画像情報特論 (1)
Advanced Image Information (1)

はじめに
Class Overview

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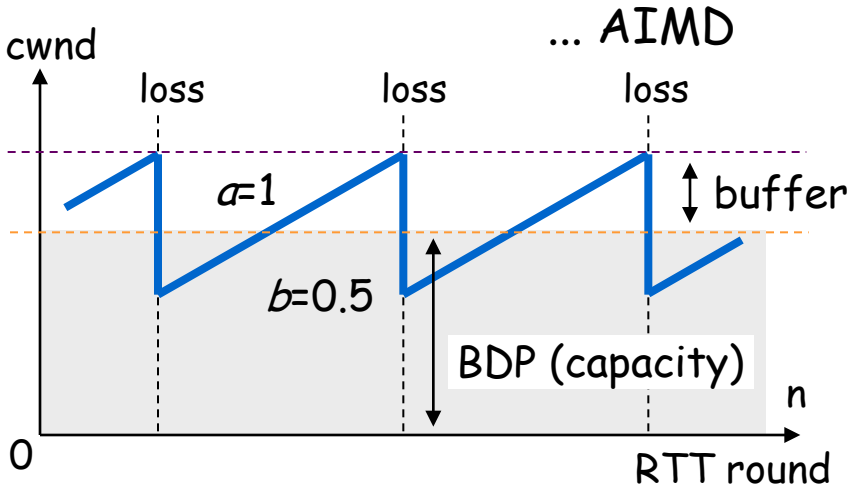
This Year's Schedule

(tentative)

4/06	Class overview
4/13	Video Streaming (1) TCP/IP
4/20	Self-study on CourseN@vi
4/27	Video Streaming (2) TFRC
5/11	Self-study on CourseN@vi
5/18	Video Streaming (3) Wireless & Sensor
5/25	Video Streaming (4) CDN, P2P, Cloud
6/01	H.264/AVC
6/08	H.265/HEVC
6/15	Super-Resolution
6/22	Feature Extraction
6/29	Sparse Coding
7/06	Marker-less AR
7/13	3D Image Processing
	"3D Image Conference" will be held on 7/12-13 in this campus
TBD	Final report

Video streaming (1) TCP/IP

- Loss-driven

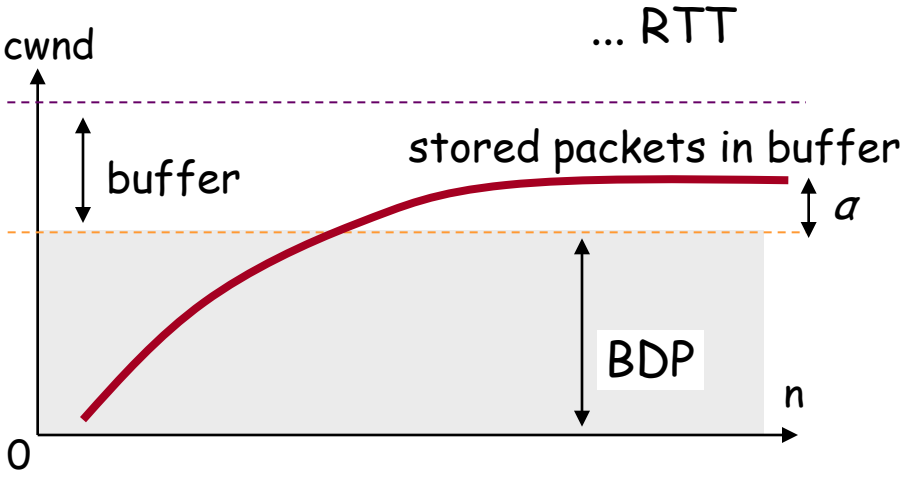


TCP-Reno, High-Speed TCP,
TCP-Westwood, CUBIC-TCP, ...

