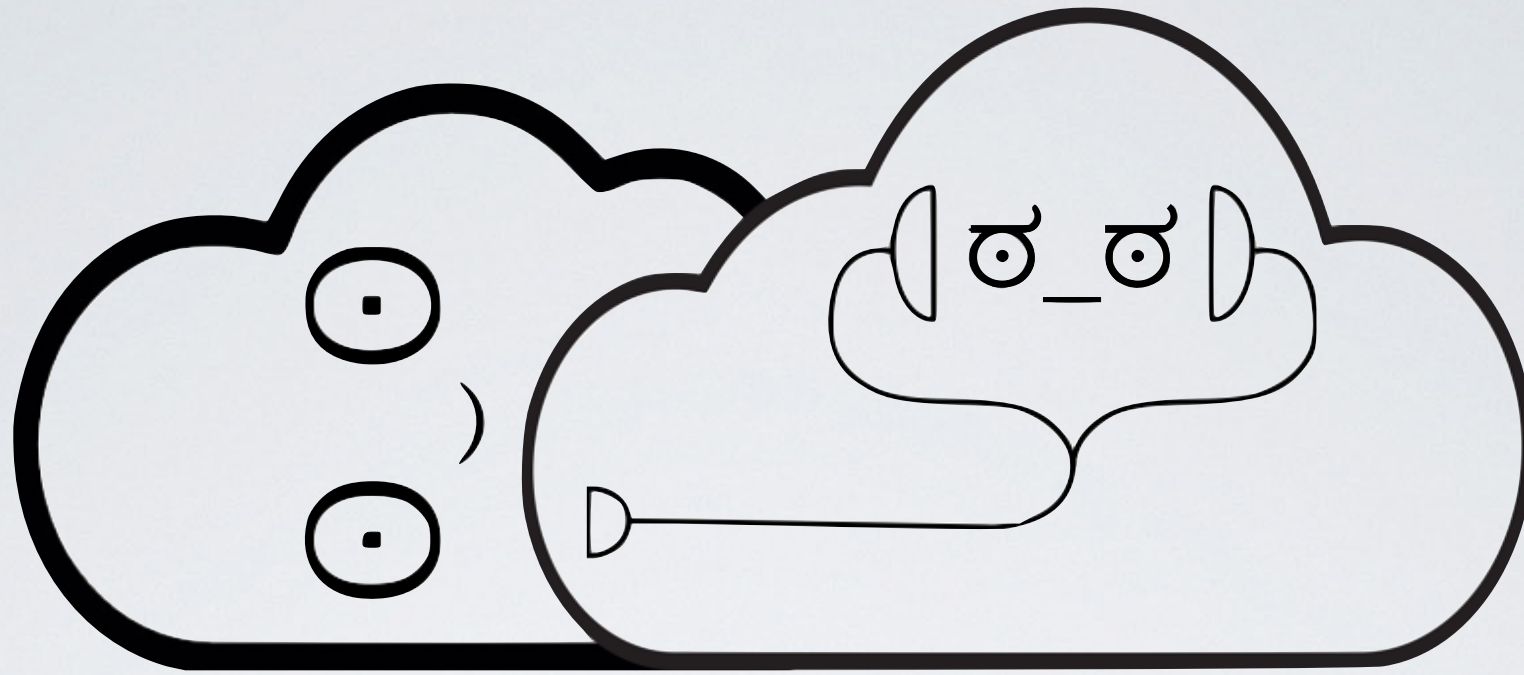


MOVING IN NEXT DOOR

Network Flooding as a Side Channel in Cloud Environments

by Yatharth Agarwal and Vishnu Murale
mentored by Jason Hennessey, Kyle Hogan, and Mayank Varia

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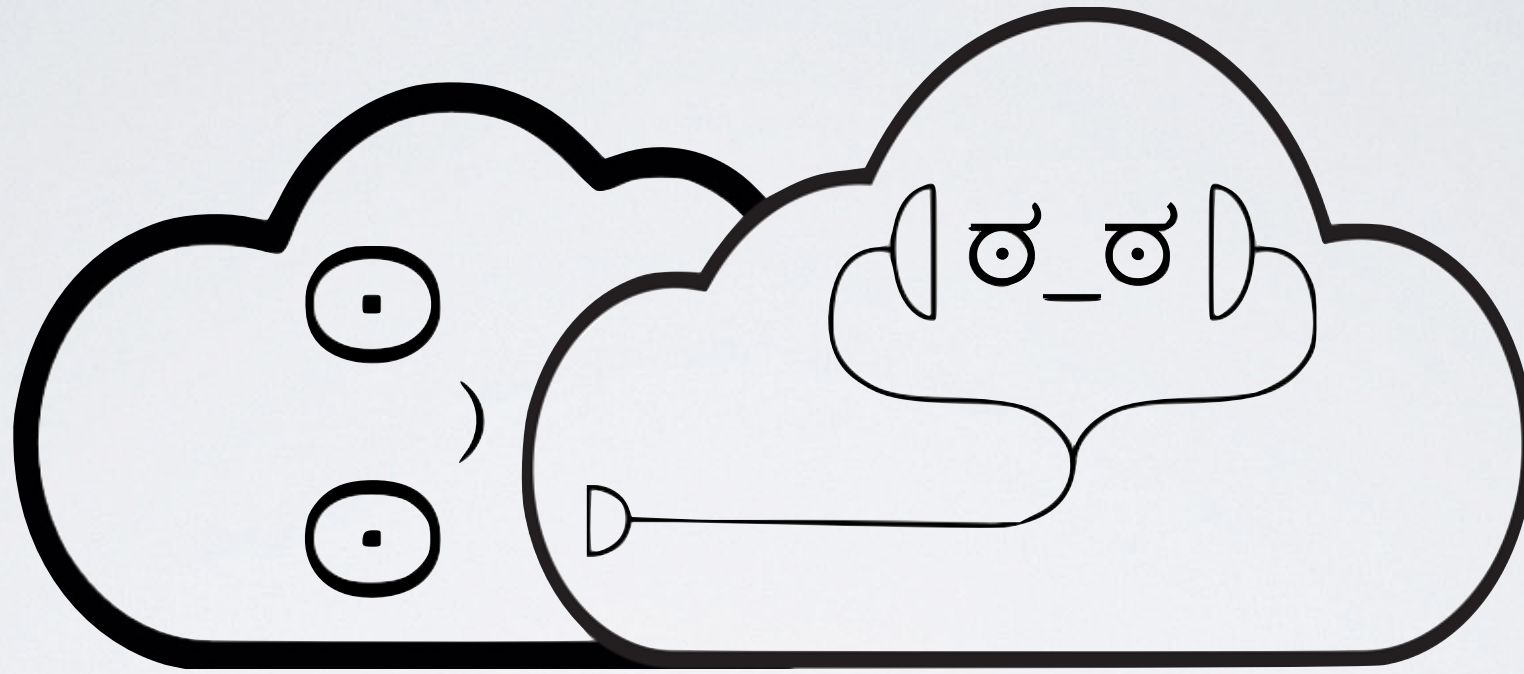
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SIDE CHANNEL

