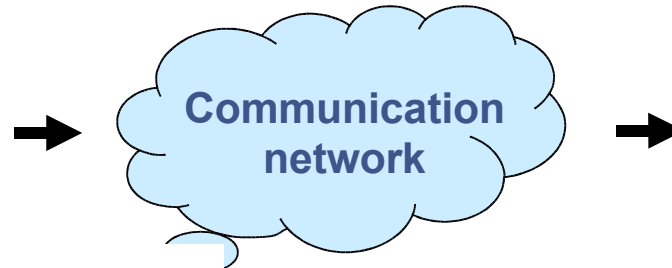# Example Real-time Video streaming

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Video stream adaptation

Stream sources

Communication network

Limited network bandwidth

Video quality degradation

Limited processing power

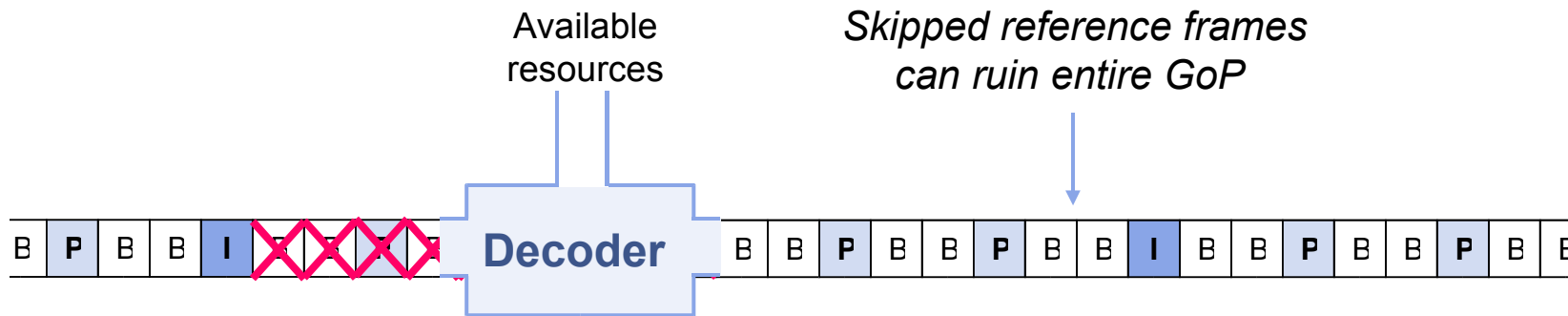**Decrease stream bitrate**

Methods

Degraded decoding algorithm

We skip frames
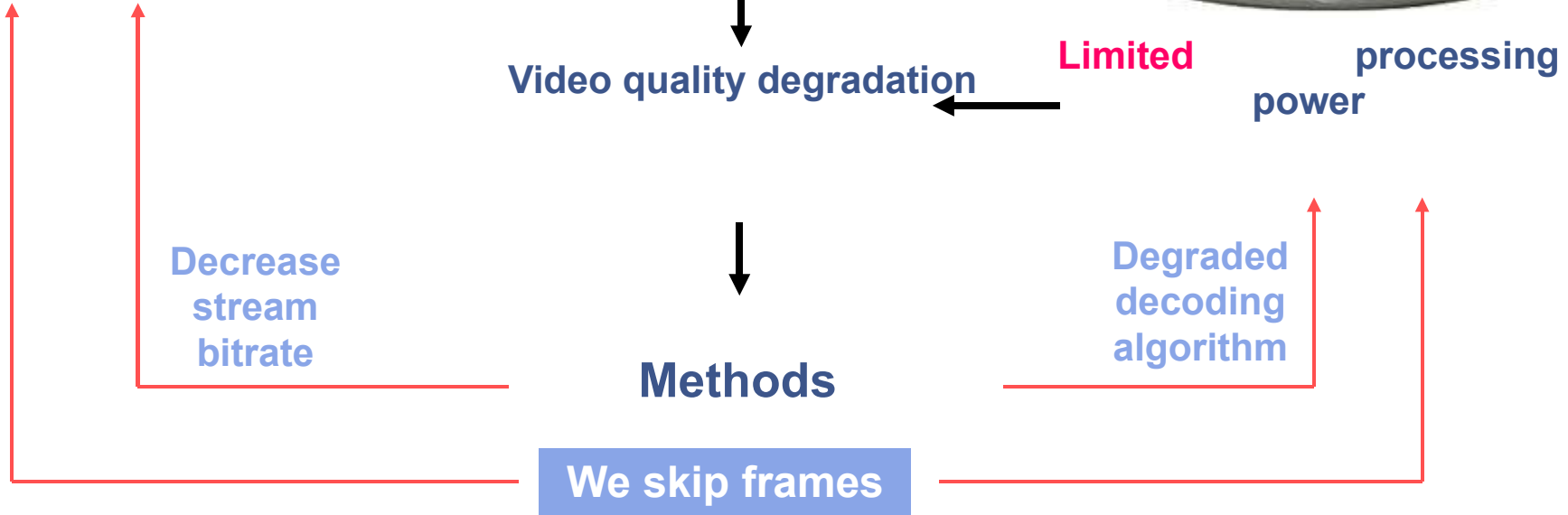
Best-effort frame skipping
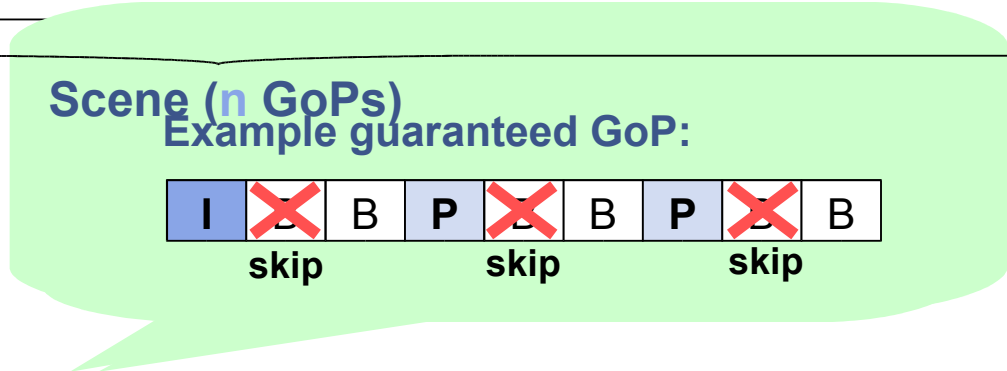
