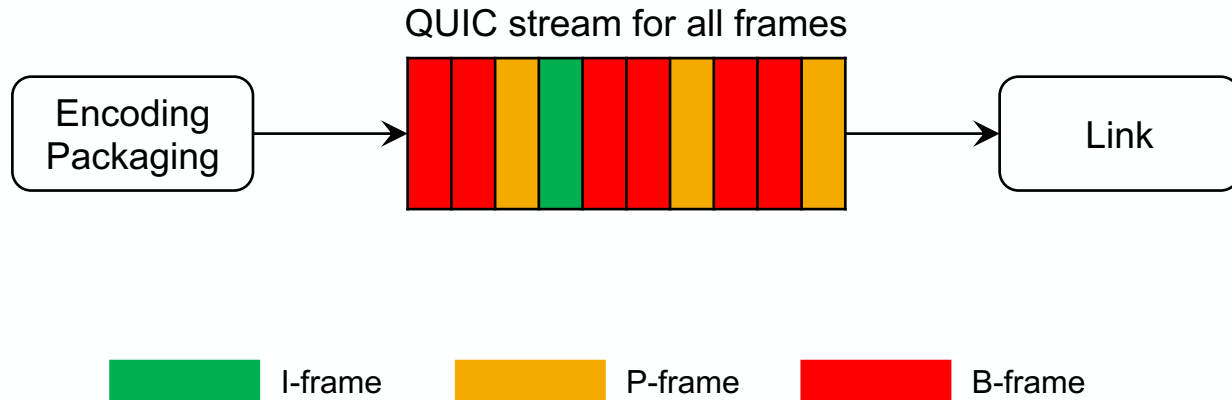
# When There Is Congestion





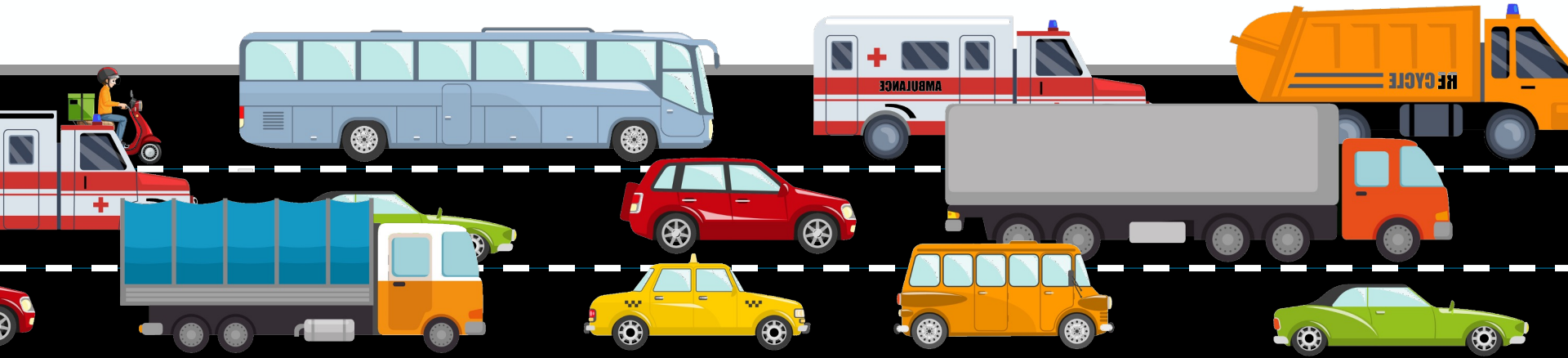
# When There Is Congestion

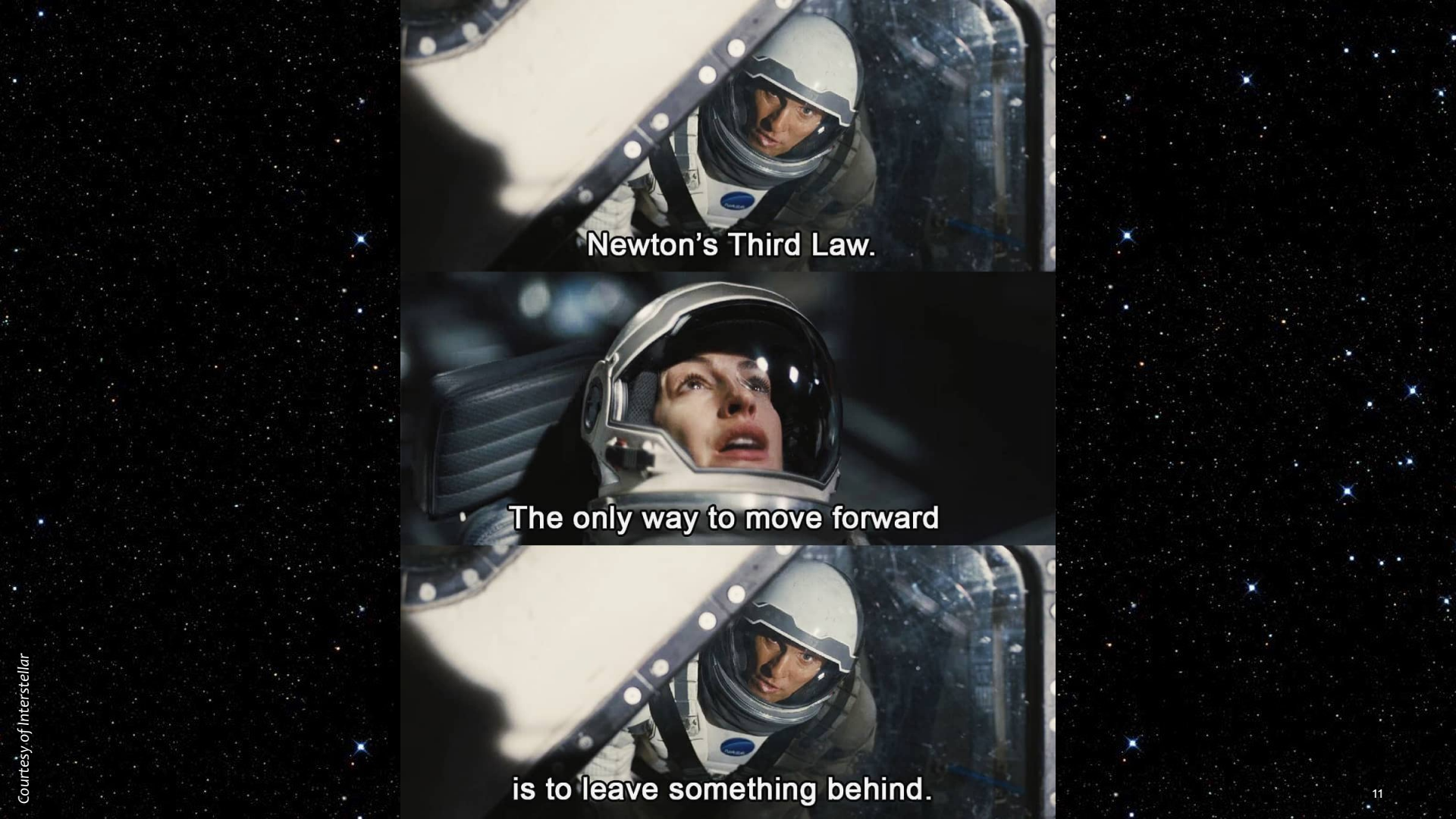
*Important stuff gets delayed (or even lost)*



# When There Is Congestion → Relieve The Congestion

(See the recording for animations)