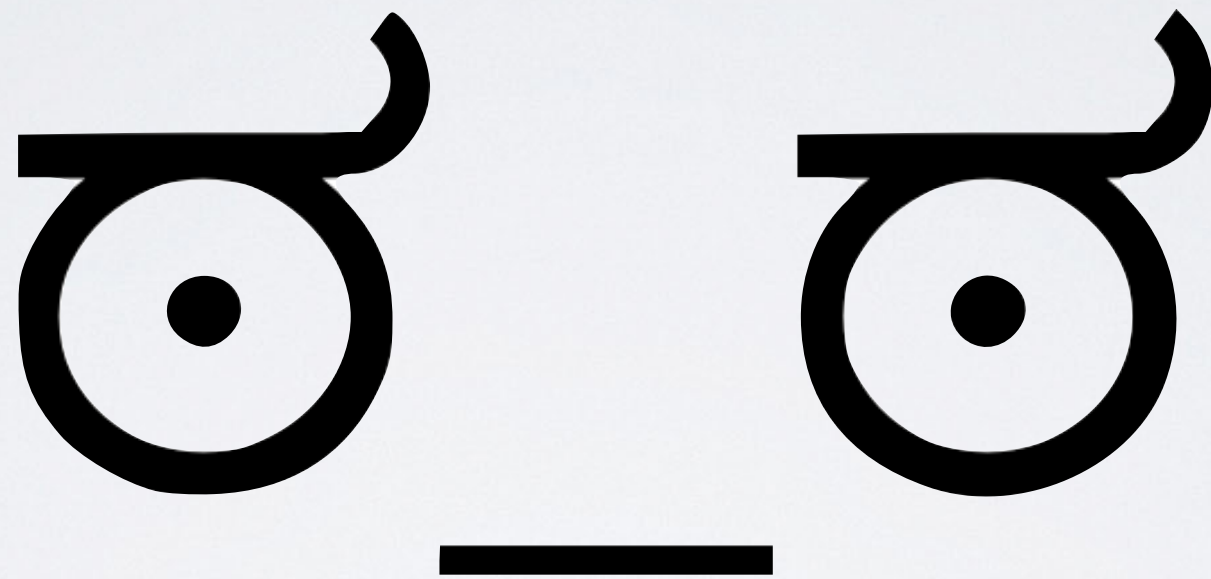


MOVING IN NEXT DOOR

by Yatharth Agarwal and Vishnu Murale
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SIDE CHANNEL



SIDE CHANNEL

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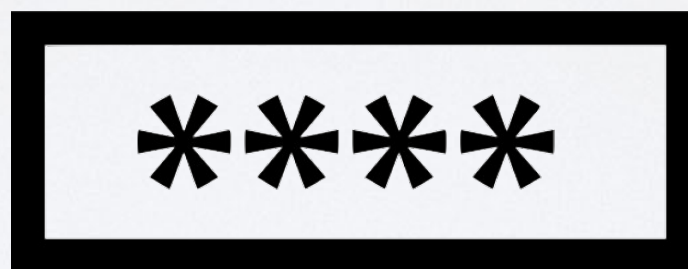
SIDE CHANNEL

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SIDE CHANNEL

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SIDE CHANNEL

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SIDE CHANNEL

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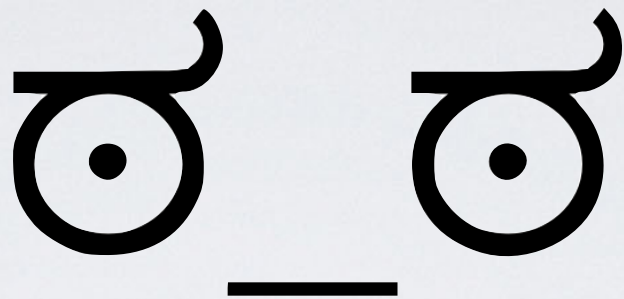


