

# Modeling of Live Video Encoding in NADA

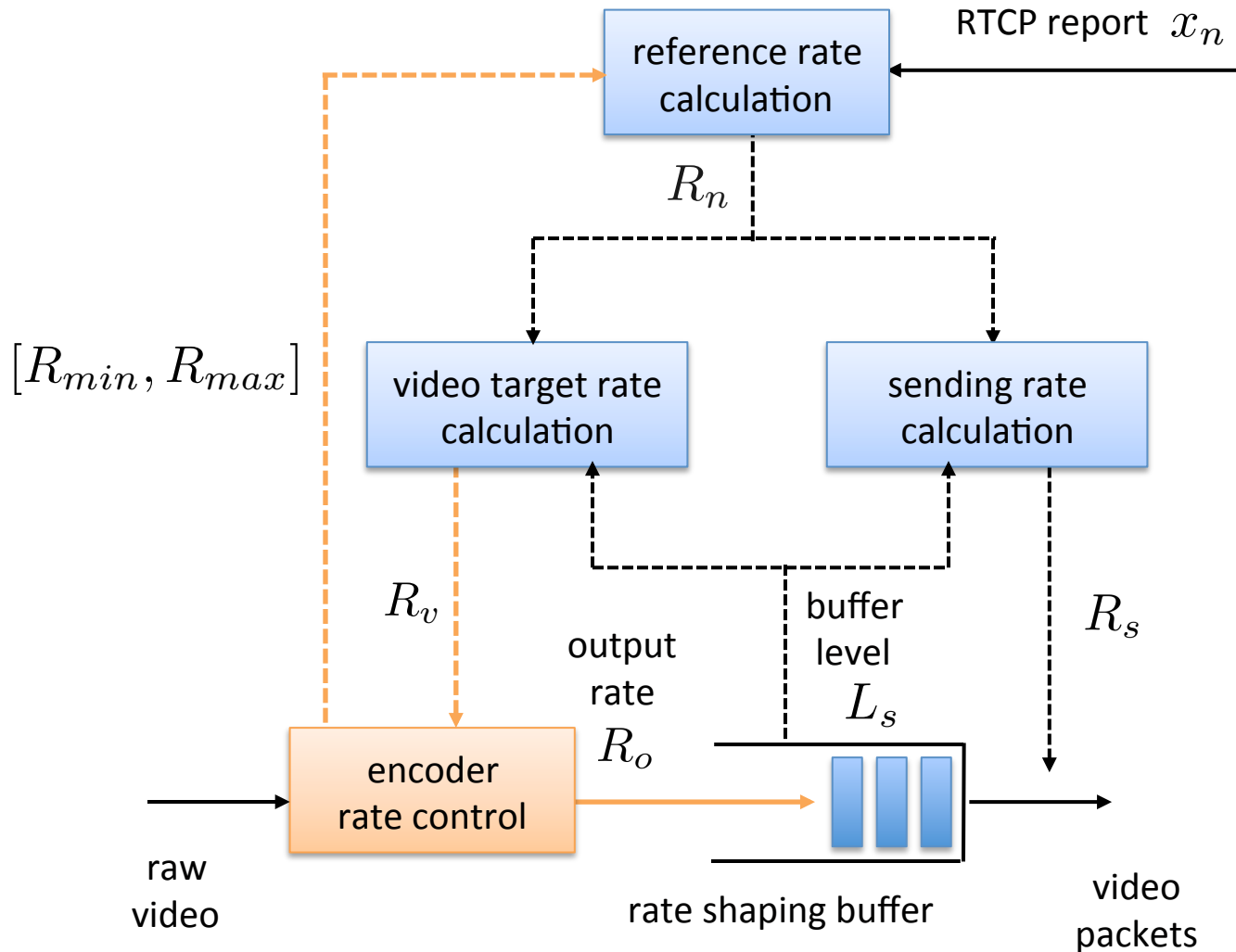
