

Asynchronous Video for Wireless Transport

Allen Y. Lao

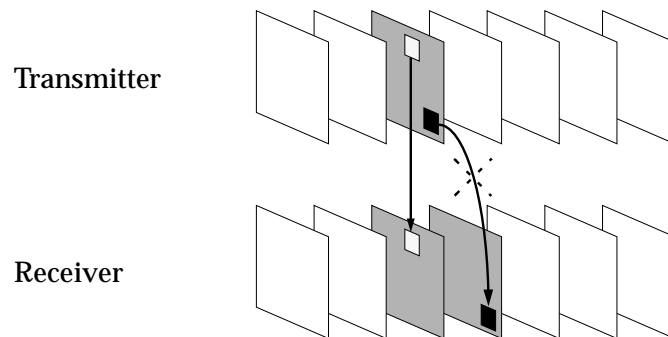
Ptolemy Miniconference

Department of Electrical Engineering and Computer Sciences
University of California at Berkeley

Motivation

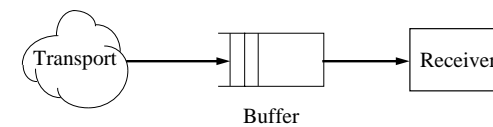
- **Network environment**
 - Wireless access the likely bottleneck
- **Video applications on wireless channel**
 - Serious drawbacks to synchronous, frame-by-frame processing of video
 - Advantages to be obtained by allowing delay jitter in transport?
- **Proposed solution: *asynchronous* video coding**

Traditional Video Processing



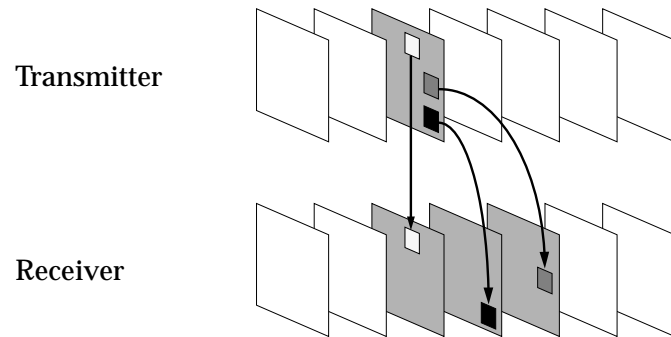
- Synchronous, frame-by-frame procedure
- Stringent delay jitter requirement

How About Buffering at Receiver?



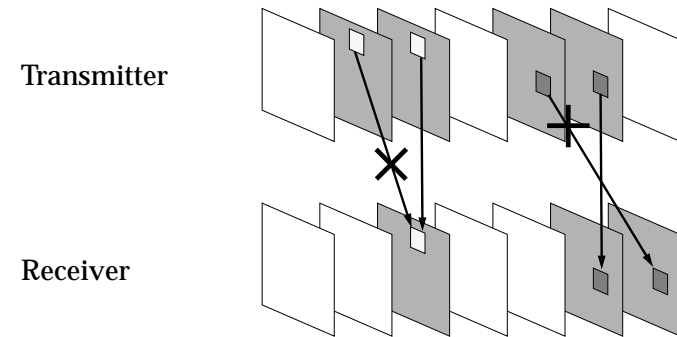
- Can smooth out delay variations at receiver
- But unsuitable for applications with low delay requirement
 - e.g., videoconferencing

Asynchronous Video (ASV)



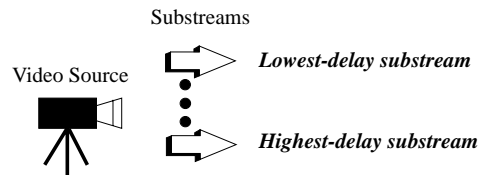
- Wide range of delay requirements permitted
- Delay jitter of multiple frame intervals possible
- Reference: [ReLa94]

How Does Receiver Process Video Asynchronously?



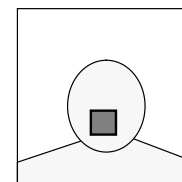
- Use frame number as means of ordering information
- Use most current data available for each region
- Throw away out-of-date or “stale” information

Substream Abstraction

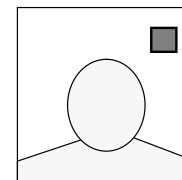


- Application traffic *logically* partitioned among set of substreams
- Quality-of-service (QOS) provisioned for each substream
- Goal: maximize traffic capacity by relaxing delay requirement on certain substreams, maintaining good subjective quality