SIDE CHANNEL

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SIDE CHANNEL



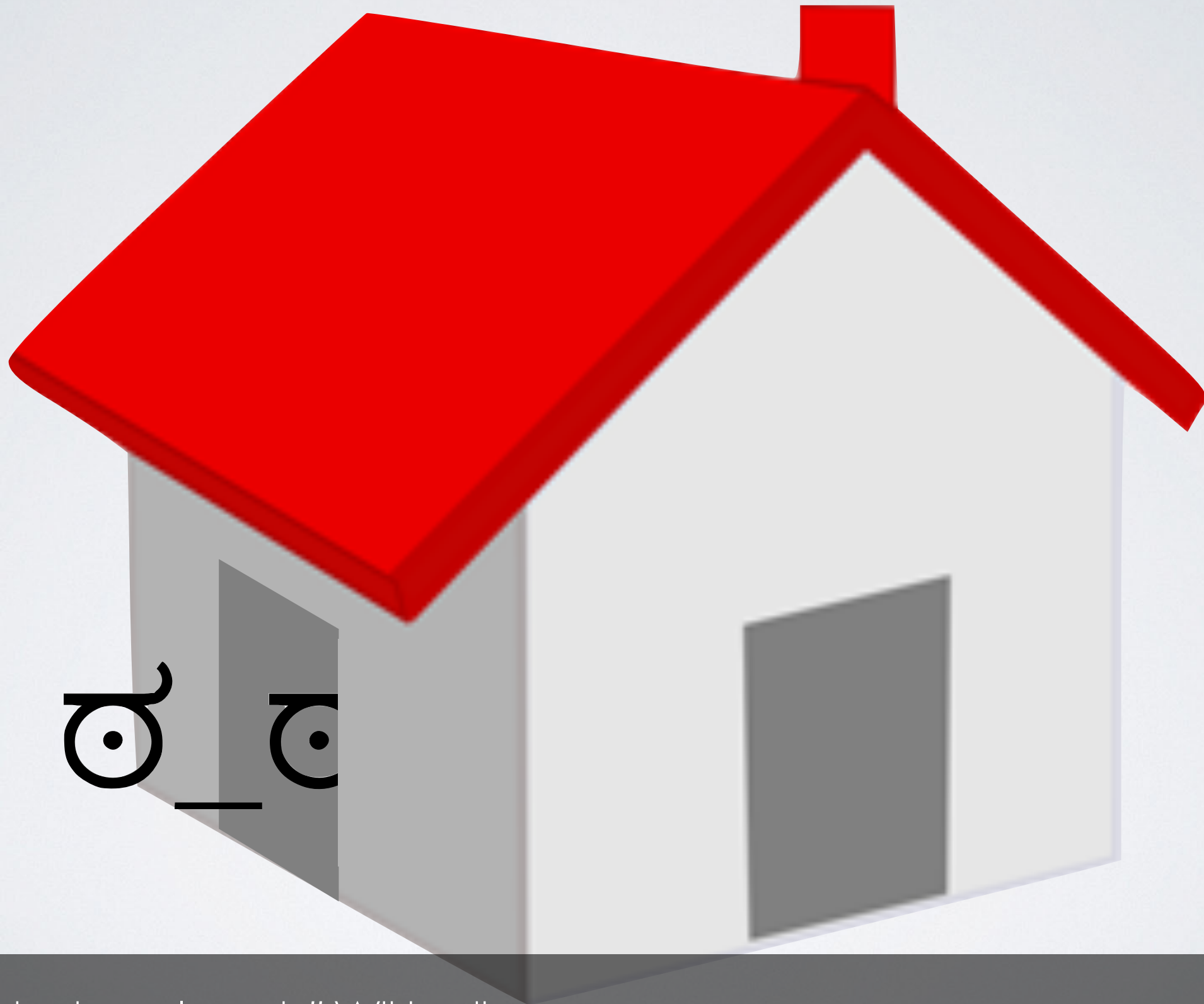
SIDE CHANNEL

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SIDE CHANNEL



SIDE CHANNEL

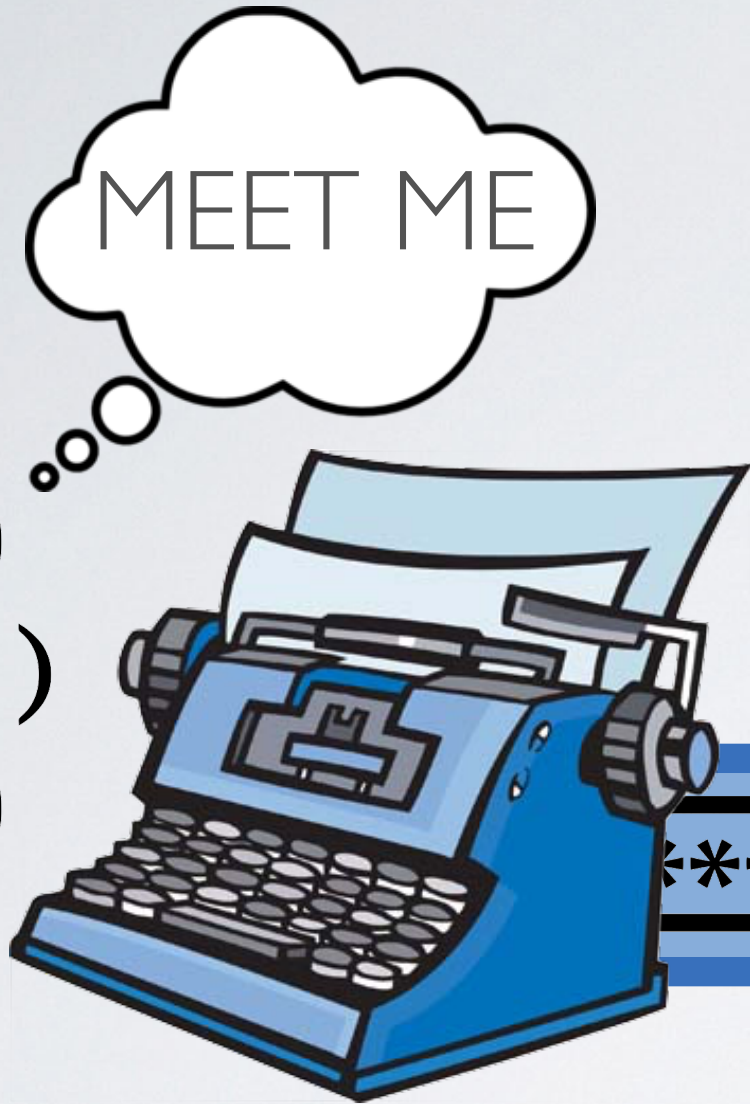


SIDE CHANNEL



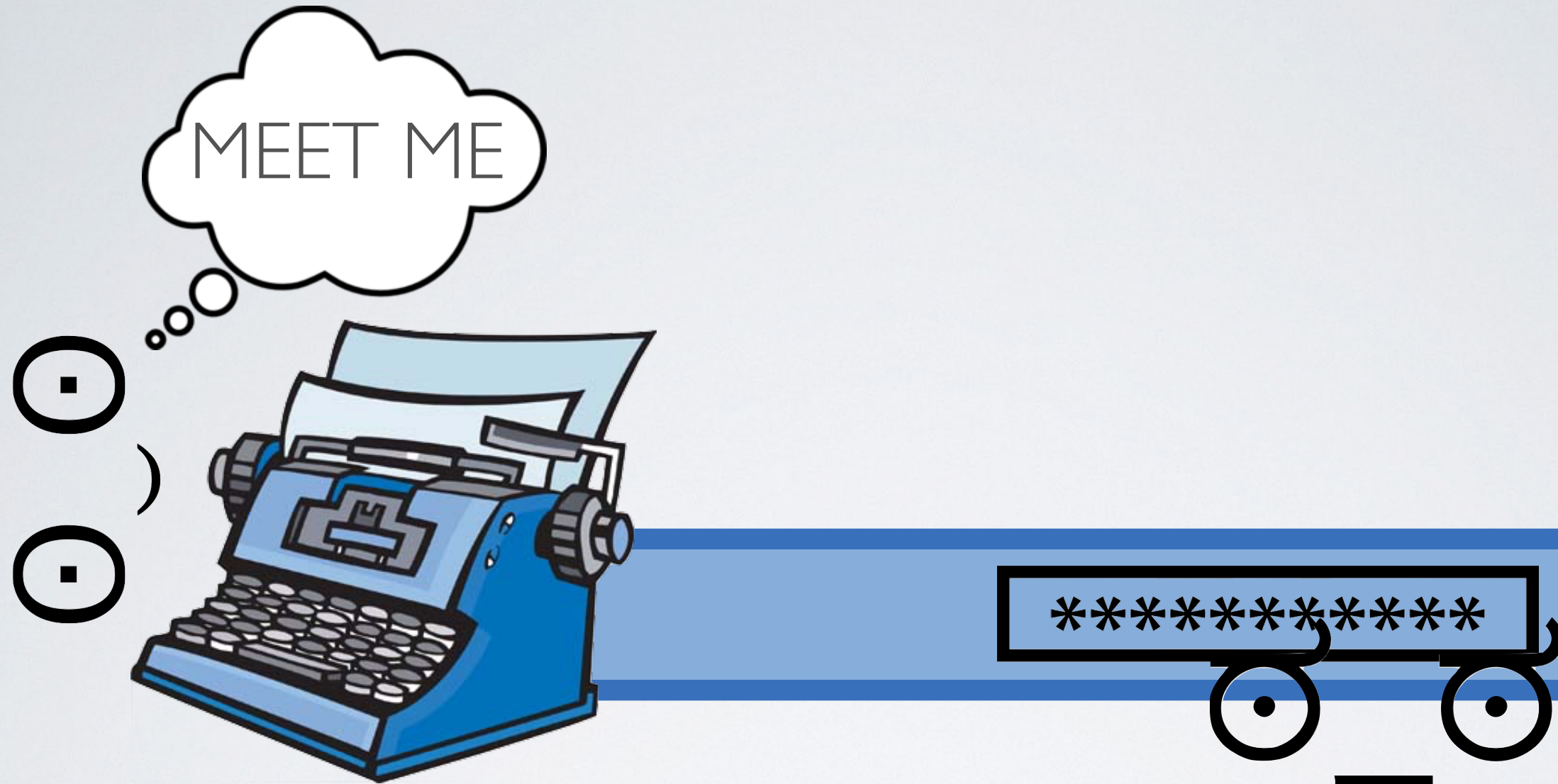
SIDE CHANNEL

MEET ME

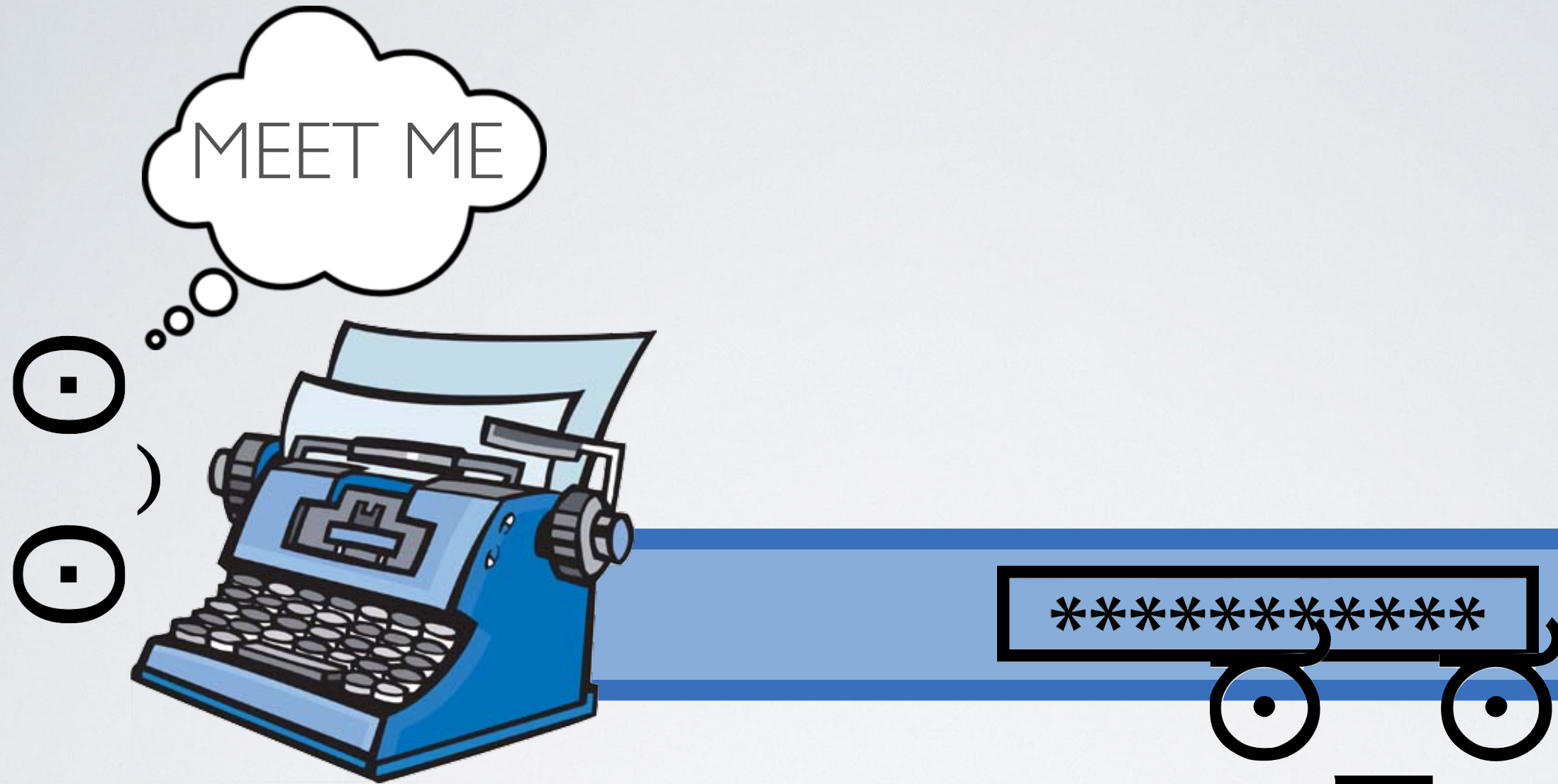


