Rate Control Algorithm In

Wireless Network, Cross Layer Design

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SDR project

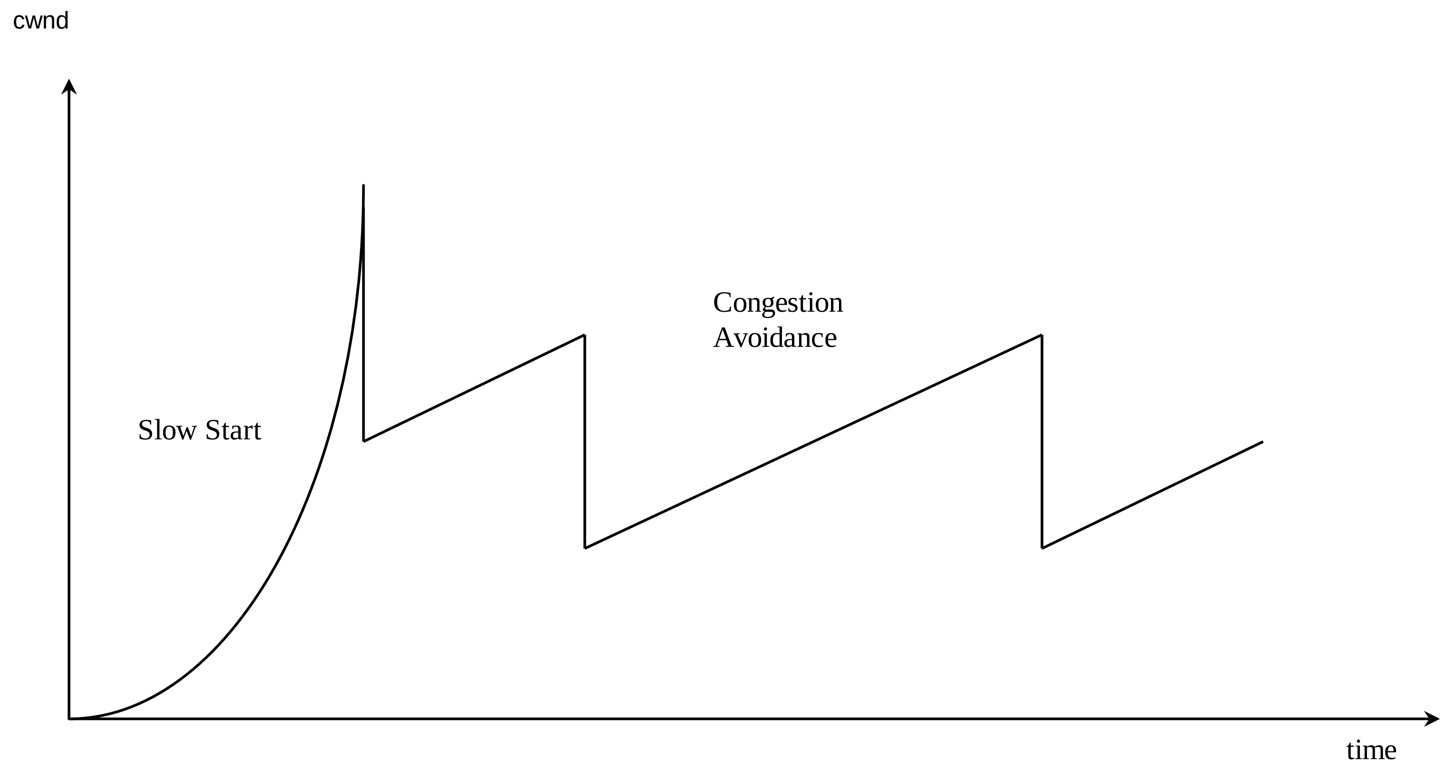
Questions

- How is rate control in wired and wireless network?
- What is the rate control problem in wireless networks?
- How Cross Layer Design could be a solution?