- When out of resources, random frames are skipped

Available
resources

*Skipped reference frames
can ruin entire GoP*

| B | **P** | B | B | **I** | ✗ ✗ ✗ ✗ | **Decoder** | B | B | **P** | B | B | **P** | B | B | **I** | B | B | **P** | B | B | **P** | B |

- Resources wasted on frames that cannot be decoded

Wasted

est   d

Decoding task

Deadline
miss

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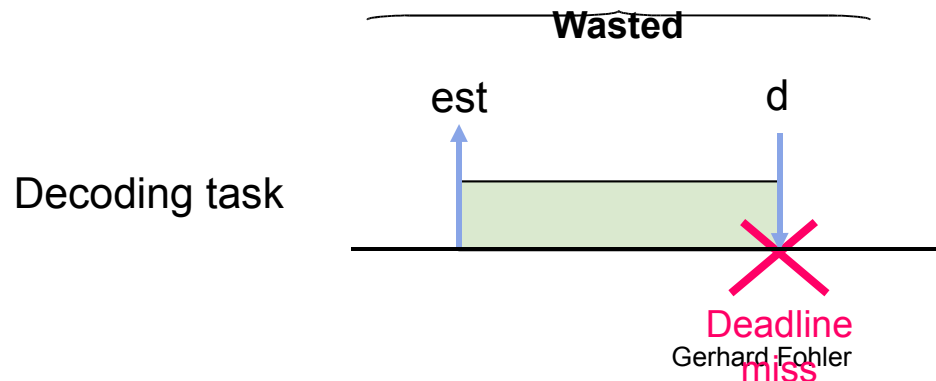
Our frame skipping approach

