Networking / Video Conferencing

Admin

- PA2
  - Write-up due now
- HW 5
  - Due now
- HW 6
  - Will be assigned Wed.
  - Due Wed. 12/2/2015

Video Conferencing

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Video Bit Rate Scaling

Temporal scaling - simply reduce frame rate

- Easy to do @ encoding
- Harder to do in network or other layer

I P P P P P I P P P P . . .

Interactive streaming usually has no B-frame

Best to drop => no thing depends on it

This one you would like to be next but: m.v. get screwed up

drift errors => m.v. that are reconstructed but off a little

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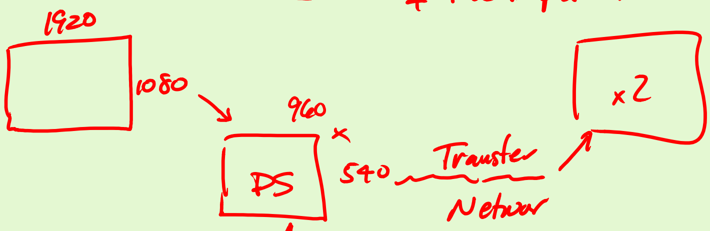
Video Bit Rate Scaling

Spatial scaling - reducing the number of pixels

Cut resolution in $\frac{1}{2}$ → $\frac{1}{4}$ the # pixels!



You would expect to be $\frac{1}{4}$ the bit rate

In practice DS needs higher lower Quantization quality

to make up details in image

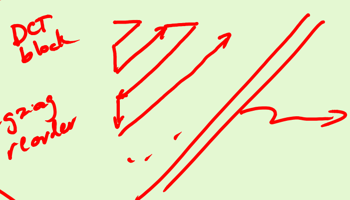
Shoot for $\frac{1}{2}$ bit rate.

Video Bit Rate Scaling

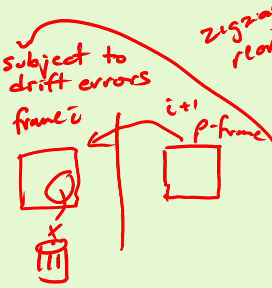
Freq scaling - reduce DCT coefficients

•) Traditionally accomplished by increasing quantization factor

•) Limit the number of coefficients



Throw away rest



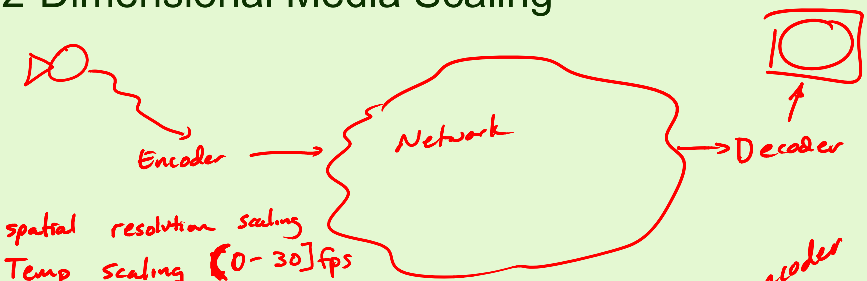
Useful in layered encodings

Enhancement layer coeff 32-63

Drop these first

High priority base layer Coeff 0-31

2-Dimensional Media Scaling



spatial resolution scaling

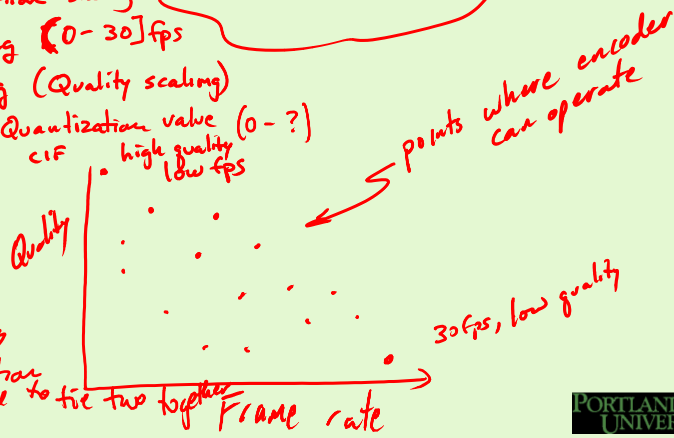
Temp scaling [0 - 30] fps

Freq. scaling (Quality scaling)

Quantization value (0 - ?)