Rate Control in Internet

- TCP congestion control
  - end to end, implicit and dynamic window
  - AIMD
- Optimization framework
  - MCFC
  - Kelly

TCP Reno



AIMD

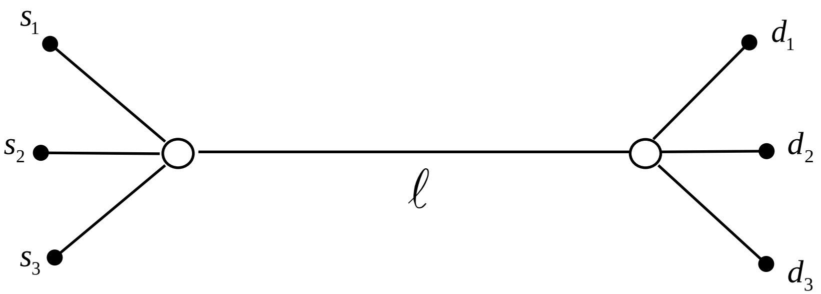
- Assume discrete time, $x_i[n]$
- Linear adaptation algorithm is as follows

$$x_i[n+1] = u_{p[n]} x_i[n] + v_{p[n]}$$

- Feedback signal is defined as

$$p[n] = \begin{cases} 0, & \text{if } \sum_{i=1}^{I} x_i[n] \le c \\ 1, & \text{o.w.} \end{cases}$$