MPEG-2 stream in

| I | B | B | P | B | B | P | B | B | I | B | B | P | B | B | P | B | B | I | B | B | P | B | B | P | B | B | … |

GoP

↓
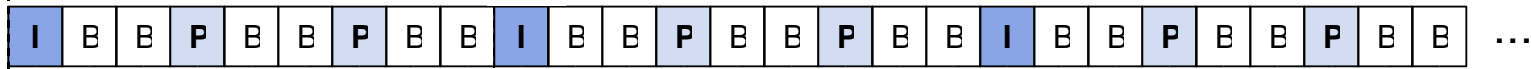
Frame **importance** assignment

↓

System load

Decoding **guarantee** algorithm

↓

RT scheduling

Tasks ☐ ☐ **Dec.** task …

Scene (n GoPs)

Example guaranteed GoP:

| I | ✗ | B | P | ✗ | B | P | ✗ | B |

skip   skip   skip

Adjusted stream out

| I | B | P | | P | B | I | B | P | | P | … |

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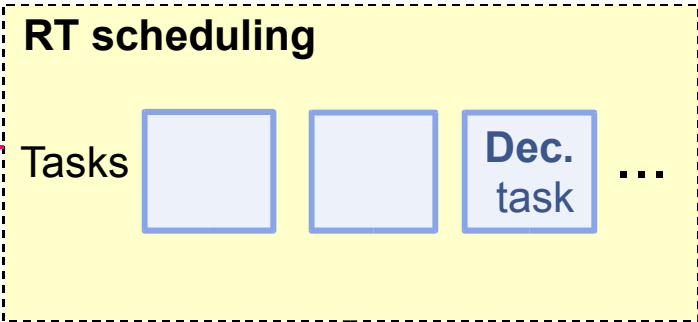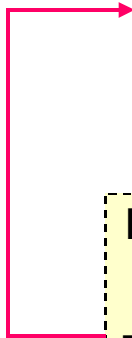
Decoding guarantee algorithm

- Decides how many frames can be timely decoded

- Input
  - GoP
  - Frame priorities
  - Available resources

- Output
  - Tailored GoPs (guaranteed to be decoded in time)

- Simple case
  - Uniform resource distribution

- Complex case
 - **Arbitrary** resource distribution

Available resources

(no other execution)

Available resources

(decoder preeempted by other tasks)

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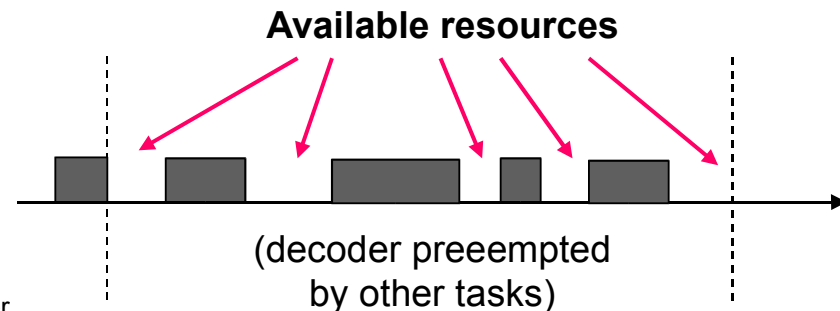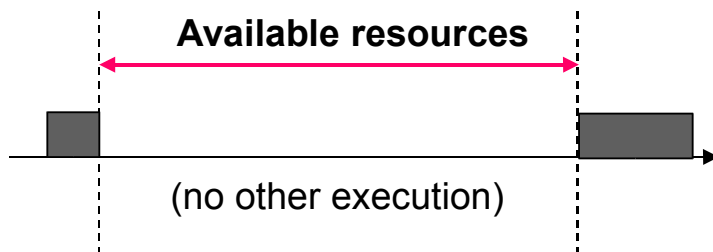
Simulation analysis