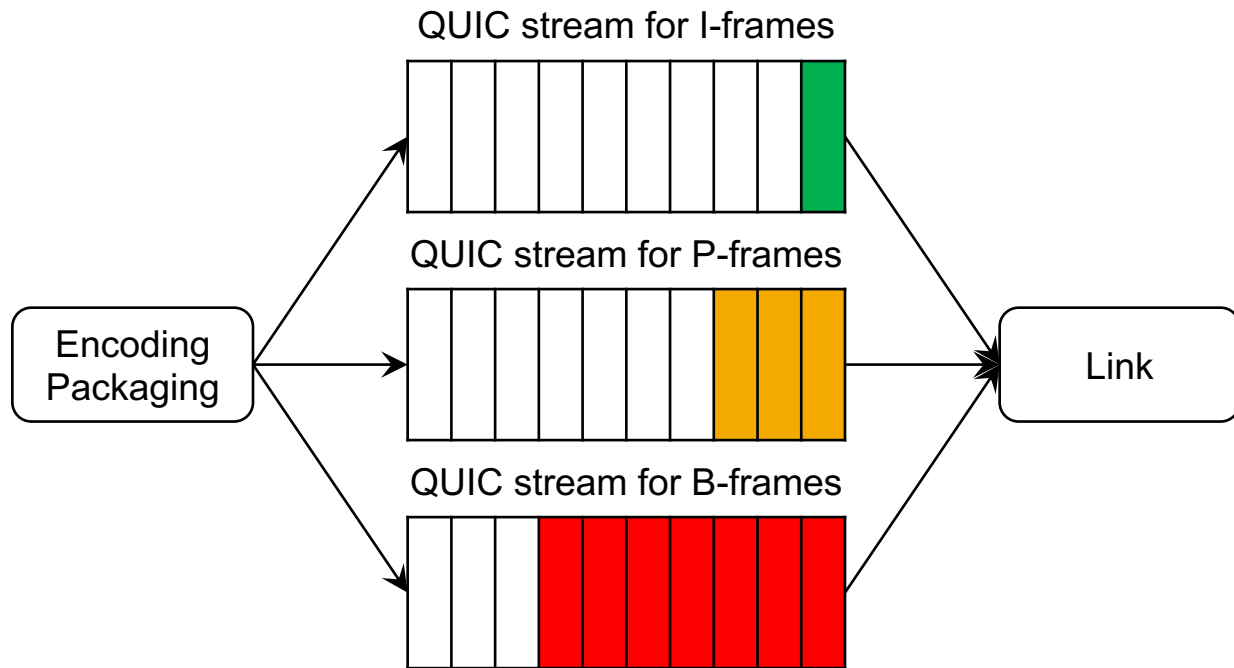
Newton's Third Law.

The only way to move forward

is to leave something behind.

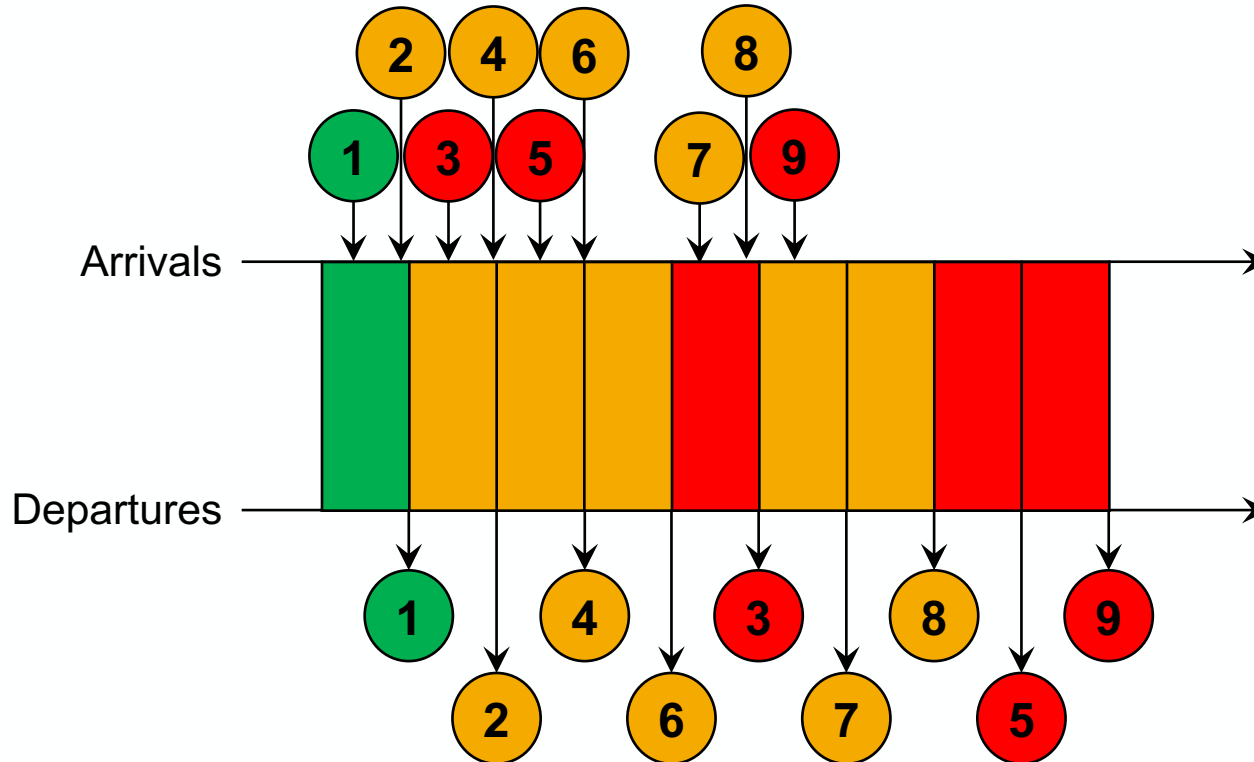
# Ali's Third Law

One way of delivering important stuff during congestion is to deprioritize (unimportant) stuff



