画像情報特論 (1)

はじめに

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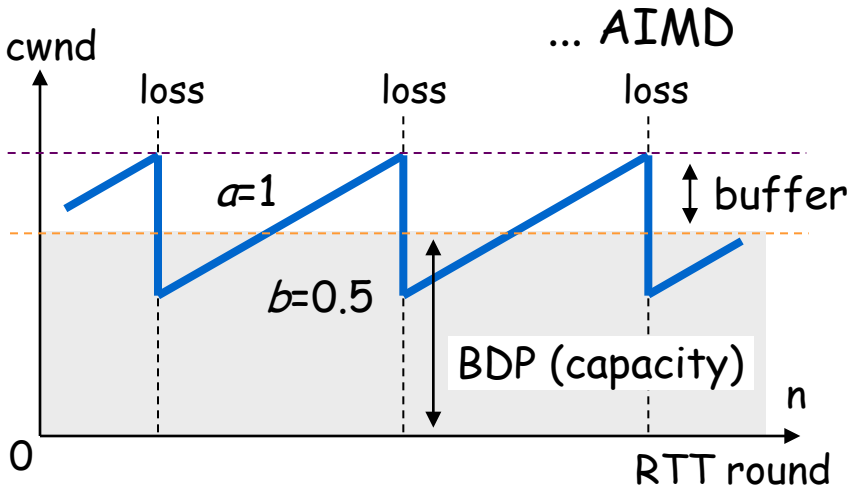
This Year's Schedule

5/06　授業の概要 (Introduction)
5/13　ハイブリッドTCP (Hybrid TCP)
5/20　理解度確認 (CourseN@vi 1)
5/27　ハイブリッドTFRC (Hybrid TFRC)
6/03　無線・海中・センサーネットワーク (Wireless/Underwater/Sensor)
6/10　P2Pストリーミング (Peer-to-Peer Streaming)
6/17　理解度確認 (CourseN@vi 2)
6/24　H.265/HVC
7/01　超解像 (Super-Resolution)
7/08　SIFT/HOG
7/15　理解度確認 (CourseN@vi 3)
7/22　スパース符号化 (Sparse Coding)
7/29　三次元画像処理 (3D Image Processing)

途中で変更の可能性あり (This is a tentative schedule)
上記とは別に、途中で2回の理解度確認 (Two more CourseN@vi's are planned)

Hybrid TCP

- Loss-driven

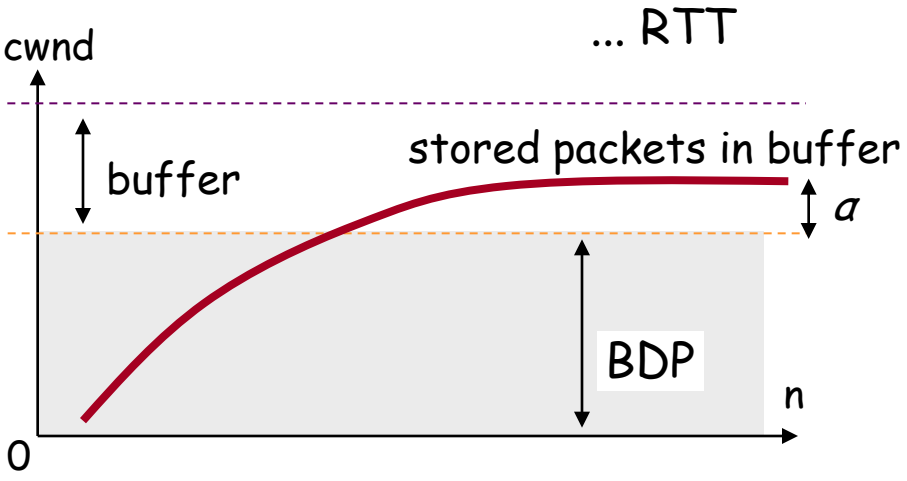


TCP-Reno, High-Speed TCP,
TCP-Westwood, CUBIC-TCP, ...