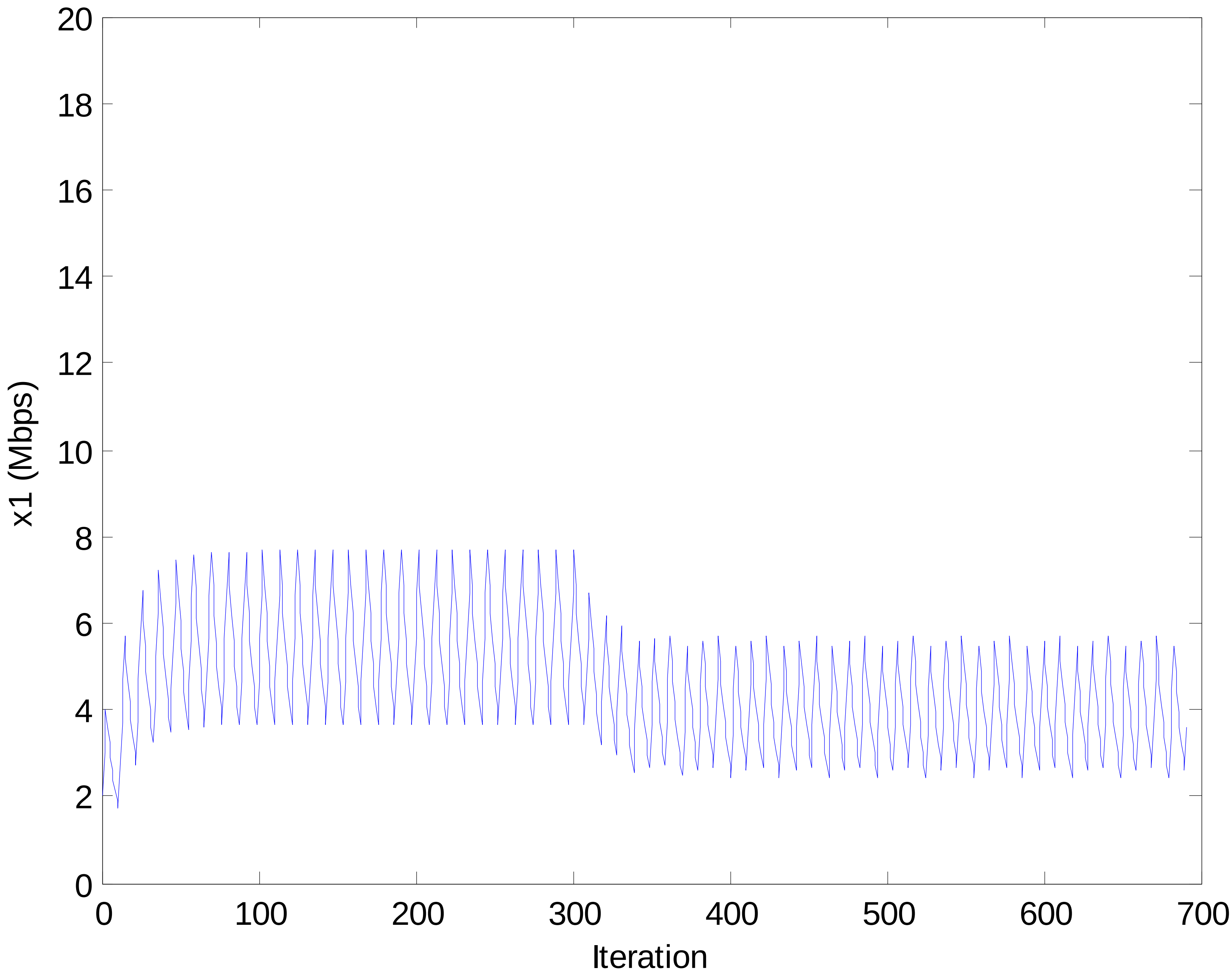
Conventional Method



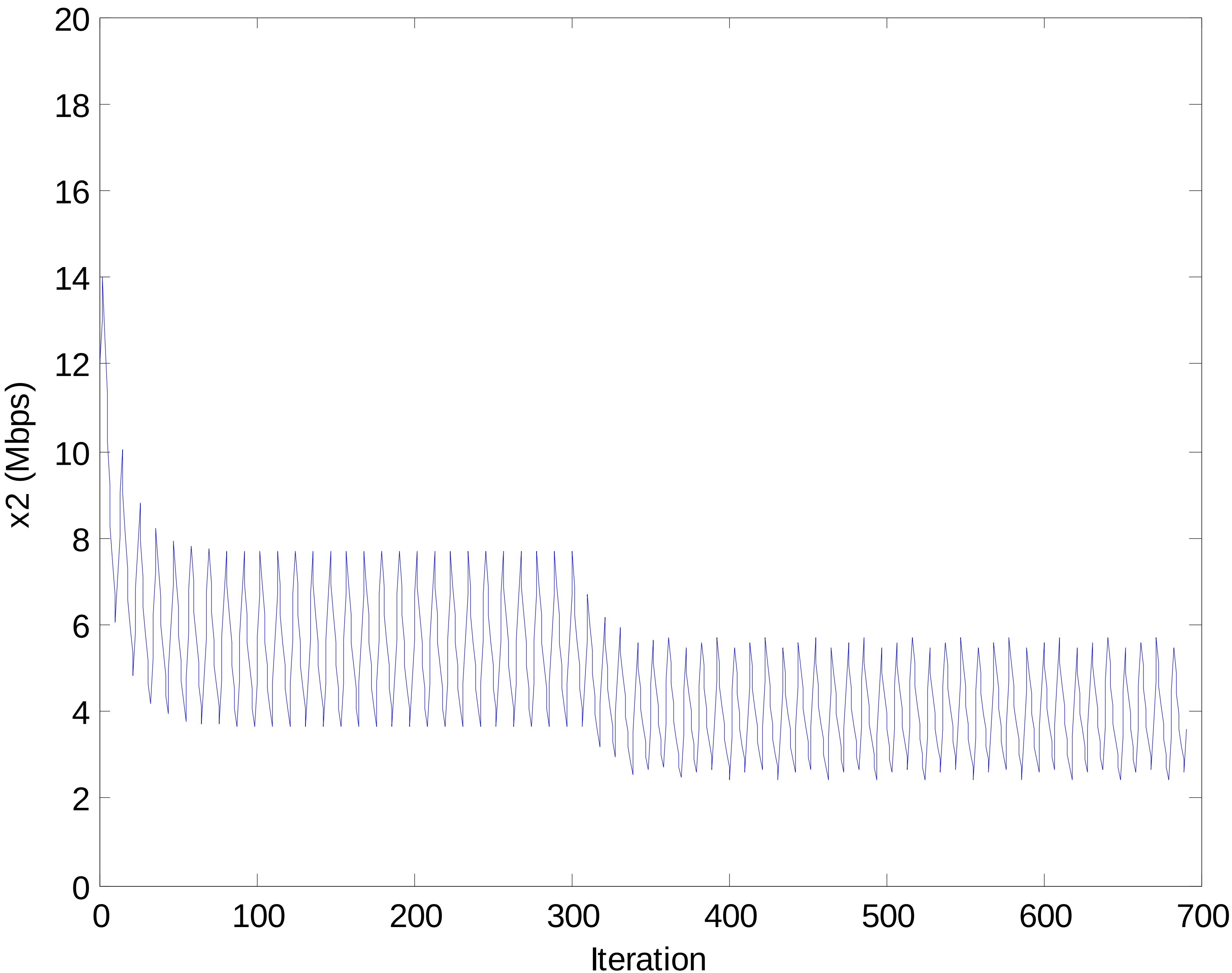
- Algorithm constants evolve as:

$$u_{p[n]} = \begin{cases} 1, & p[n]=0 \\ s, & p[n]=1 \end{cases} = 1 - s \cdot p[n] \qquad v_{p[n]} = \begin{cases} k, & p[n]=0 \\ 0, & p[n]=1 \end{cases} = k \cdot (1 - p[n])$$

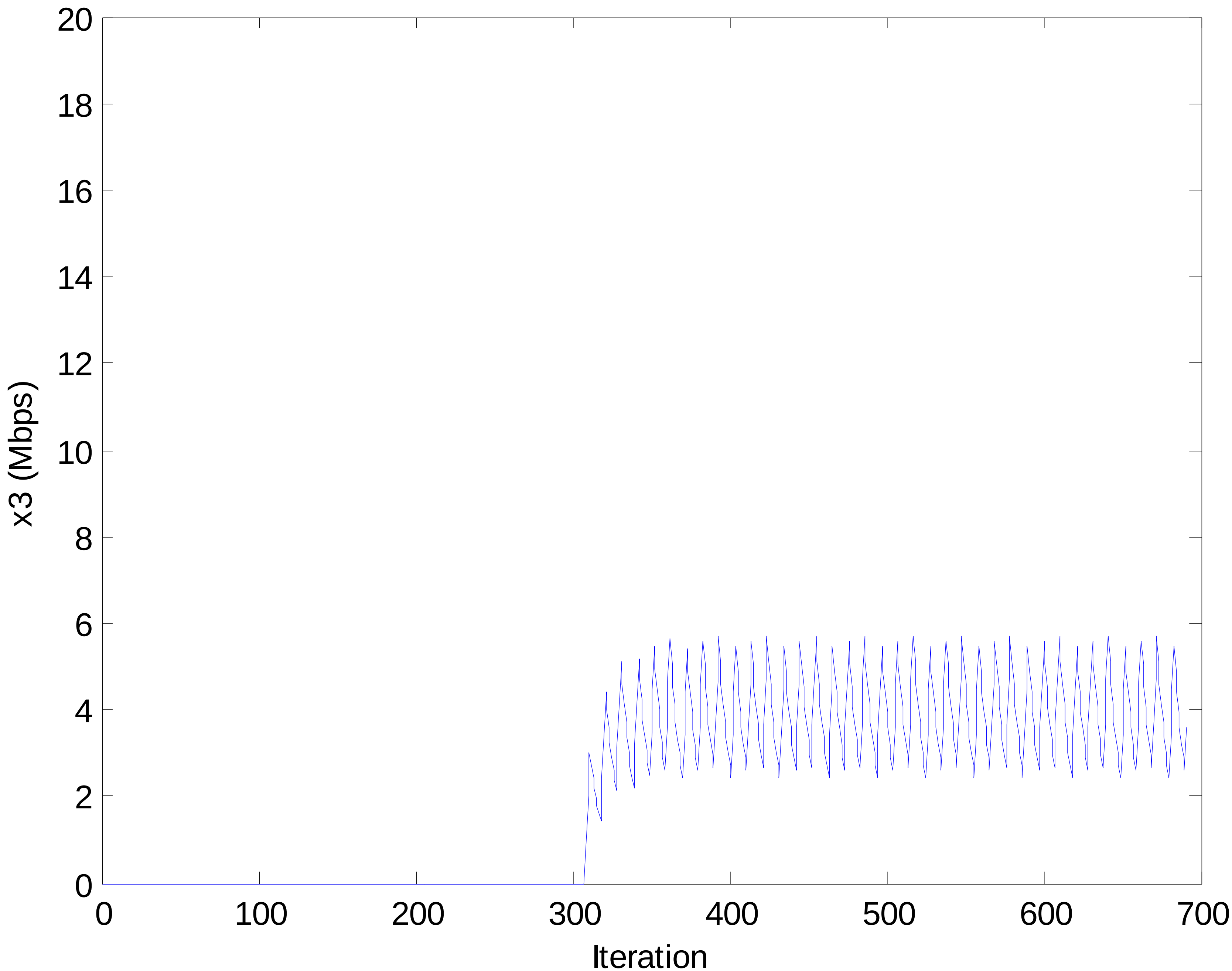
- Where $0 < s < 1$ & $k > 0$

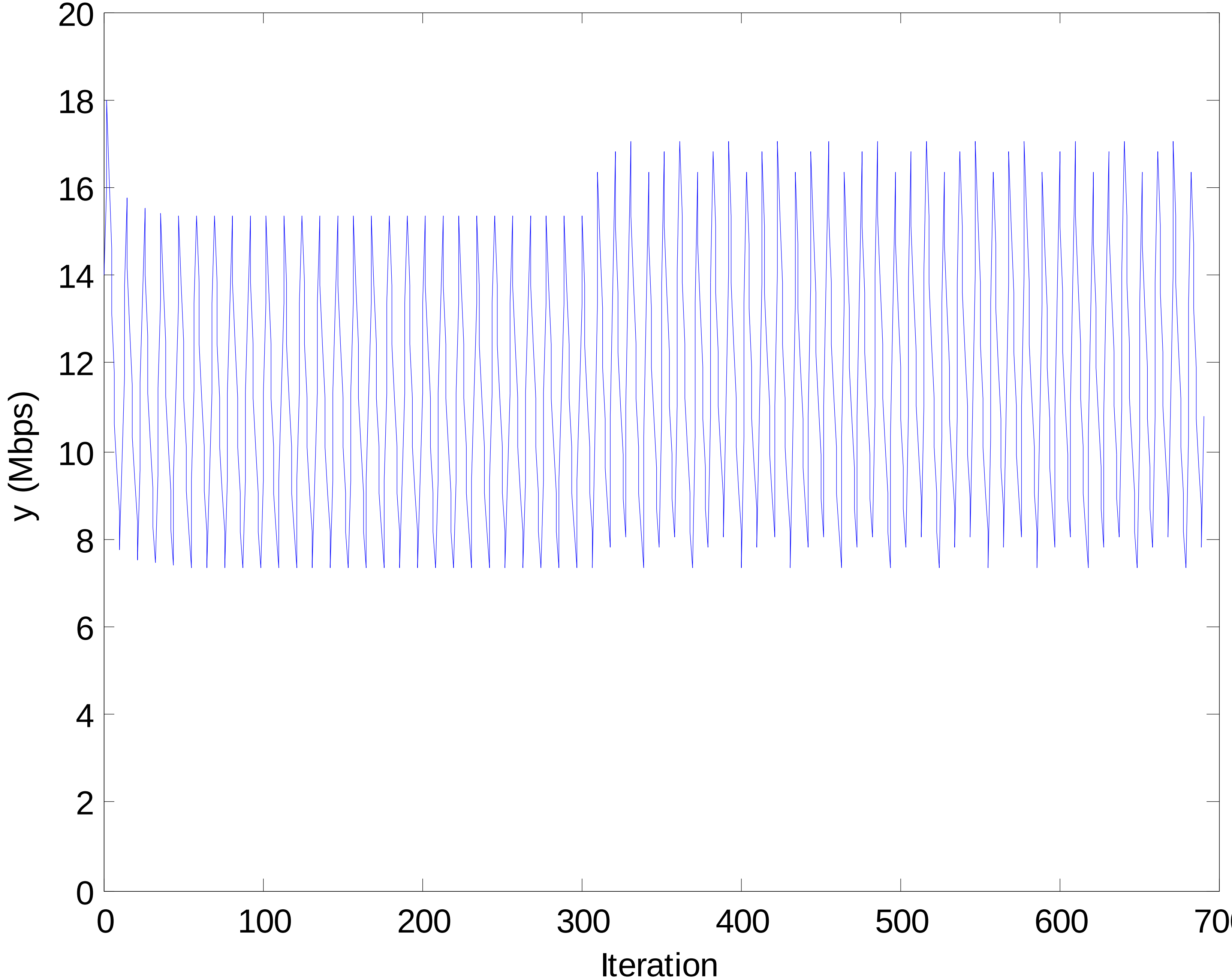


x1 (Mbps)
20
18
16
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
700
Iteration