# Ali's Third Law

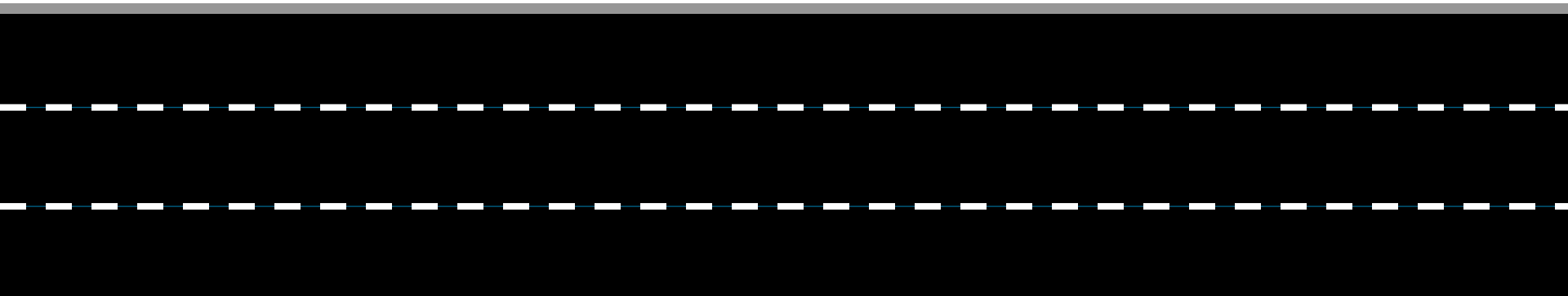
One way of delivering important stuff during congestion is to deprioritize (unimportant) stuff



# Ali's Third Law

*One way of delivering important stuff during congestion is to deprioritize (unimportant) stuff*