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SIDE CHANNEL



SIDE CHANNEL



SIDE CHANNEL

MEET ME



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SIDE CHANNEL

MEET ME



SIDE CHANNEL

MEET ME



SIDE CHANNEL



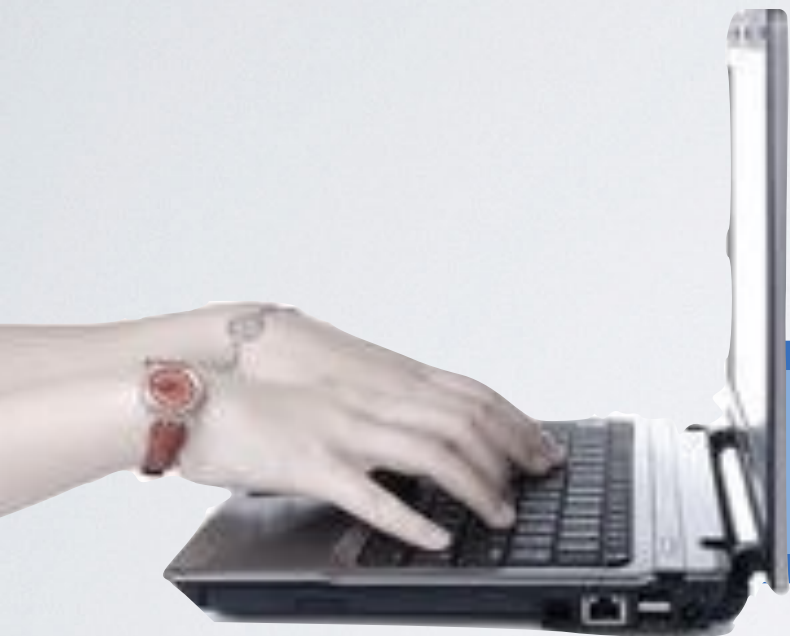
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SIDE CHANNEL



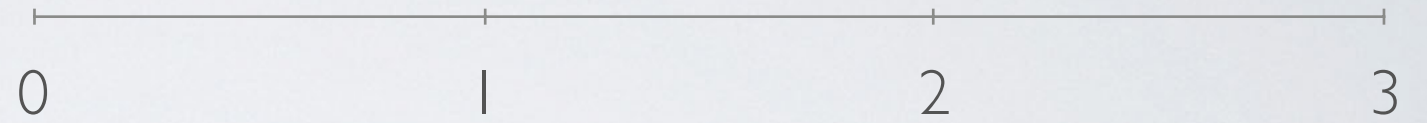
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SIDE CHANNEL