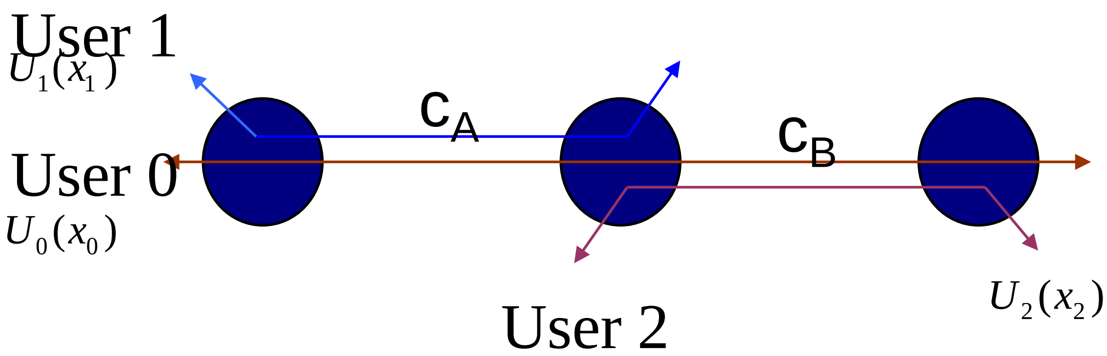


x2 (Mbps)
20
18
16
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
700
Iteration


x3 (Mbps)
20
18
16
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
700
Iteration


20
18
16
14
12
10
8
6
4
2
0
0
100
200
300
400
500
600
700
y (Mbps)
Iteration

Optimization Framework , Example:



$$\max_{x_0,x_1,x_2} \sum_{i=1}^{3} U_i(x_i)$$

$$\begin{aligned} x_0 + x_1 &\leq c_A \\ x_0 + x_2 &\leq c_B \\ x_i &\geq 0 \end{aligned}$$

MCFC:

$$x_r[n+1] = \left\{ x_r[n] + k_r \cdot \left(\omega_r - x_r[n] \cdot \sum_{j \in R_r} \mu_j[n] \right) \right\}^+$$

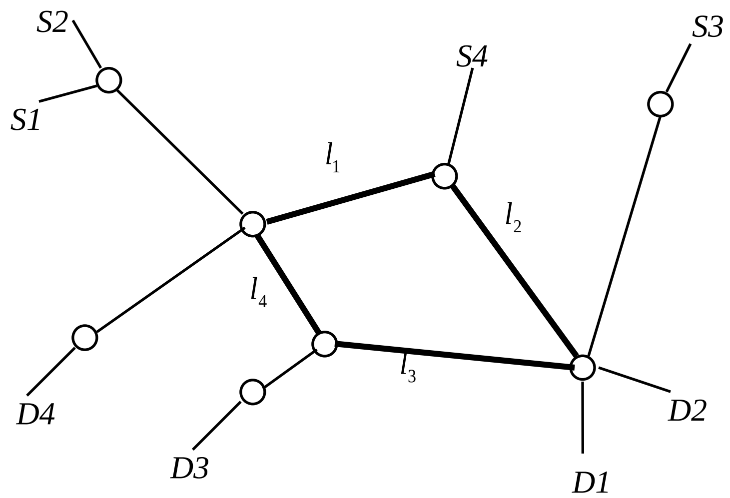
$$\omega_r = x^*{}_r \cdot \sum_{j \in R_r} p_j \Big(\sum_{s: j \in R_s} x^*{}_s \Big)$$