BDP/Buffer relationship

small buffer → × efficiency
large buffer → × delay

- Delay-driven



TCP-Vegas, FAST-TCP

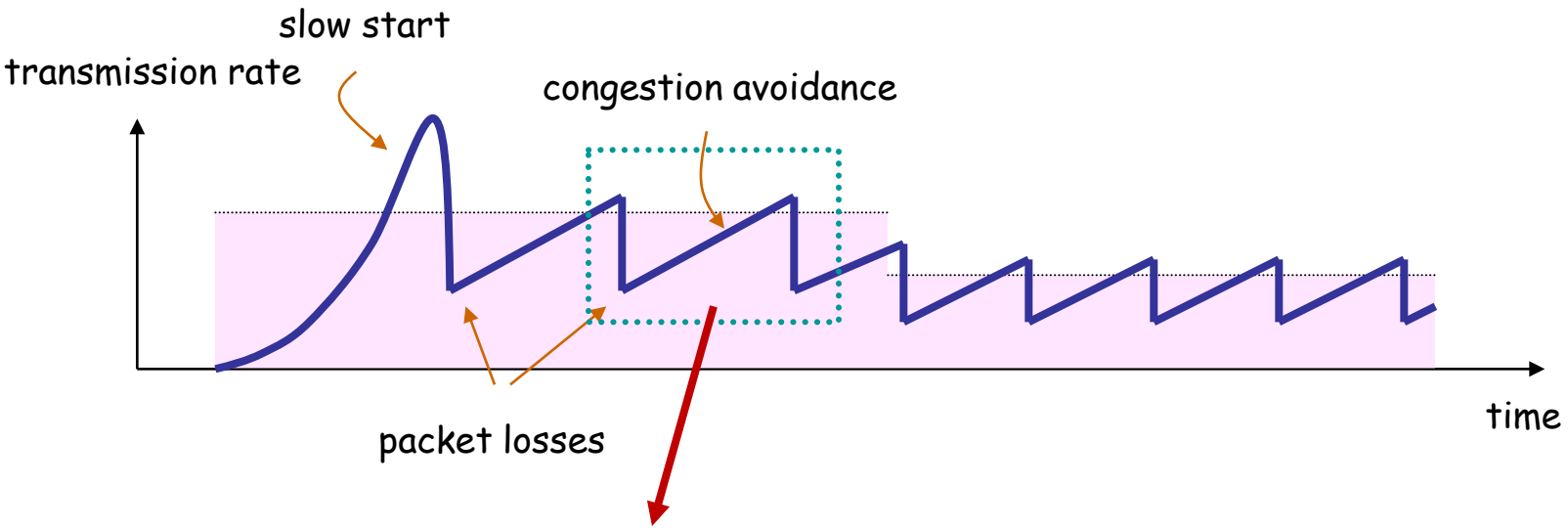
Unfairness by loss-driven TCP

× friendliness

BDP: Bandwidth-Delay Product

Video streaming (2) TFRC

- TFRC



Modeling of steady-state TCP behaviors

$$R = \frac{1}{RTT}\sqrt{\frac{3}{2p}}$$

p: packet loss rate

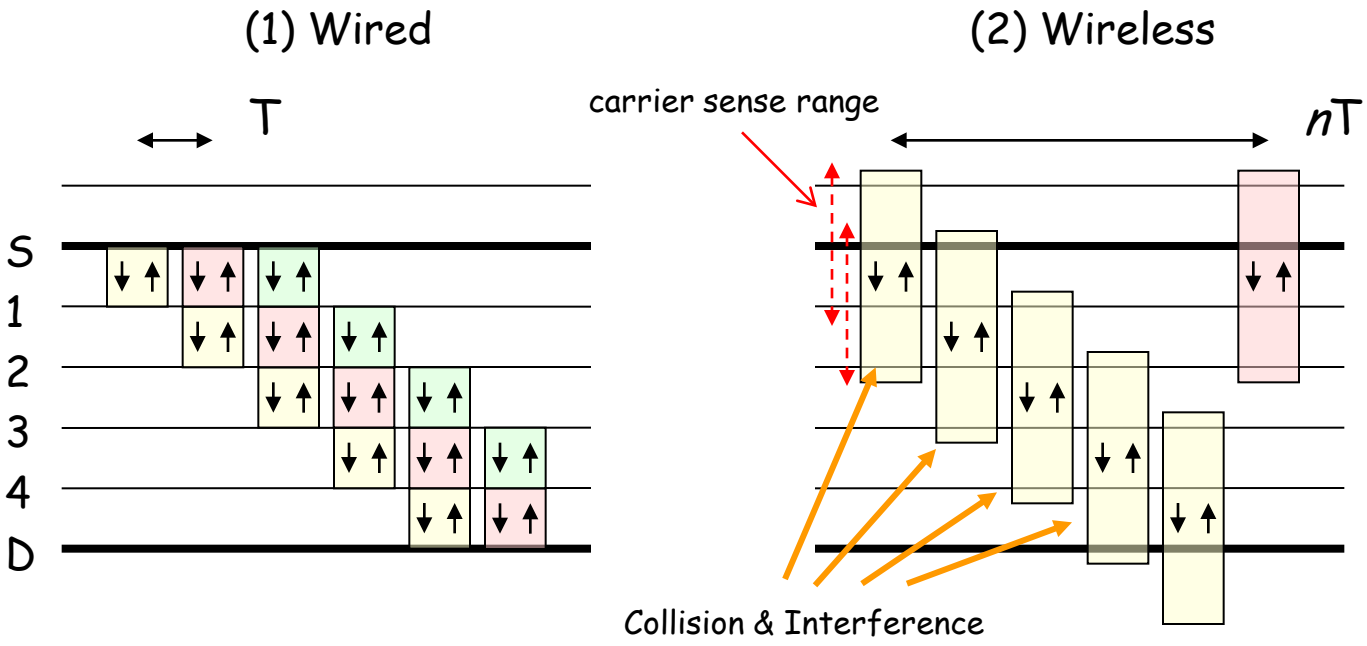
BDP/Buffer relationship

small buffer → × efficiency
large buffer → × delay

TFRC: TCP Friendly Rate Control

Video streaming (3) Wireless

- Single-Channel Multi-hop Network



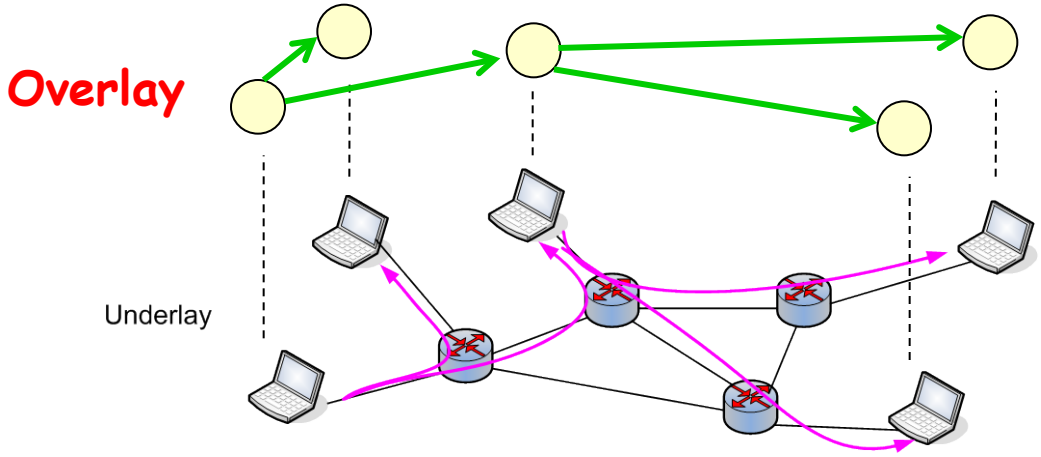