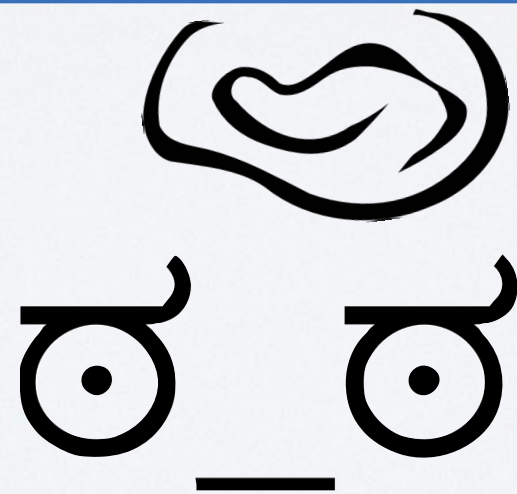


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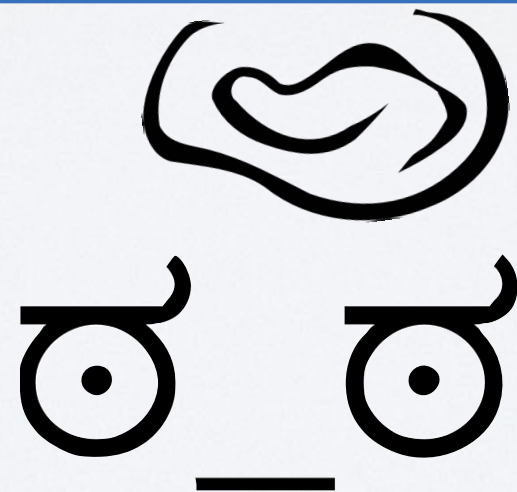
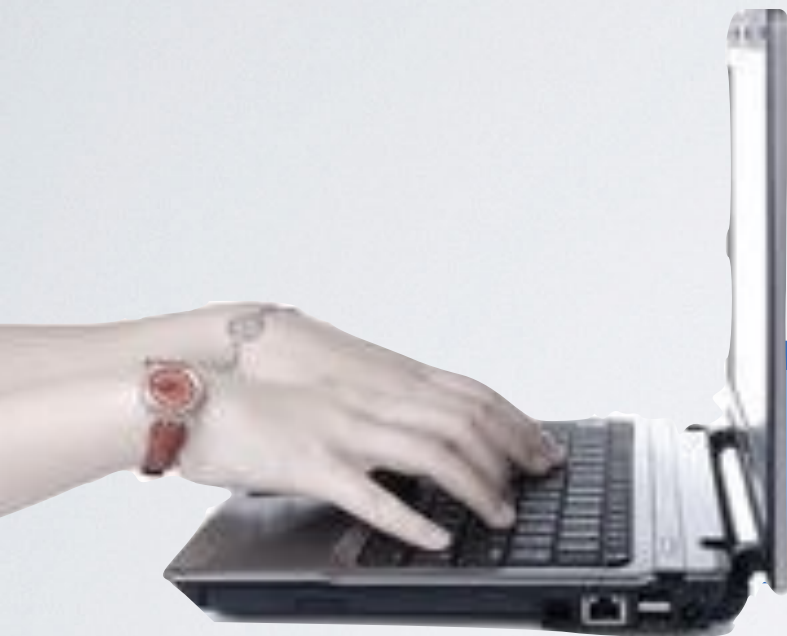
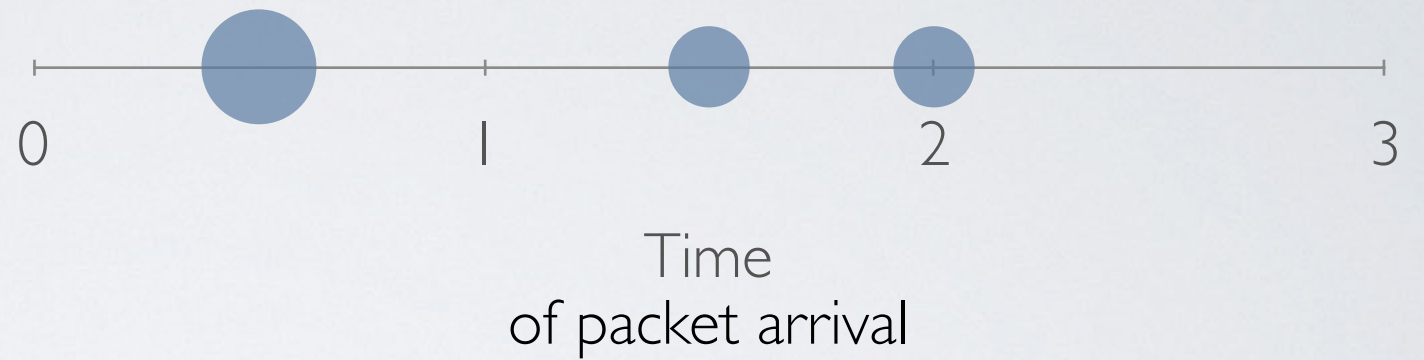
SIDE CHANNEL



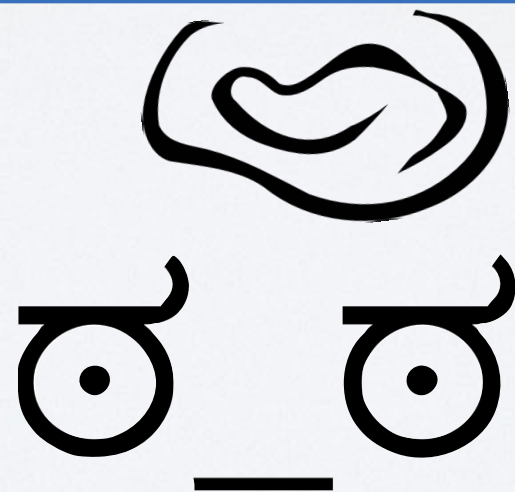
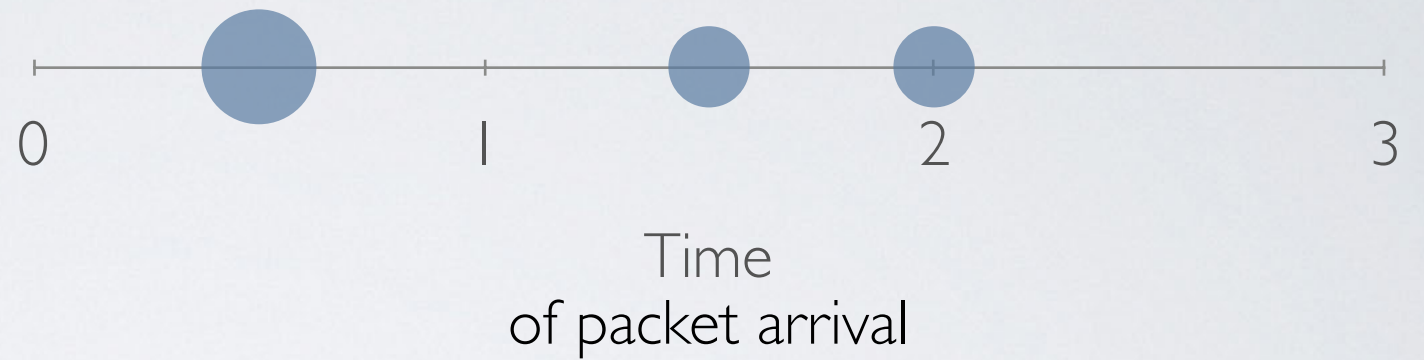
Time
of packet arrival