Modified MCFC

$$k_s\left(x_s[n]\right)=\frac{\upsilon}{\beta+\max\left\{\left(\frac{x_s[n]}{c_1}\right)^{\theta},\left(\frac{x_s[n]}{c_2}\right)^{\theta},\left(\frac{x_s[n]}{c_3}\right)^{\theta},\ldots\right\}}$$

$$=\frac{\upsilon}{\beta+\left(\frac{x_s[n]}{\min\left\{c_1,c_2,c_3,\ldots\right\}}\right)^{\theta}}$$

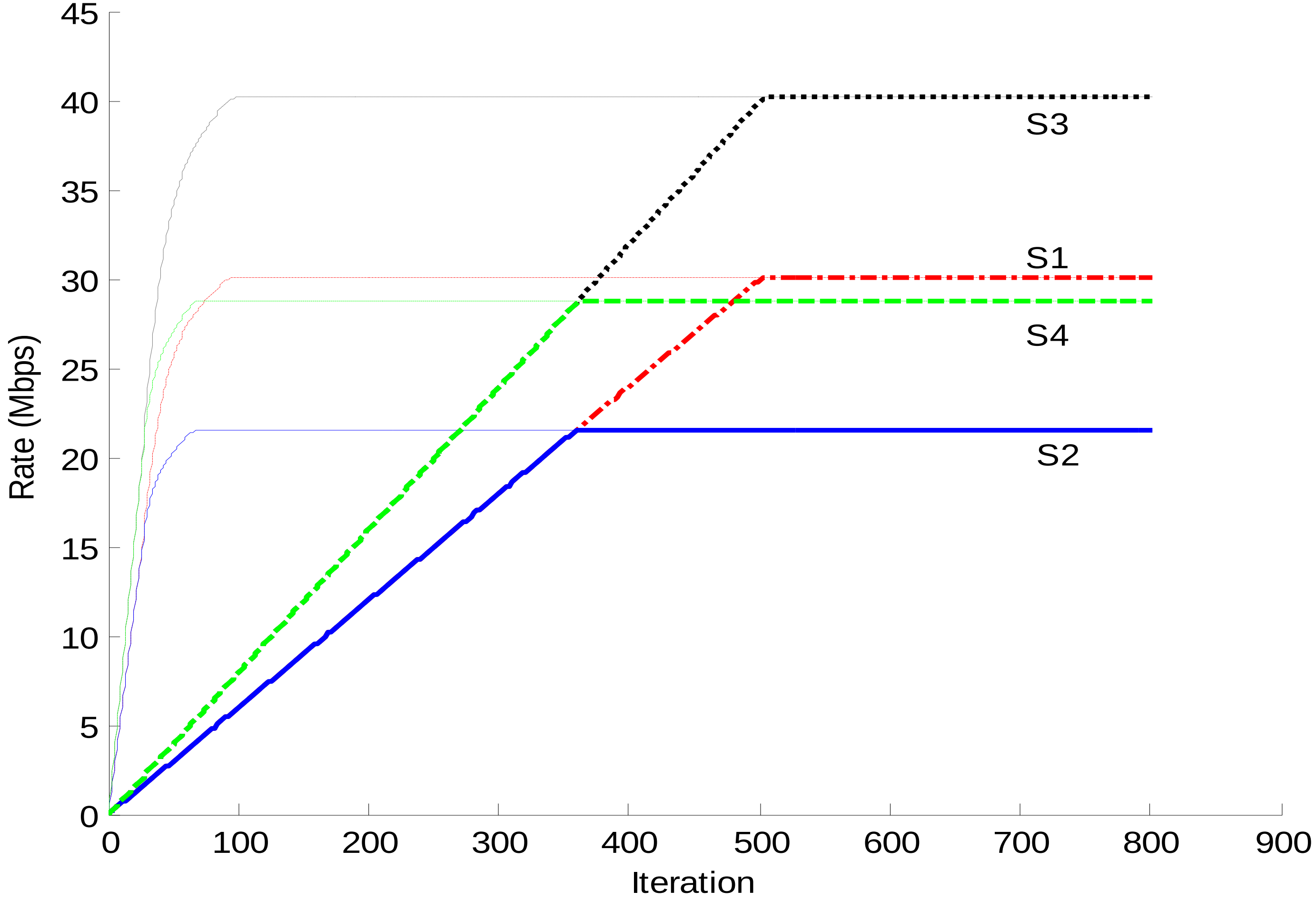
Simulation:



$$c_1 = 50Mbps, c_2 = 30Mbps, c_3 = 60Mbps, c_4 = 70Mbps$$

Session1	L3,L4
Session2	L1,L2
Session3	L4
Session4	L1

Result :