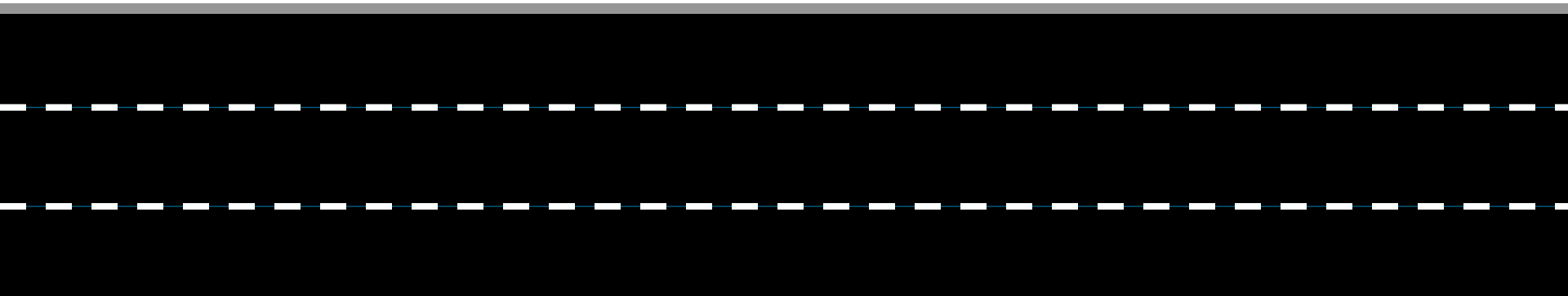
**(See the recording for animations)**



## Ali's Third Law (Alternative)

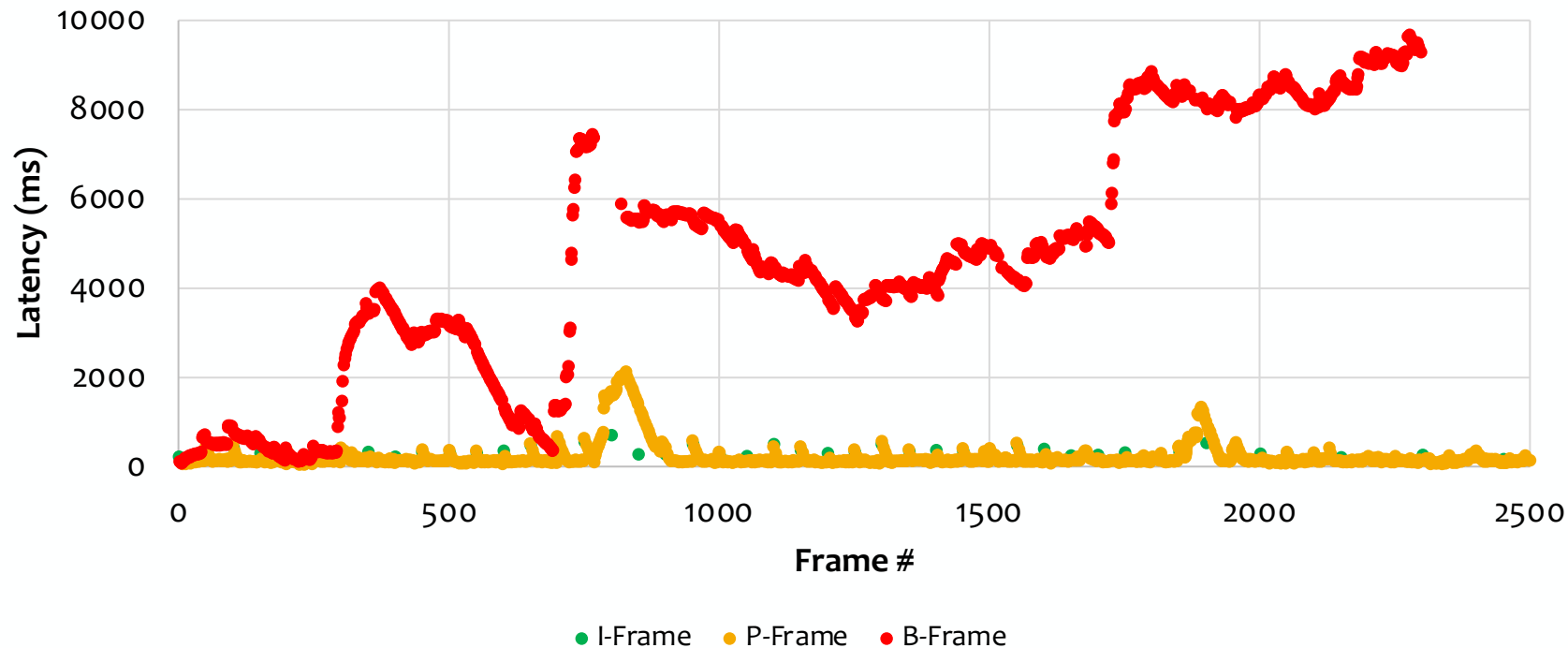
*Another way of delivering important stuff during congestion is to send less stuff*

(See the recording for animations)