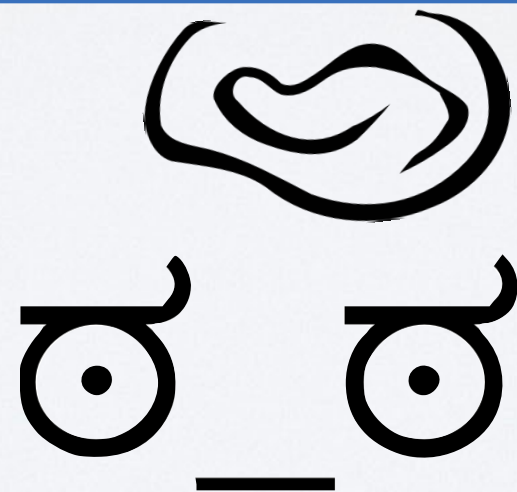
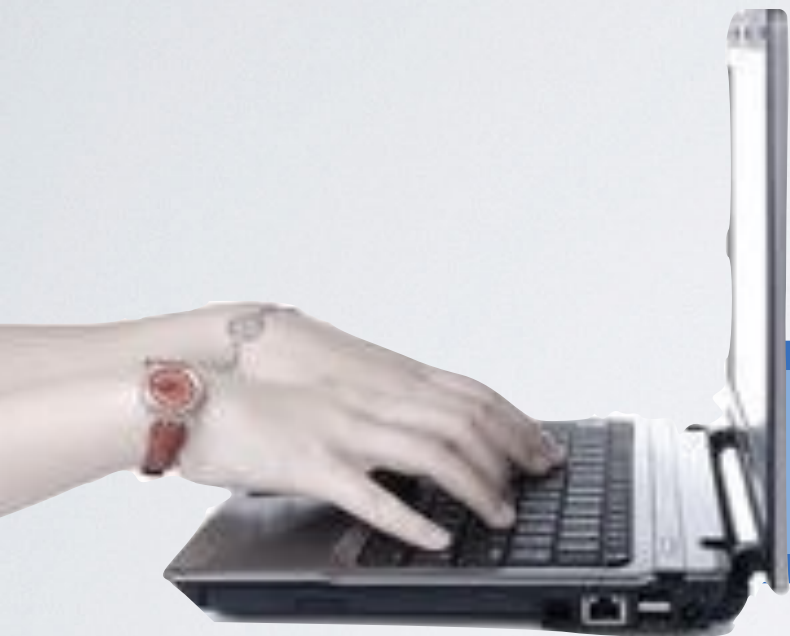
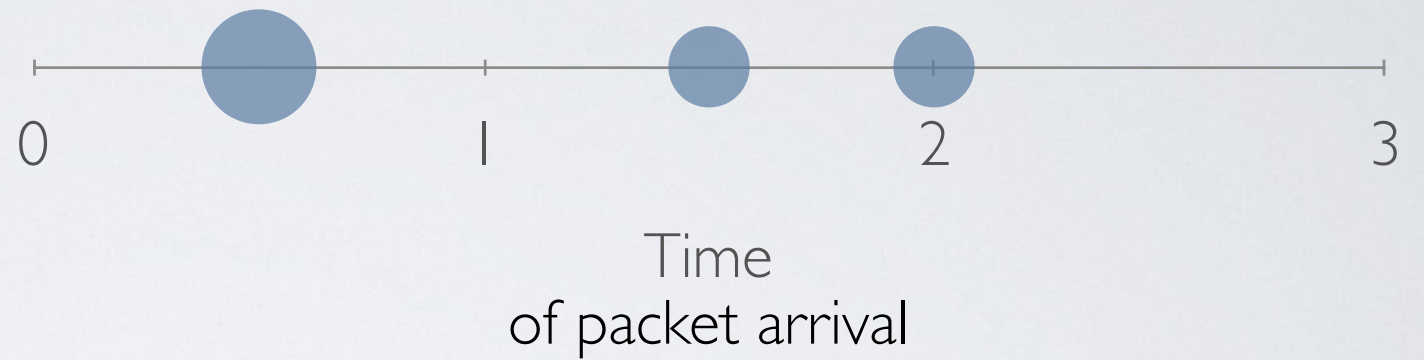
SIDE CHANNEL



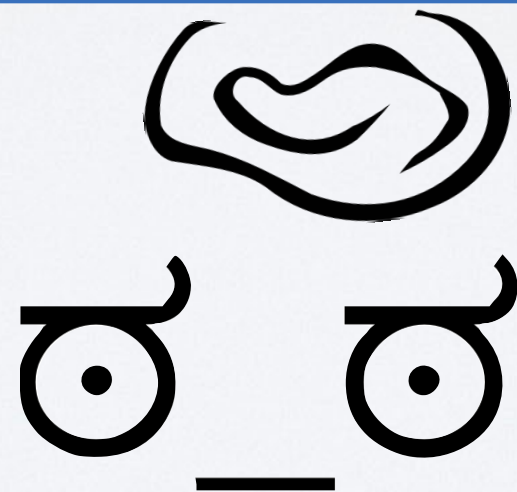
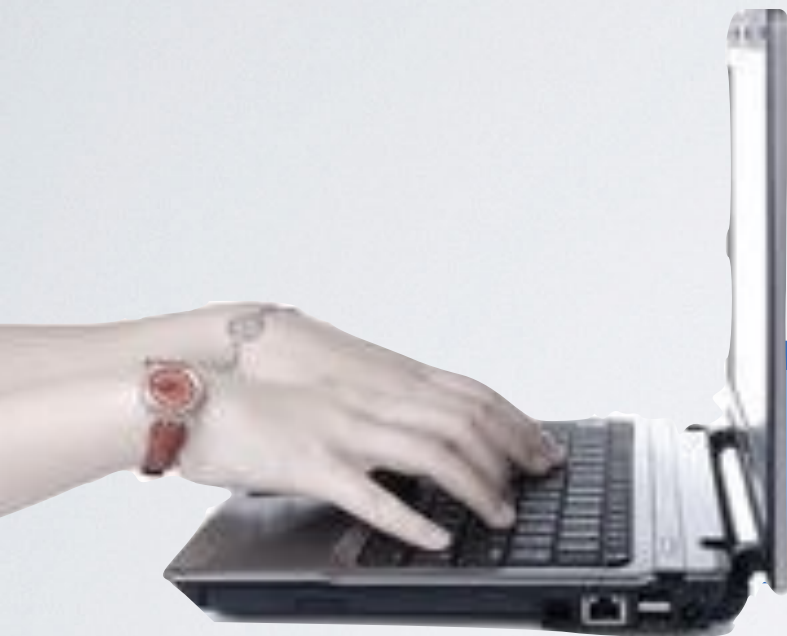
SIDE CHANNEL



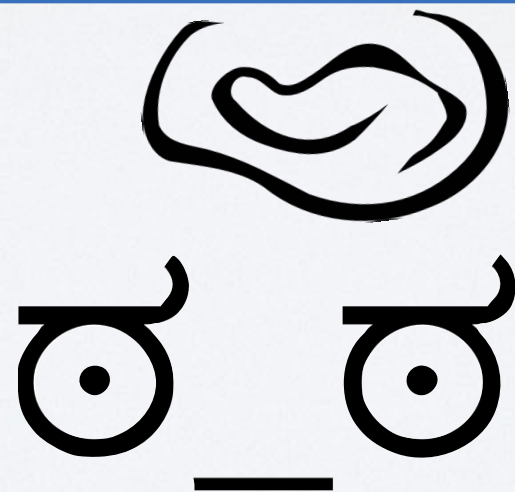
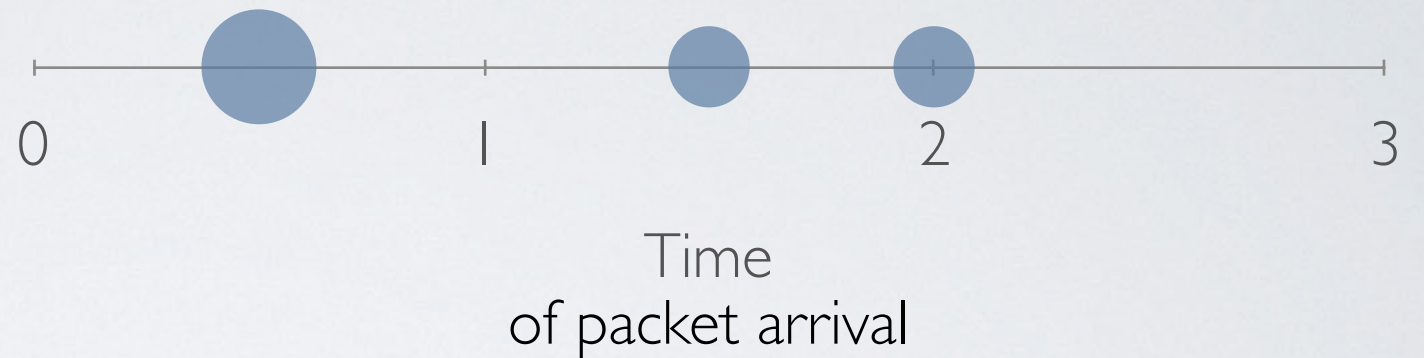
SIDE CHANNEL