- We compared our method to a best-effort algorithm
  - Useful resource consumption
  - Total decoded frame

- Assumptions
  - Randomly distributed load
  - Both exact and estimated decoding execution times

- Real-time scheduling: "slot shifting" method
  - Table-driven scheduling with **offline** scheduled tasks → more challenging
  - Very suitable for **fast online access** of available system resources
  - Other methods can be used

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Simulation analysis
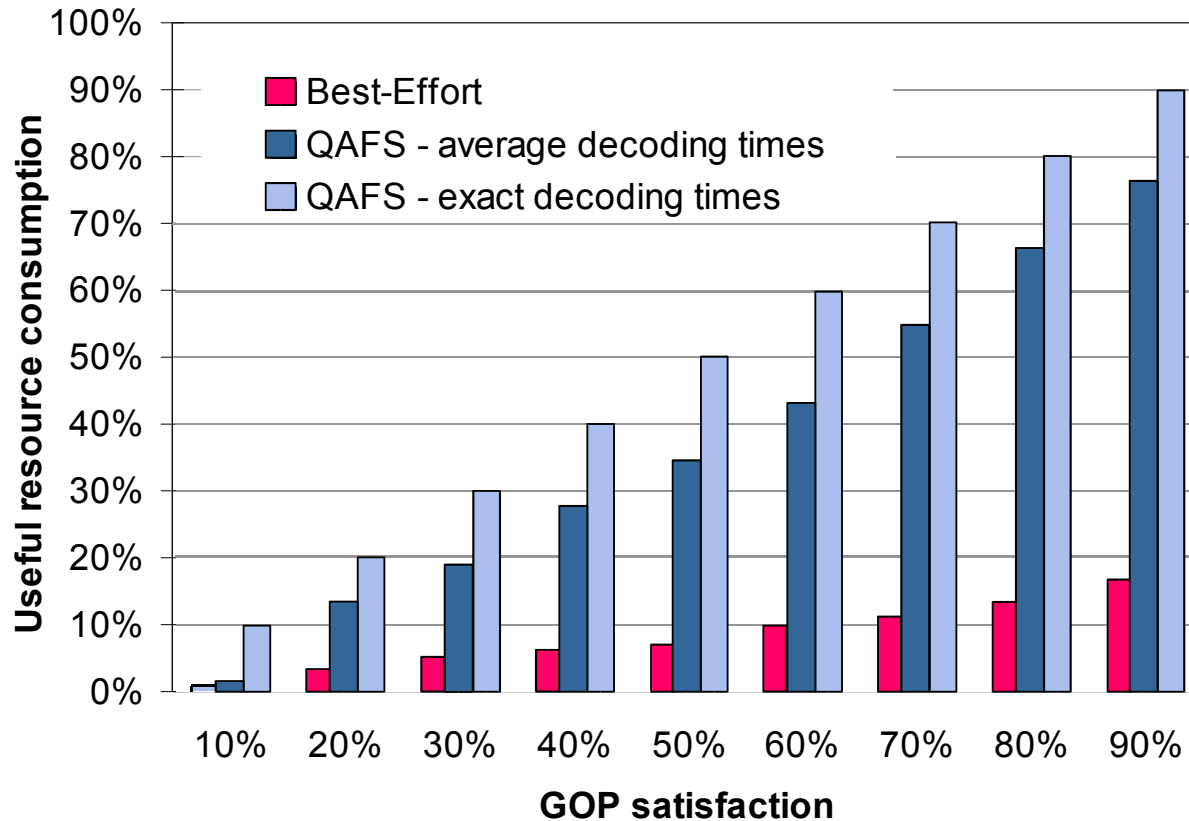
Useful resource consumption = time spent on decoding frames that **contribute** to the overall picture quality

GoP satisfaction = $\dfrac{\text{resources } \textbf{offered} \text{ to a GoP}}{\text{resources } \textbf{needed} \text{ by the GoP}}$

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