45
40
35
30
25
20
15
10
5
0
Rate (Mbps)
0
100
200
300
400
500
600
700
800
900
Iteration
S3
S1
S4
S2

Questions

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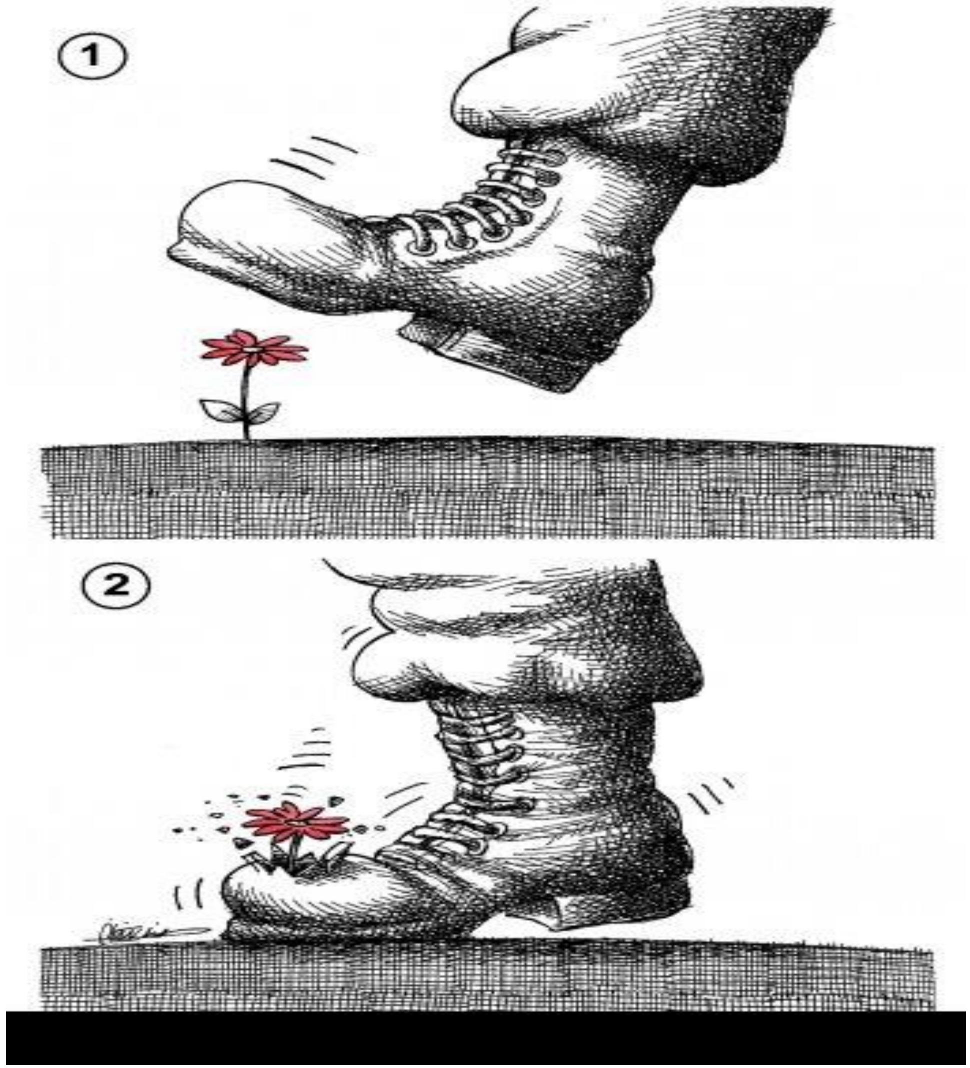
Thank You!



Questions?