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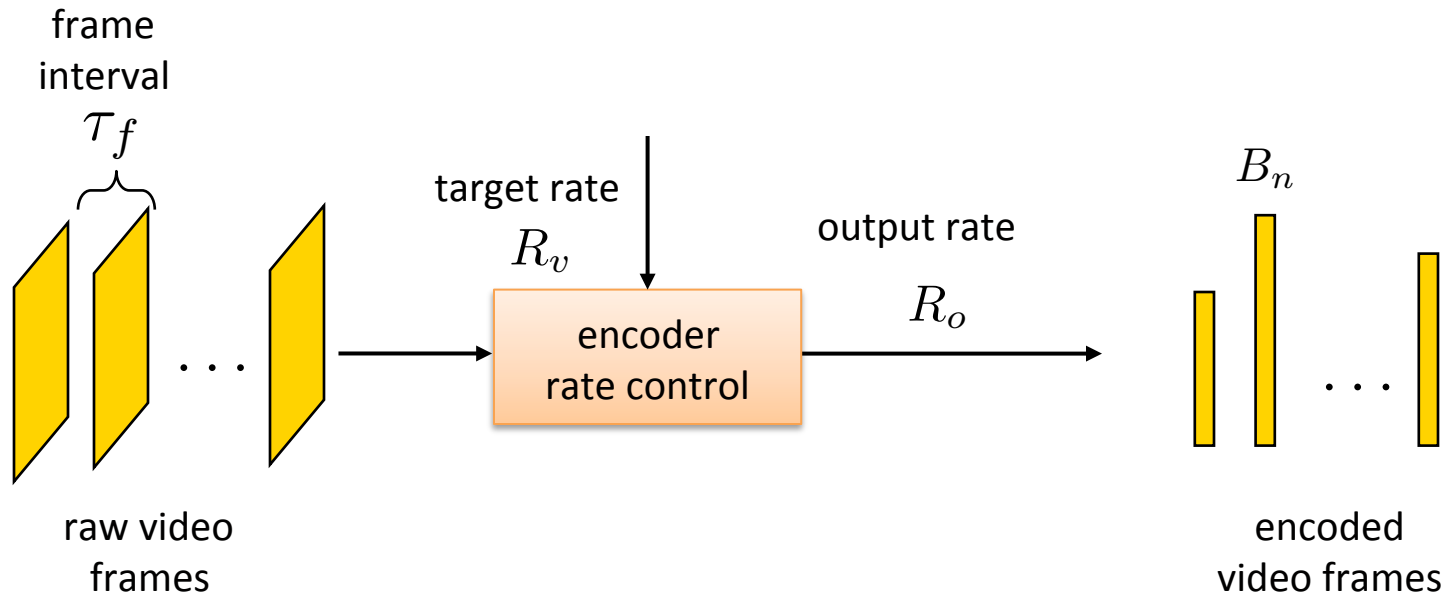
# Why This Talk, At All?