Higher motion video favor fps

lower motion video favor quality



During adaptation still need to tie two together

~~Video Bit Rate Scaling~~

2D Scaling

For videos operating points Q1, Q2, Q3, Q4 (Q1 = highest, Q4 = lowest)

fps 5, 10, 15, 24, 30 fps

Highest quality = 30fps, Q1

30fps, Q2

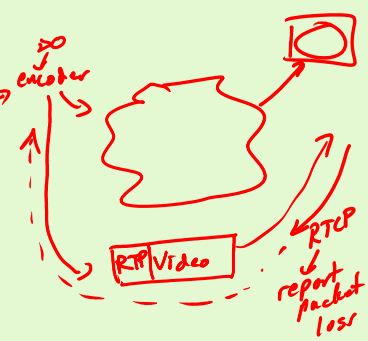
24fps, Q2

15fps, Q2

15 fps, Q3

⋮

Lowest quality 5fps, Q4



Live Video over Best Effort

Principles/characteristics of best-effort networking

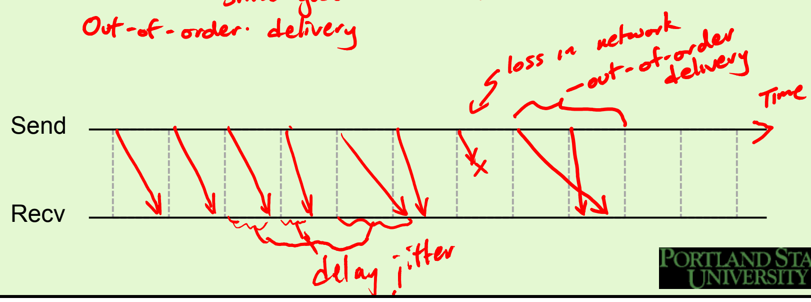
Ideal: no delay jitter, no packet loss

Delay jitter is variation in end-to-end delay

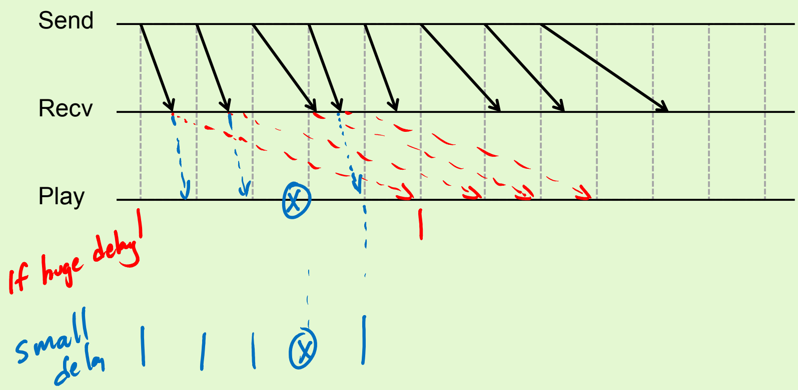
loss in network due to congestion

- show goes on
- manage through FEC - forward error correction
- Retransmit (increases delay)
- show goes on but conceal loss

Out-of-order delivery

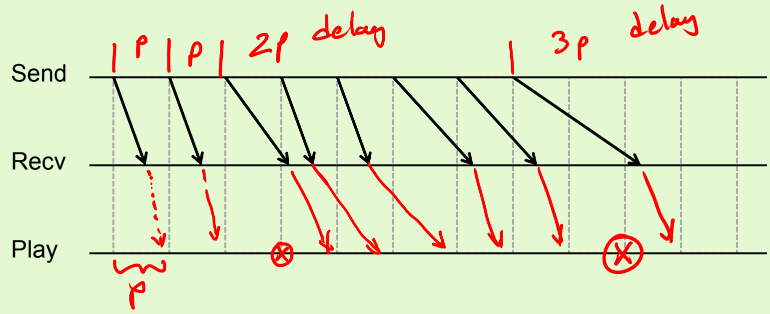


Taking Care of Delay Jitter



Fundamental Initial Playout Strategies

Let naturally occuring network delay determine playout latency



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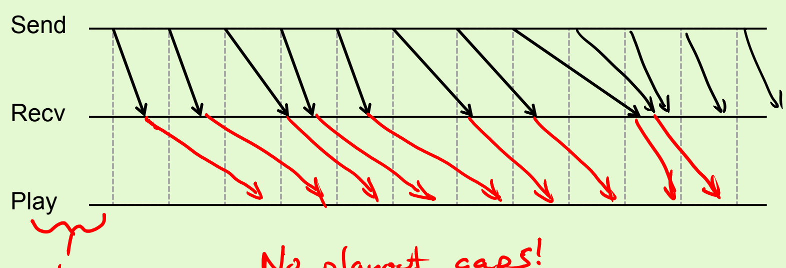
Fundamental Initial Playout Strategies

Avoid initial sequence of playout gaps by estimating network delay and setting it accordingly



active probing

est. 3P delay

No playout gaps!