Channel Efficiency = 1

Channel Efficiency = 1/*n*

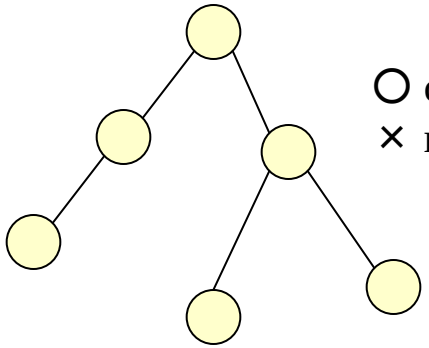
(*n* : # of multi-hops)

Video streaming (4) CDN, P2P & Cloud

- Overlay networks

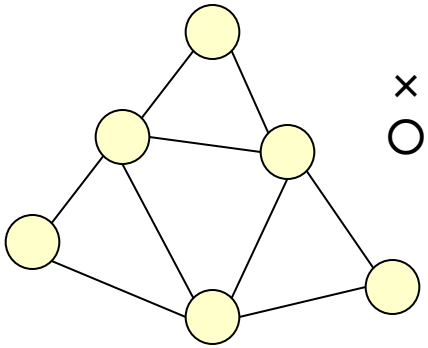


- tree



○ complexity
× robustness

- mesh

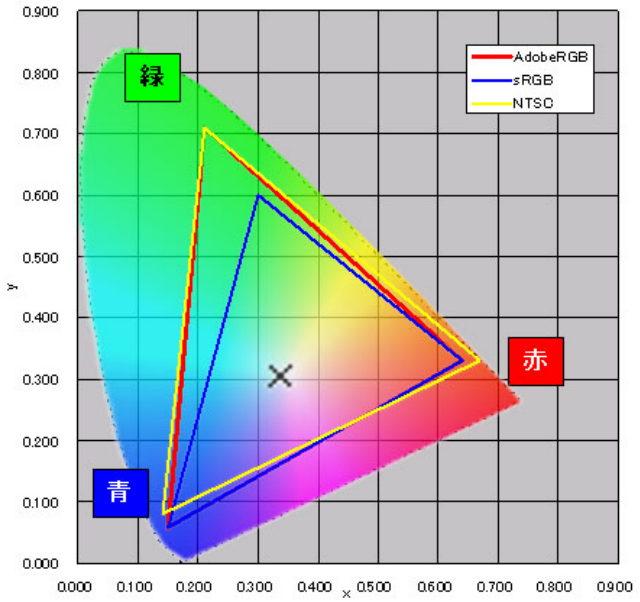


× complexity
○ robustness

Video Compression (2) H.265

- H.265/HEVC
  - HEVC: High Efficiency Video Coding
  - NGVC: Next Generation Video Coding
- Other topics
  - Higher resolution
    - spatial: U-HDTV
    - temporal: 10,000 frames
  - Gamut expansion
  - High dynamic range
  - 3D / freeviewpoint