Mapping Image Areas to Substream by Motion Content

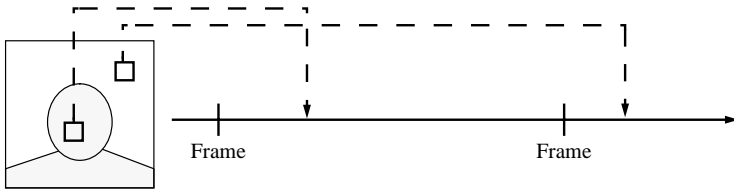


High-motion areas
Low-delay substreams



Low-motion areas
High-delay substreams

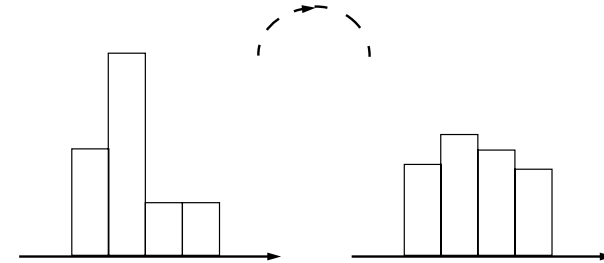
Contrast: Asynchronous vs. Synchronous



Asynchronous: Perceptual delay of application determined by lowest-delay substream

Synchronous: Constrained by highest-delay information

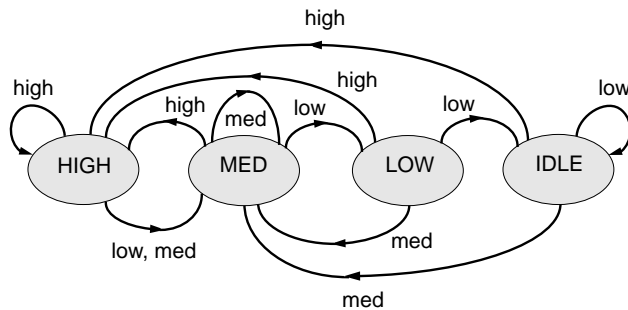
Relaxed Delay Requirements \Rightarrow Traffic Capacity Gain



Smoothing of traffic by network nodes

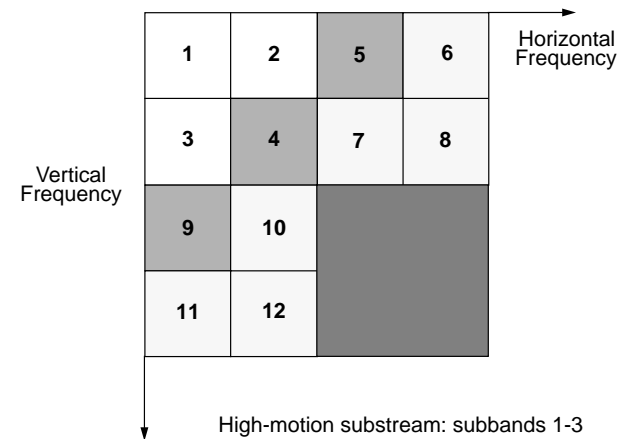
- selective transmission and delaying of information
- more efficient resource utilization

Substream Coder



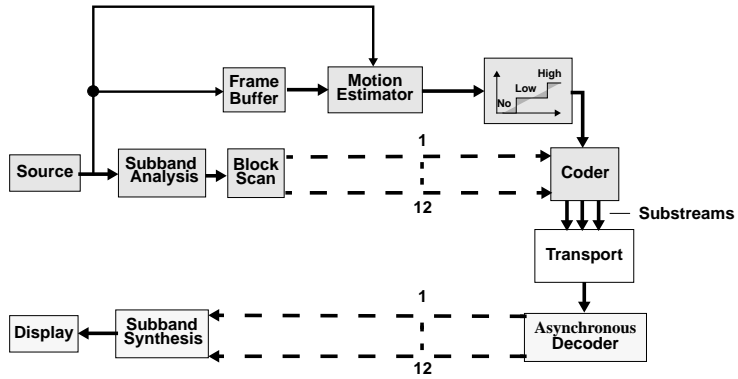
- states labeled according to motion level associated with substream
- arcs labeled according to estimated amount of motion

Mapping of Substreams to Subbands



- High-motion substream: subbands 1-3
- Medium-motion substream: subbands 1-5, 9
- Low-motion substream: subbands 1-12

ASV Codec Implementation with Subband Filtering



Simulation with Ptolemy

- **Speed?**
 - Sparc 20 (55 MHz)
 - Frame size: 320 x 240
 - Approximately one frame output per minute
- **Domains?**
 - Subband analysis/synthesis in SDF
 - Top-level network in DE