BDP/Buffer relationship

small buffer → × efficiency
large buffer → × delay

- Delay-driven



TCP-Vegas, FAST-TCP

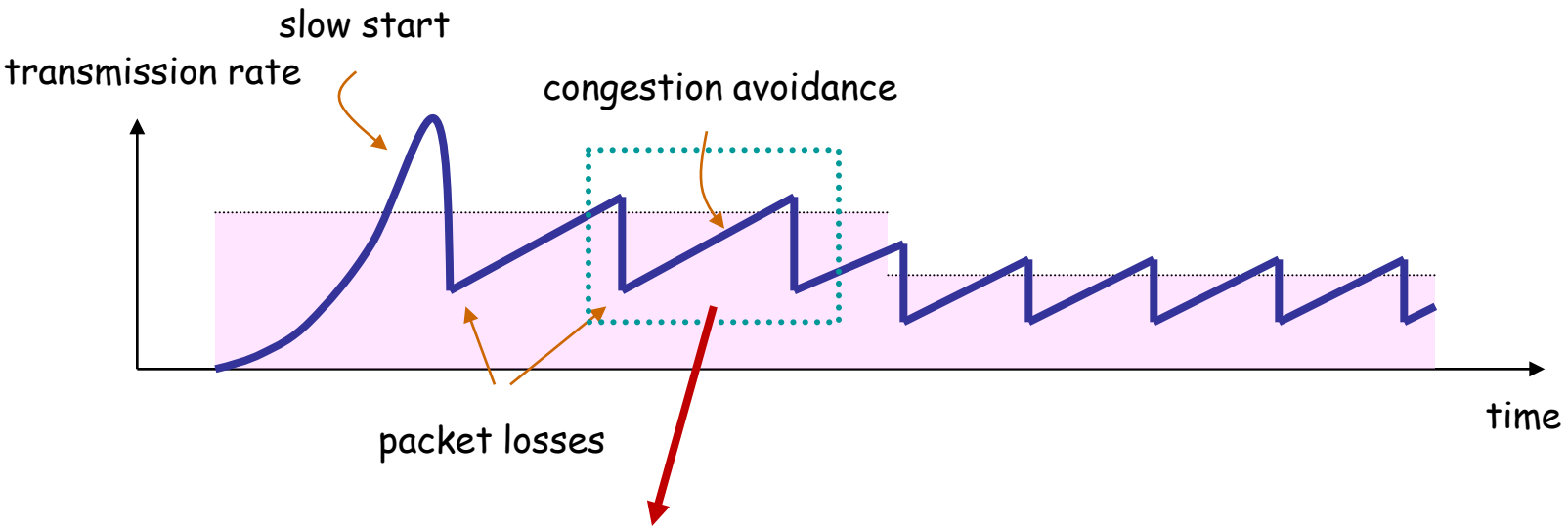
Unfairness by loss-driven TCP

× friendliness

BDP: Bandwidth-Delay Product

Hybrid TFRC

- TFRC



Modeling of steady-state TCP behaviors

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

p: packet loss rate