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Estimating Network Delay

Send a packet with a timestamp

Enqueued @ other side timestamp + d

delay

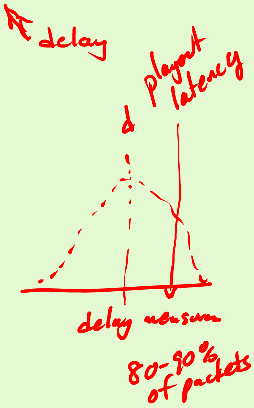
Basic algorithm

playout latency = $d + k * v$

d = estimated average delay

v = estimated variation in delay

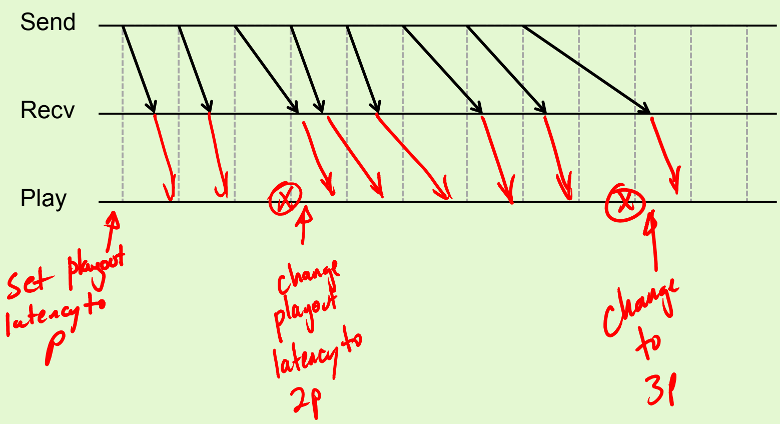
k = congestion estimator



Fundamental Late Arrival Strategies

Play media as they arrive

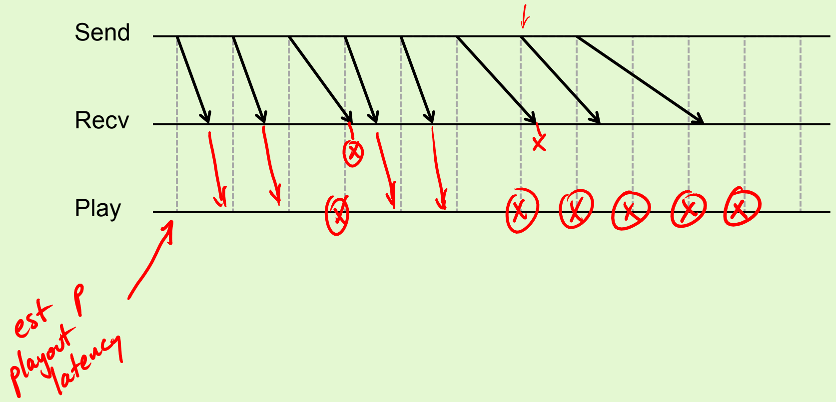
Essentially change playout latency



Fundamental Late Arrival Strategies

Discard "late" samples

Keep playout latency the same



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Fundamental Tension

Large delay = continuous playback

poorer interactivity

Small delay = gaps in playback

better interactivity

Carefully balance both

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Queue Monitoring

Rather than compute network delay, infer it
from length of display queue

growing display queue – network delay is decreasing

shrinking display queue – network delay is increasing

constant = stable over time

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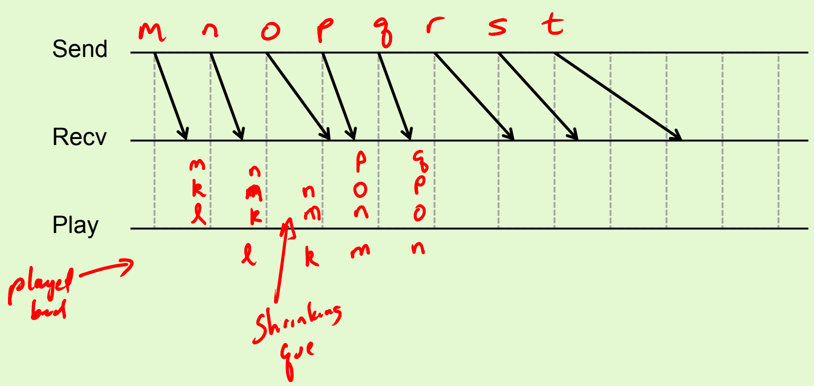
Queue Monitoring

SWITCH

Example



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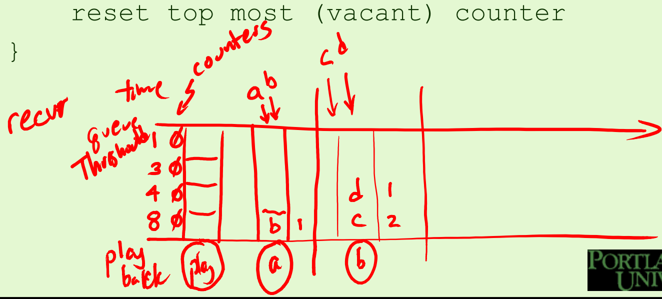
Queue Monitoring Algorithm Pseudo-code

```
1.   Set counters for all levels = 0;
2.   while (1){
3.     Move oldest data to playback;
4.     Enqueue all arriving samples in period
5.     Increment all counters for levels with data
6.     Reset all counters for levels w/ no data
7.     If any counter >= to its threshold
8.         drop the oldest sample in queue
9.         reset top most (vacant) counter
10.    }
```



Handout