- Ongoing debate: *is it worthwhile to use a statistical video traffic model for evaluating RMCAT solutions?*
  - [Y] Hitting a sweet spot in tradeoff between complexity vs. authenticity: easier than working with a live video encoder; more meaningful than CBR;
  - [N] It is simply too hard to capture all the key characteristics of a real-world live video encoder; don't even try.
- Well, let's examine one concrete example of such a model, and:
  - Poke holes at it;
  - Decide whether this path is worth pursuing at all.

# Recap: NADA Sender Behavior

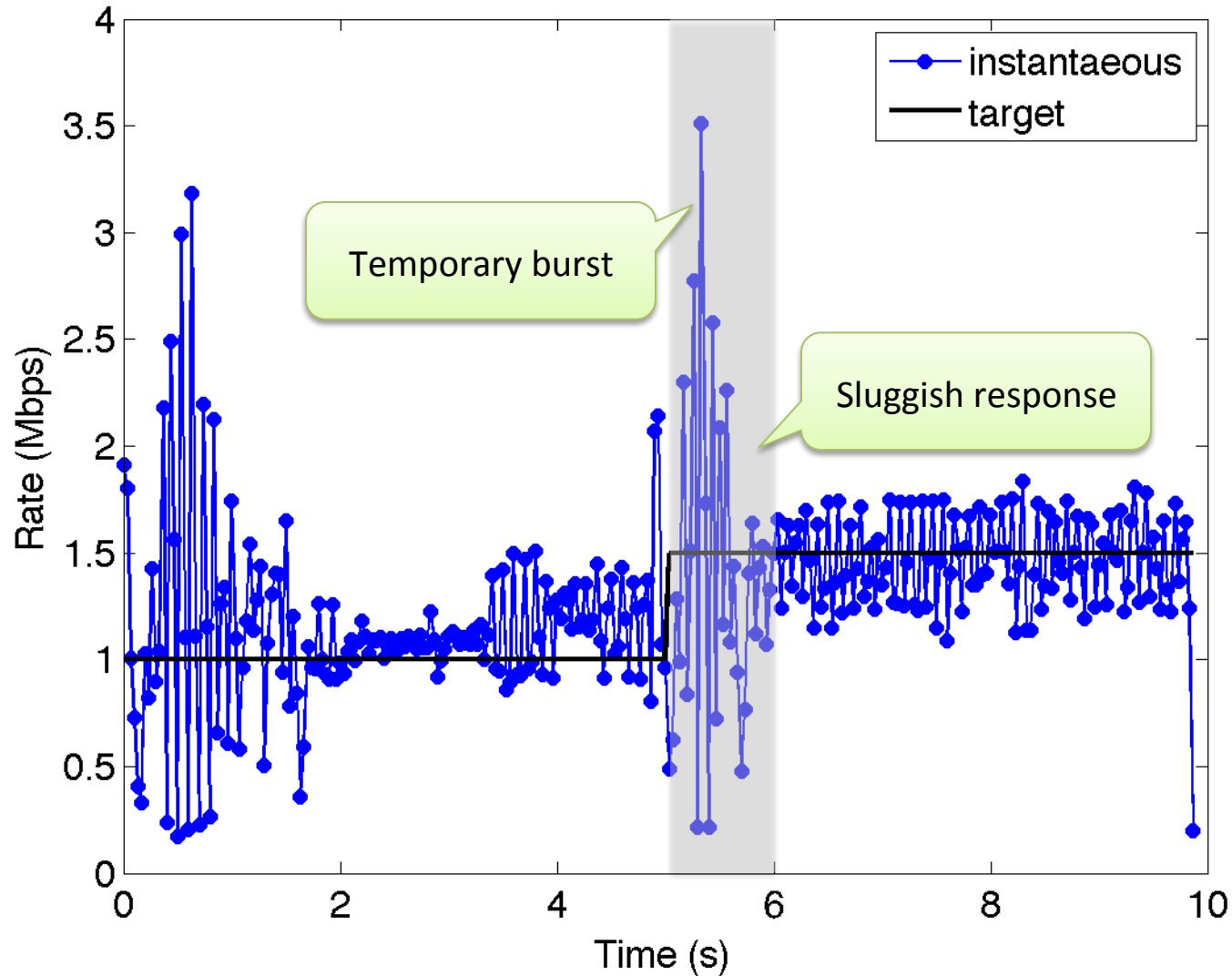


# Encoder Rate Control Modeling

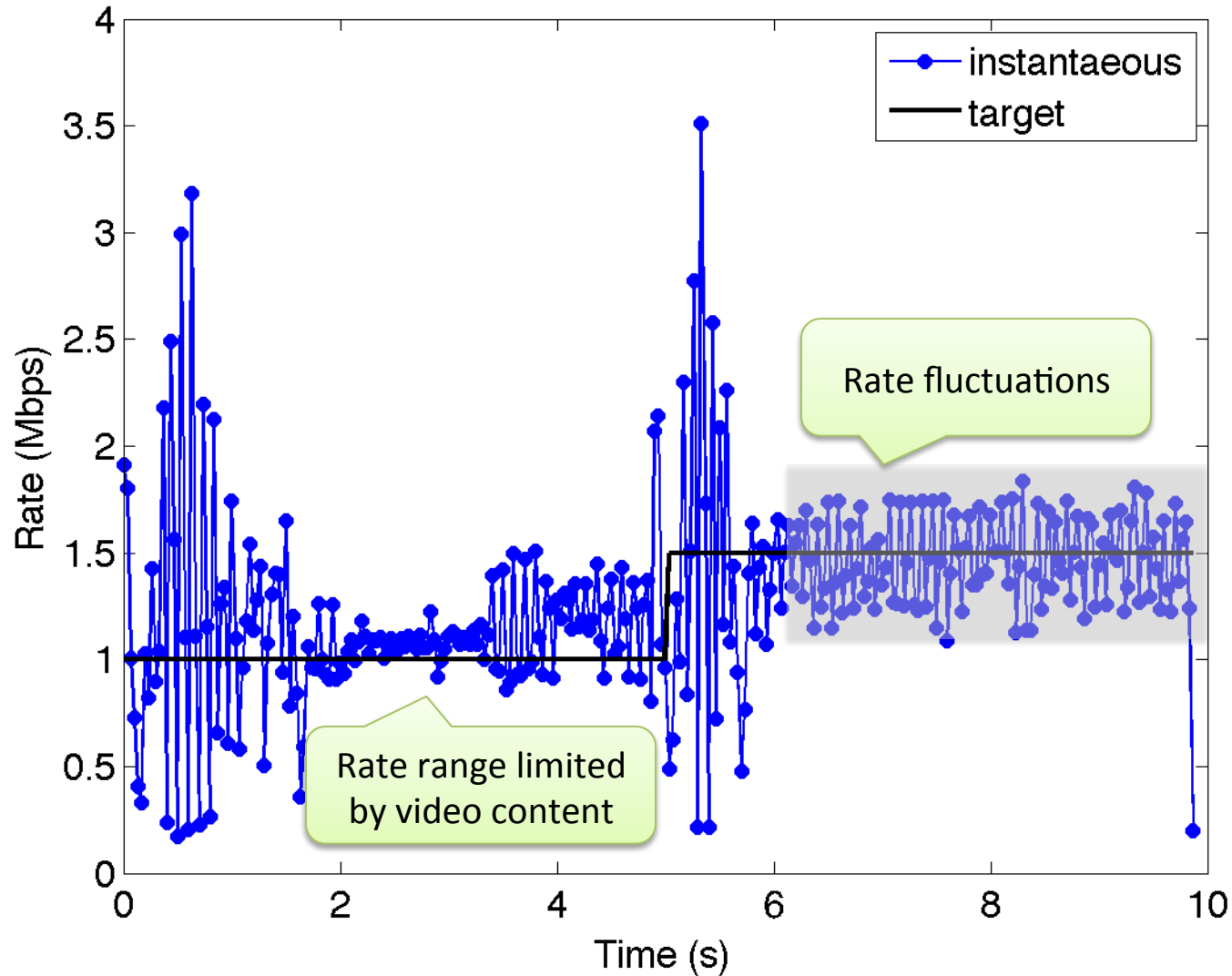


Mapping between frame size and instantaneous video rate: 
$$R_o = \frac{B_n}{\tau_f}$$

# Observations From A Live Video Encoder: Transient Behavior



# Observations From A Live Video Encoder: Steady-State Behavior



# A Statistical Model

- **Sluggish response:** encoder can react to rate update changes only once per  $\tau_v$  seconds
- **Temporary burst:**
  - Burst size  $K_r$  : ratio between burst frames size
  - Burst duration  $K_d$  : number of frames in the burst event
- **Rate variations:**
  - Uniform:  $R_o \sim \mathcal{U}(R_v - \Delta R, R_v + \Delta R)$
  - Normal:  $R_o \sim \mathcal{N}(R_v, \sigma)$
- **Limited rate range:**