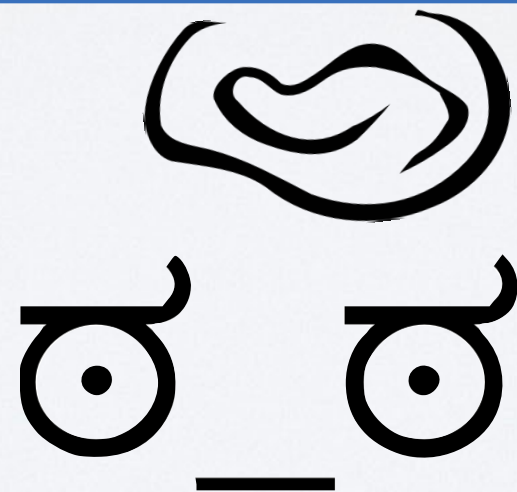
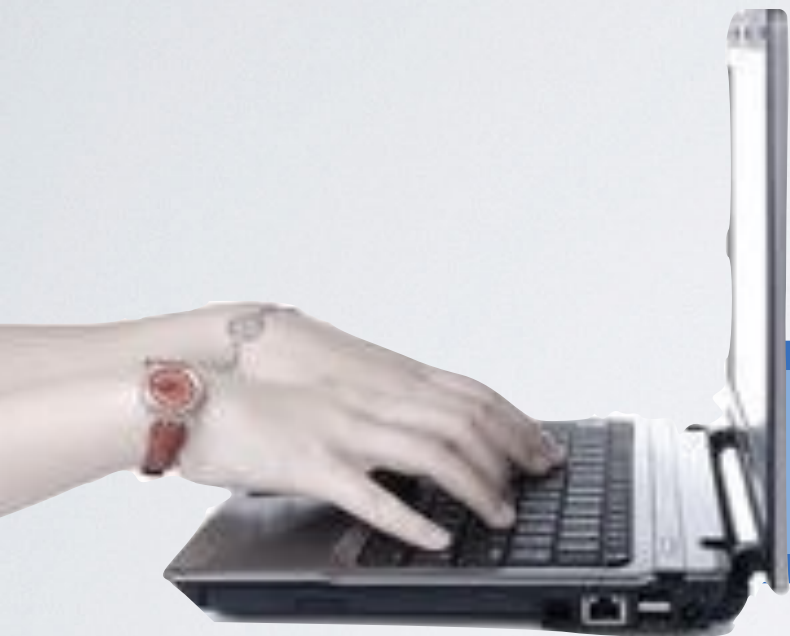
SIDE CHANNEL



SIDE CHANNEL



SIDE CHANNEL



SIDE CHANNEL

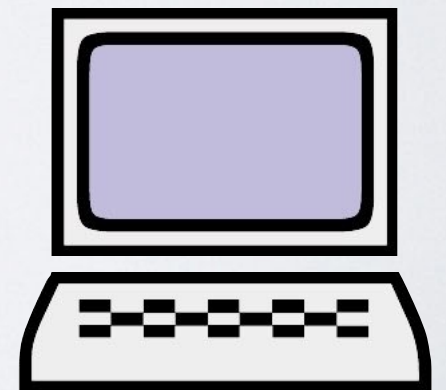
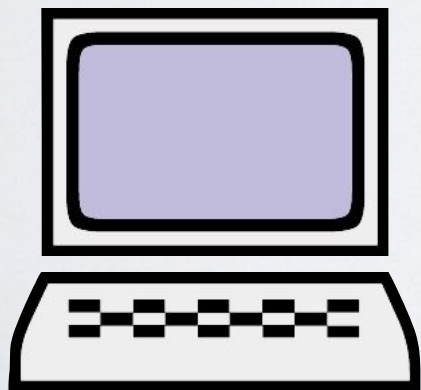
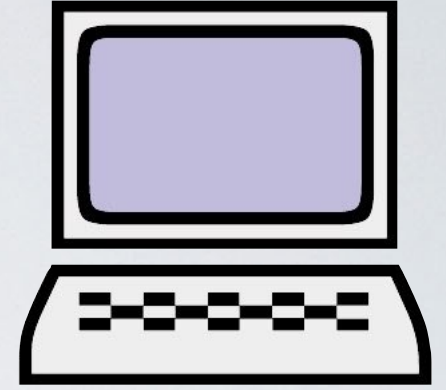
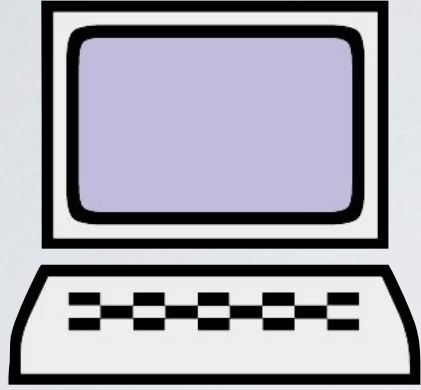