# Illustration of Ali's Third Law

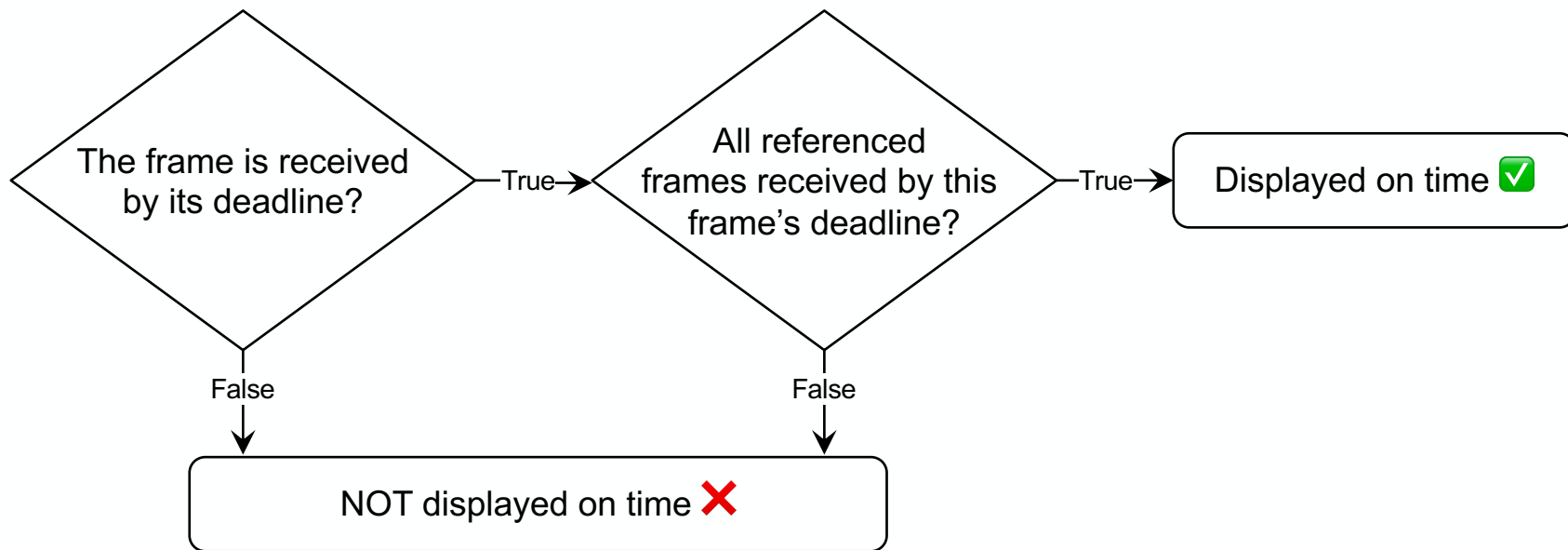
*Latency when the link is fully filled*





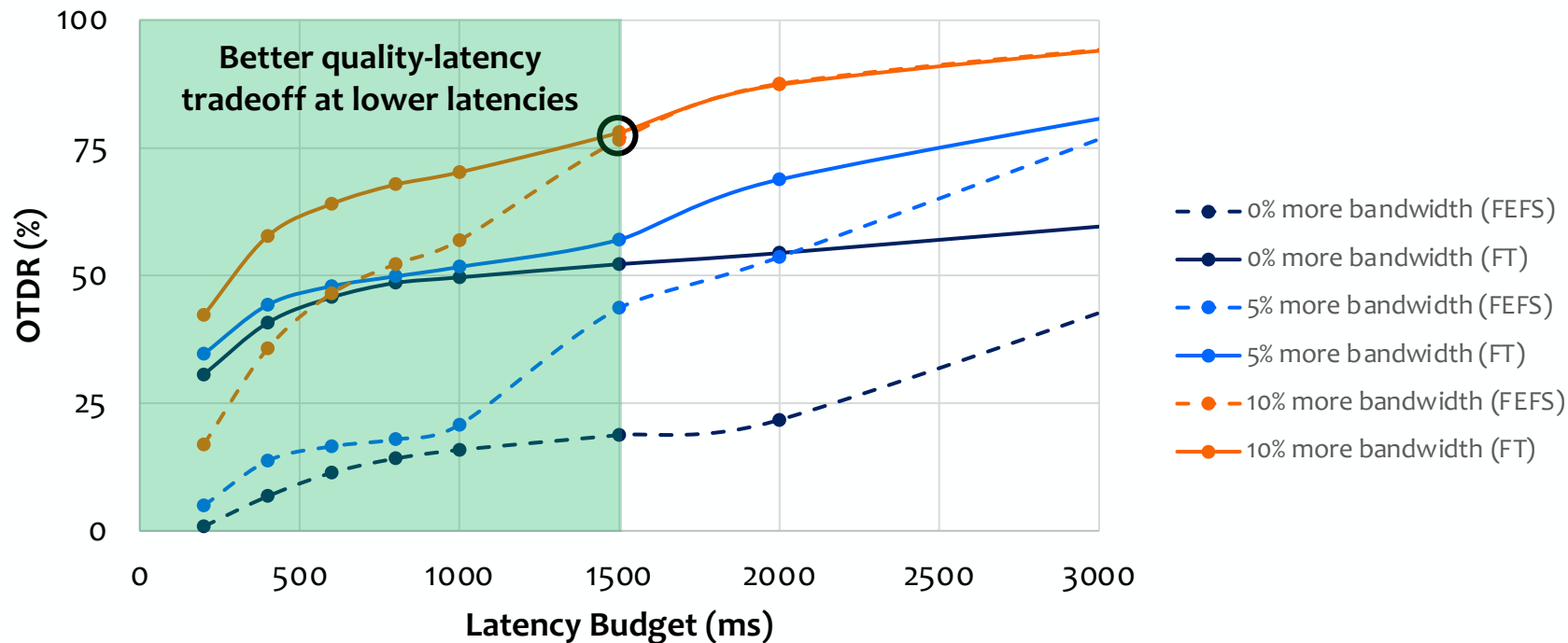
# On-Time-Display-Ratio (OTDR)