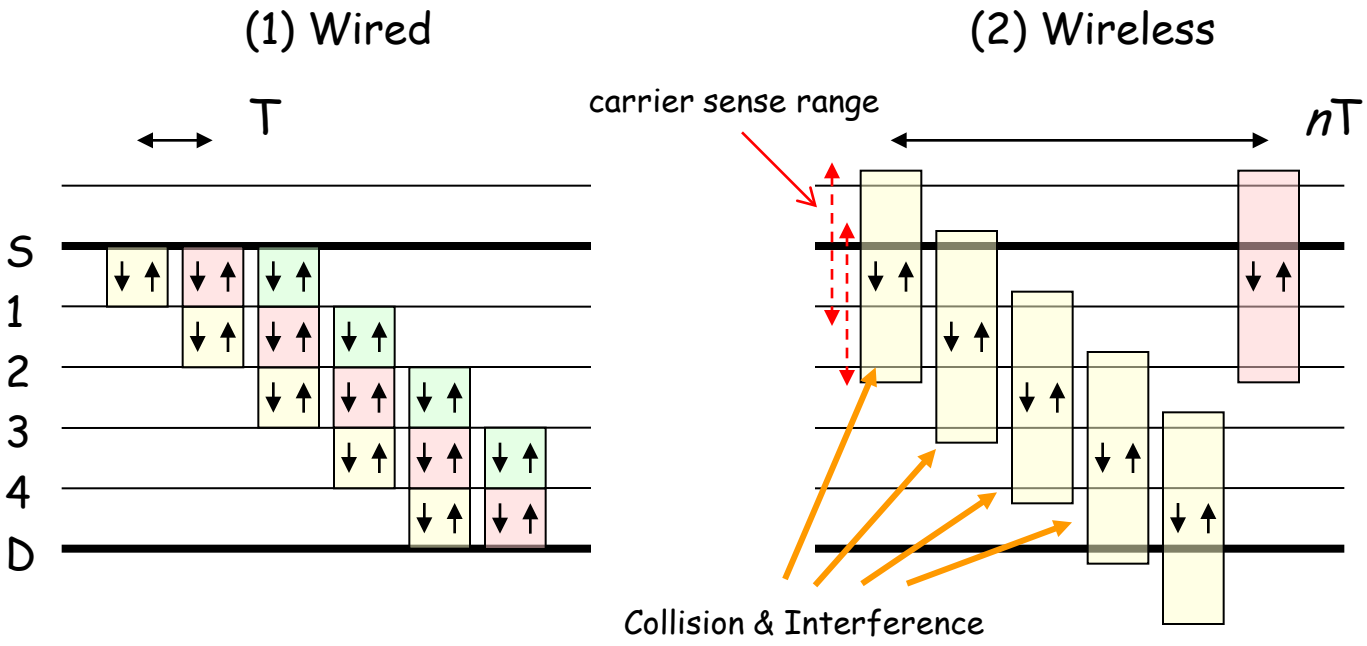
BDP/Buffer relationship

small buffer → × efficiency
large buffer → × delay

TFRC: TCP Friendly Rate Control

Wireless/Underwater/Sensor

- Single-Channel Multi-hop Network



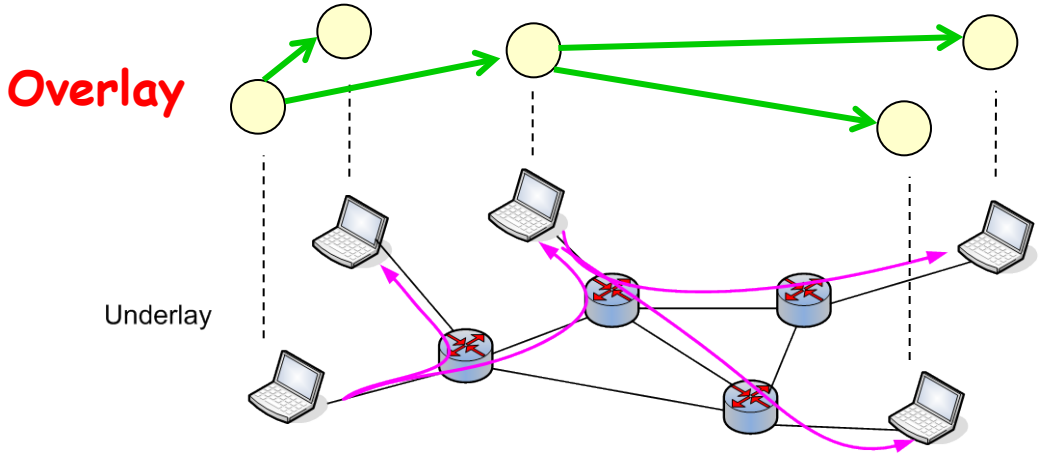
Channel Efficiency = 1

Channel Efficiency = 1/*n*

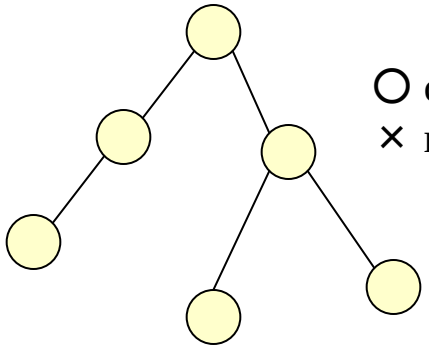
(*n* : # of multi-hops)