$$R_o \in [R_{min}, R_{max}]$$

# Choice of Parameter Values in NADA

- **Sluggish response:**

$$\tau_v = 0.5 \text{ s}$$

- **Temporary burst:**

$$K_r = 1, K_d = 0$$

- **Rate variations:**

$$\Delta R = 0.1 R_v, \text{ or}$$

$$\sigma = 0.1 R_v$$

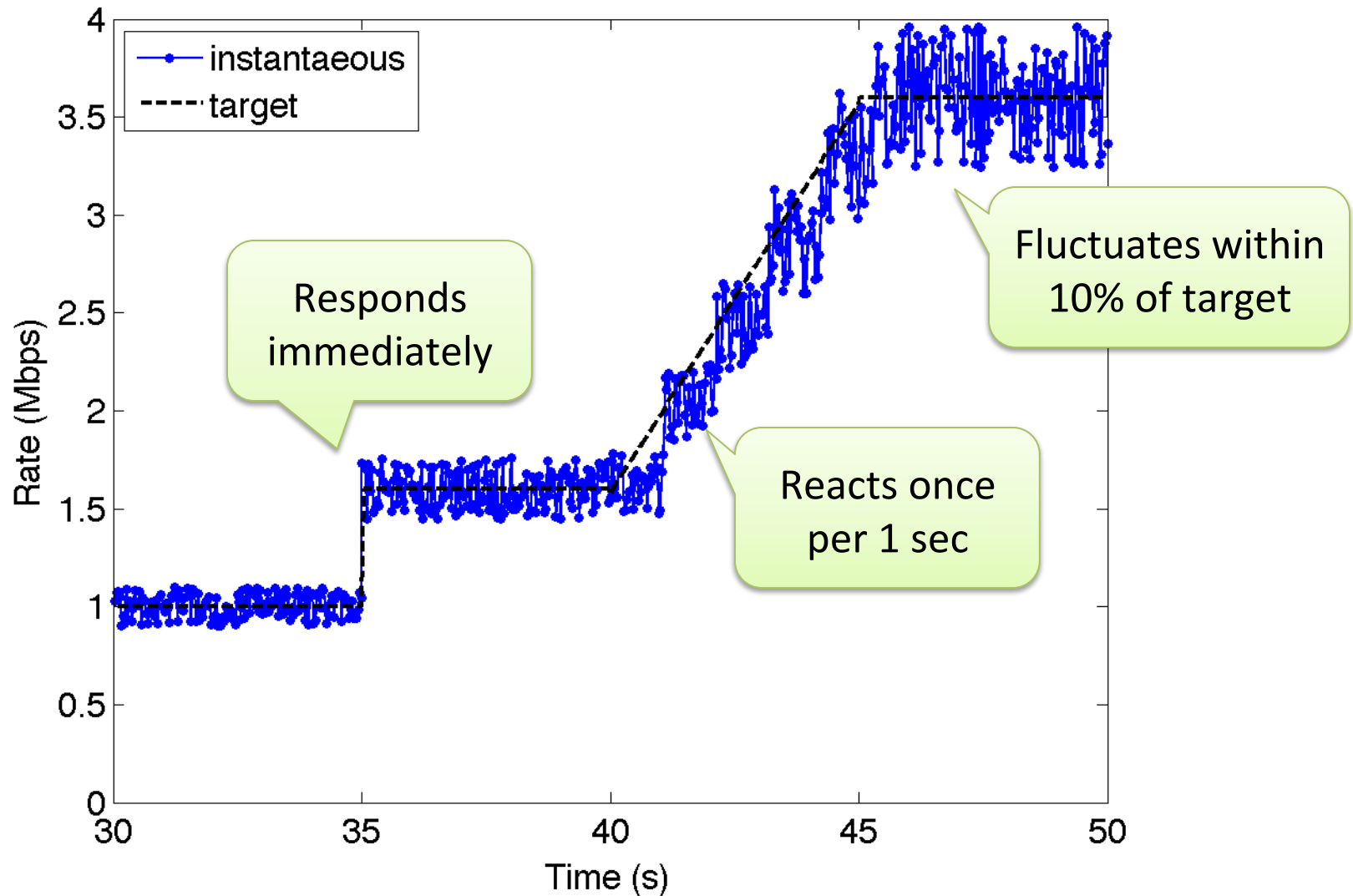
- **Limited rate range:**

$$R_{min} = 0.1 \text{ Mbps}$$

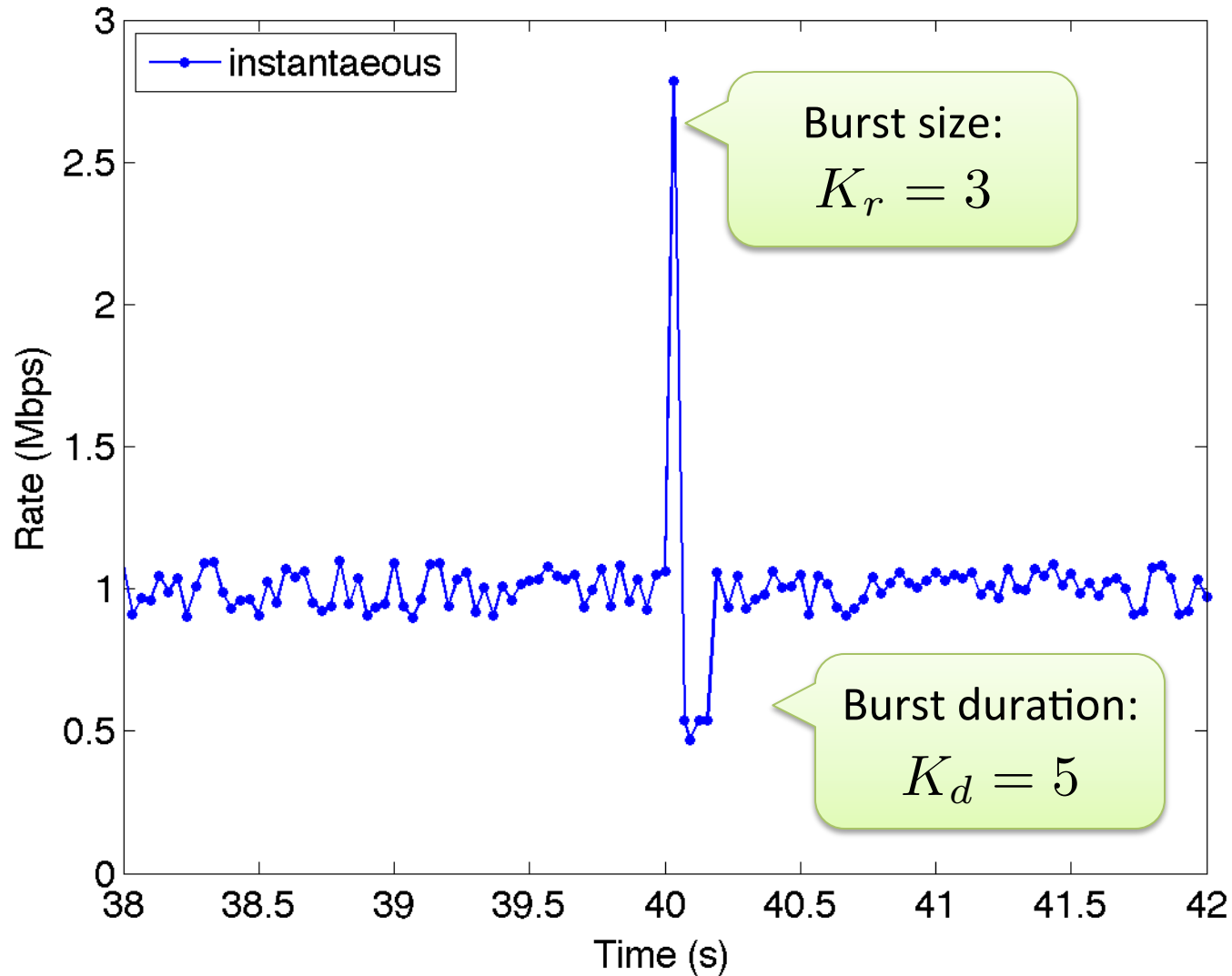
$$R_{max} = 6.0 \text{ Mbps}$$



# Encoder Modeling Results: Reaction to Continuous Rate Request Changes



# Encoder Modeling Results: Mimicking a New Burst Event



# In Summary

- A statistical model for live video encoding that captures both transient and steady-state behaviors:
  - Sluggish response
  - Temporary bursts
  - Rate fluctuations
  - Limited rate range
- Need further validation against an extensive collection of live video encoder rate traces