*A crude video quality metric*



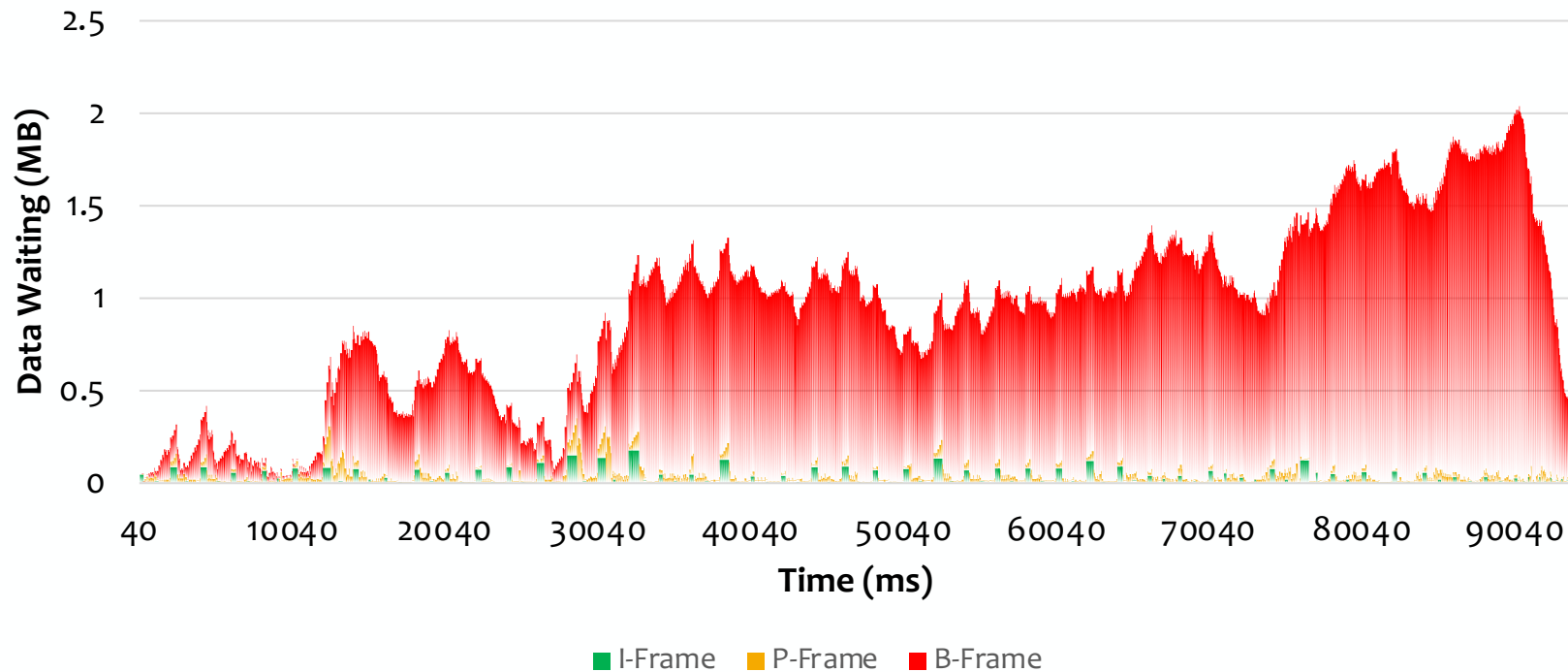
# OTDR for Various Link Bandwidths

*FEFS: first encode, first send (one QUIC stream), FT: frame type (three QUIC streams)*



# Data Waiting to Be Sent

*25 fps and two-second GoPs*



# SCIENTISTS



# DEVELOPERS