P2P Streaming

- Overlay networks

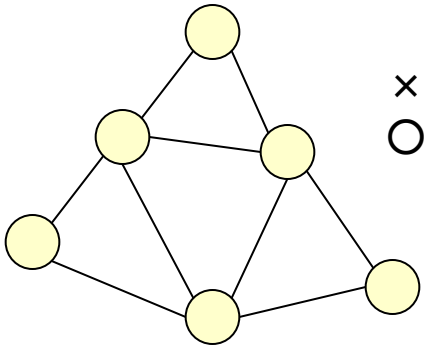


- tree



○ complexity
× robustness

- mesh

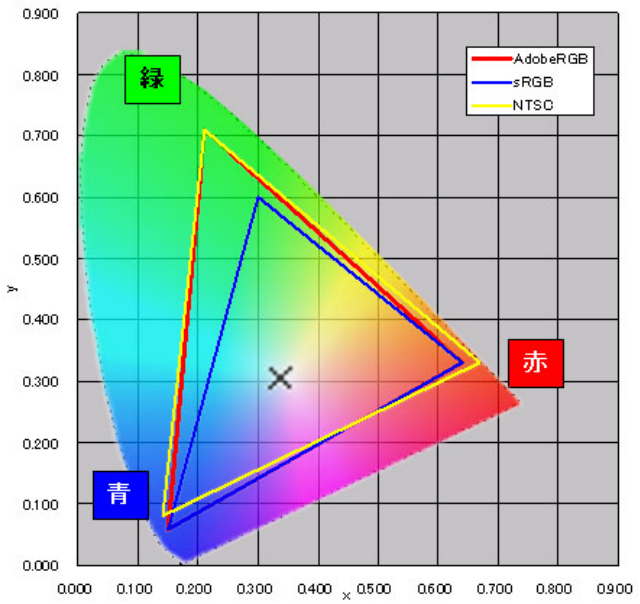


× complexity
○ robustness

H.265/HVC

- H.265
  - HVC: High-performance 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

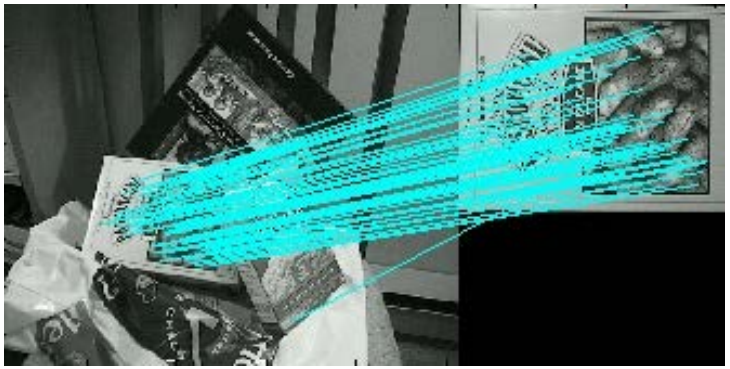
- 超解像
  - 高周波数成分推定 (Frequency domain)
  - 複数画像からの高解像度化 (Multiple images)
  - １枚の画像の高解像度化 (Example-based)

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.

SIFT / HOG

- Scale Invariant Feature Transform



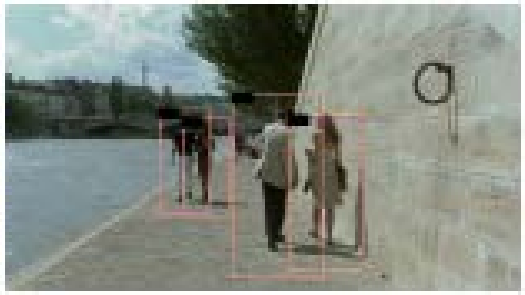
SIFT descriptors
Point correspondence

局所的な輝度勾配の
ヒストグラム

- 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)

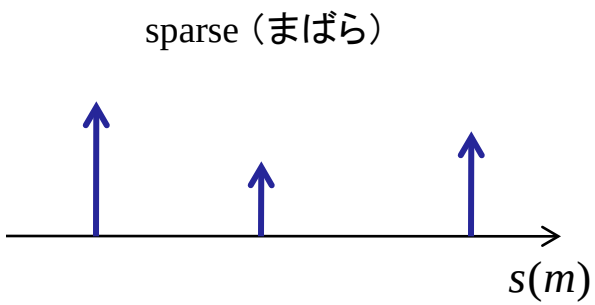
M>N: overcomplete (解が無数)

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 (ユークリッド距離)

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
  - OpenCV
  - MATLAB (Image Processing Toolbox)