color diagram



http://plusd.itmedia.co.jp/pcuser/articles/0805/23/news001.html

Super-resolution

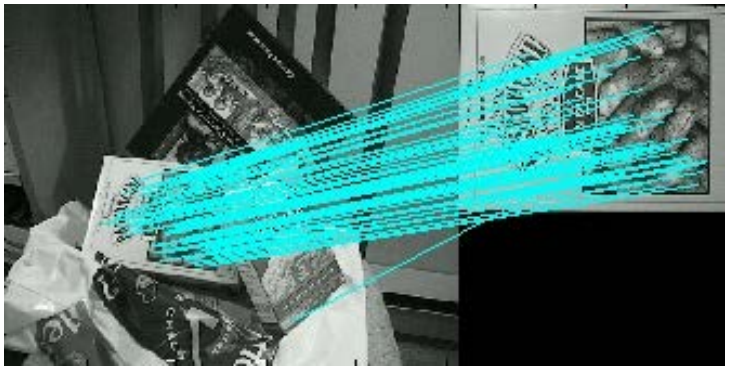
- Super-resolution
  - Missing frequency estimation (freq. domain)
  - Multiple image approach (registration)
  - Single image approach (example-based, data-base)

a: LR Frame 45 b: Data Fused Frame 45 c: Deblurred Frame 45

S.Farsiu et al.: "Advances and Challenges in Super-Resolution", IJIST, Aug.2004.

Feature Extraction

- Scale Invariant Feature Transform



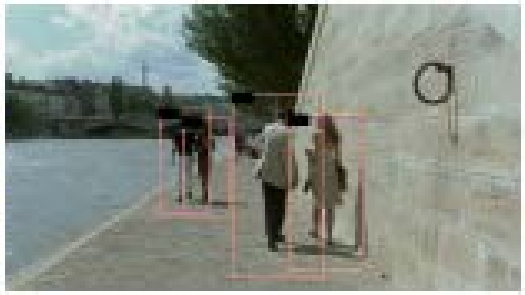
SIFT descriptors
Point correspondence

oriented gradients
in local regions

- Histogram of Oriented Gradient

Human body detection





http://www.cs.ubc.ca/~lowe/keypoints/, http://www.navneetdalal.com/

Sparse Coding (1)

- Sparse Decomposition

$$\mathbf{f} = A\mathbf{s}$$

M=N: complete (orthogonal, unique)

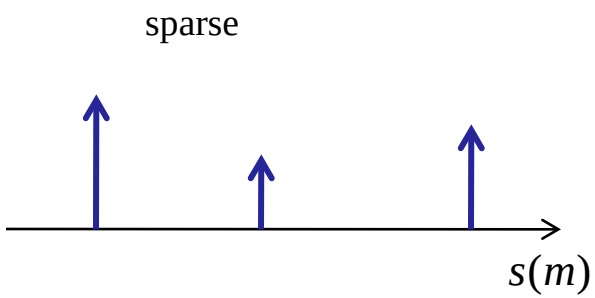
M>N: overcomplete (infinite solutions)

f: N-d vector (input)
A: MxN matrix (transform matrix)
s: M-d vector (transform coefficient)

$$\hat{\mathbf{s}} = \arg\min_{s} \frac{1}{2}\|\mathbf{f} - A\mathbf{s}\|_2^2 + \lambda\|\mathbf{s}\|_1$$

L2-norm (Euclid)

L1-norm



Sparse Coding (2)

- Sparse Coding

$$\left(\hat{A},\hat{s}\right)=\arg\min_{A,\mathbf{s}}\frac{1}{2}\sum_i\left\|\mathbf{f}_i-A\mathbf{s}_i\right\|_2^2+\sum_i\left\|\mathbf{s}_i\right\|_1$$

Basis vector learning from sample images

Original

Noisy (12.77dB)

Denoise (29.87dB)

http://www.cs.technion.ac.il/~elad/talks/

Preparation

- Tools
  - ns-2 / ns-3
  - OpenCV
  - MATLAB (Image Processing Toolbox)