NETWORK FLOODING



NETWORKING 101

NETWORKING 101



NETWORKING 101



NETWORKING 101



NETWORKING 101



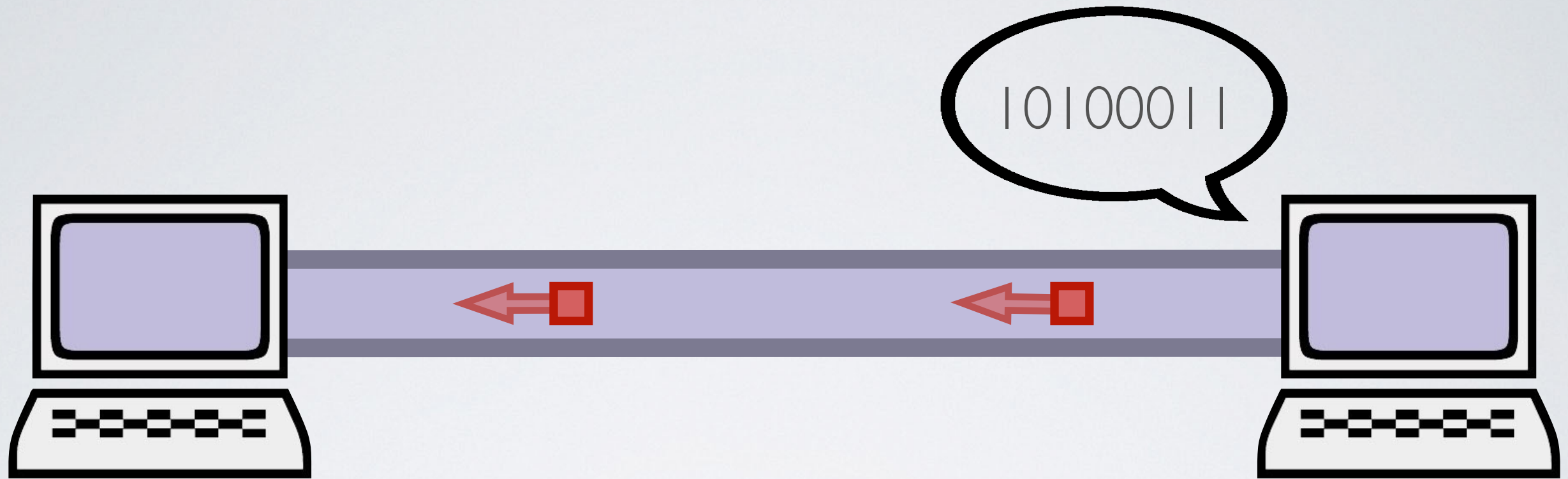
NETWORKING 101



NETWORKING 101

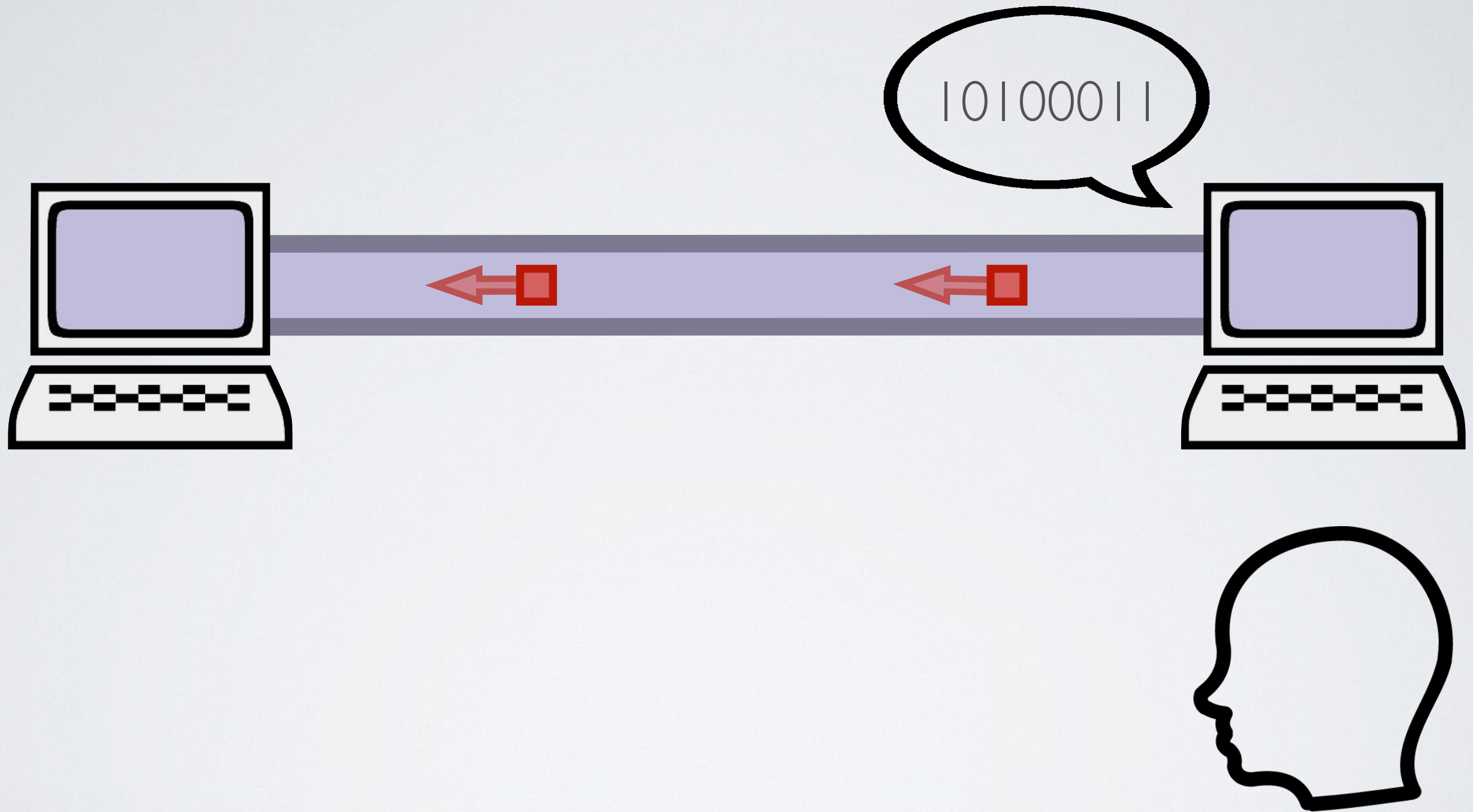


NETWORKING 101

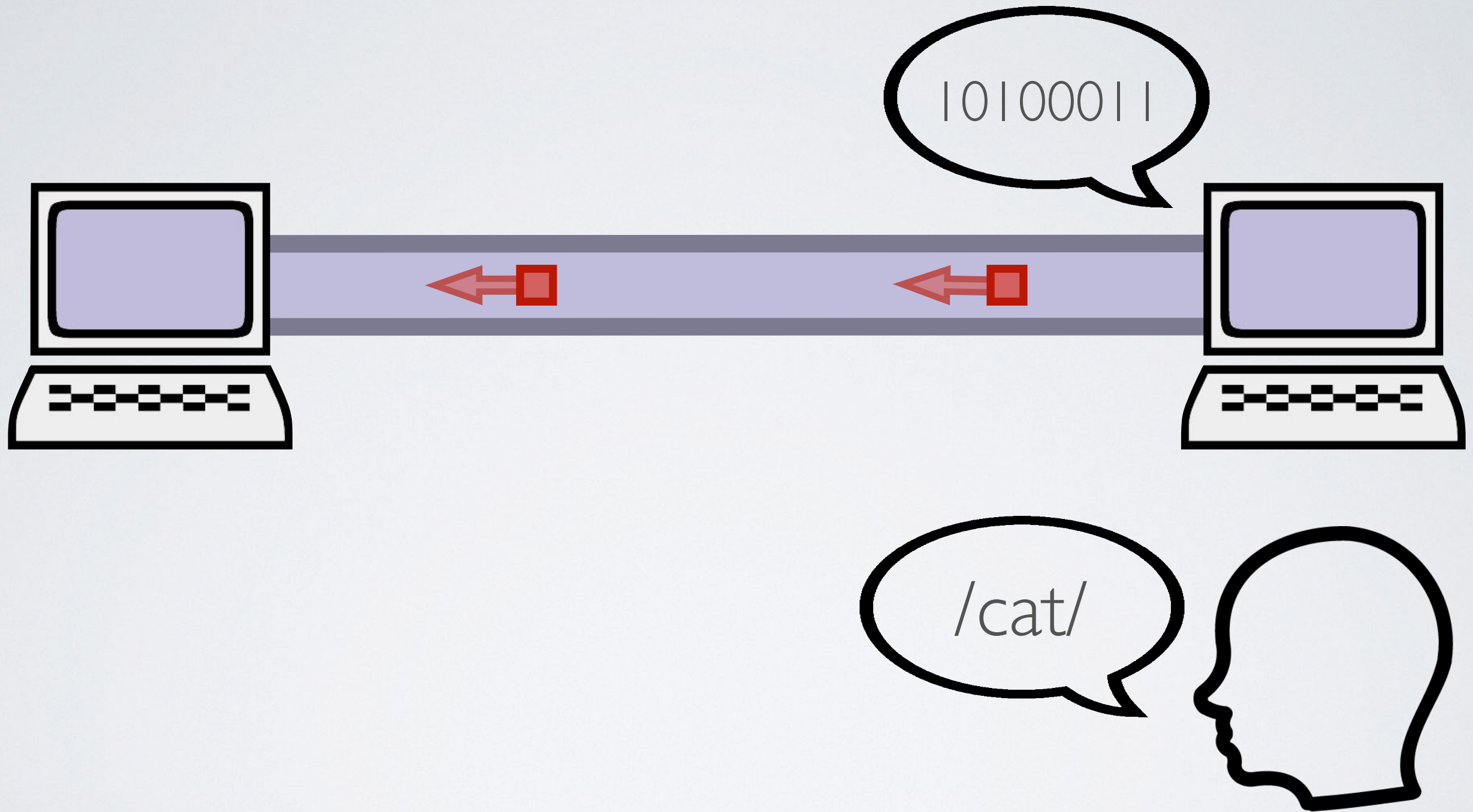


Technicality: Signals might be transmitted as analog.

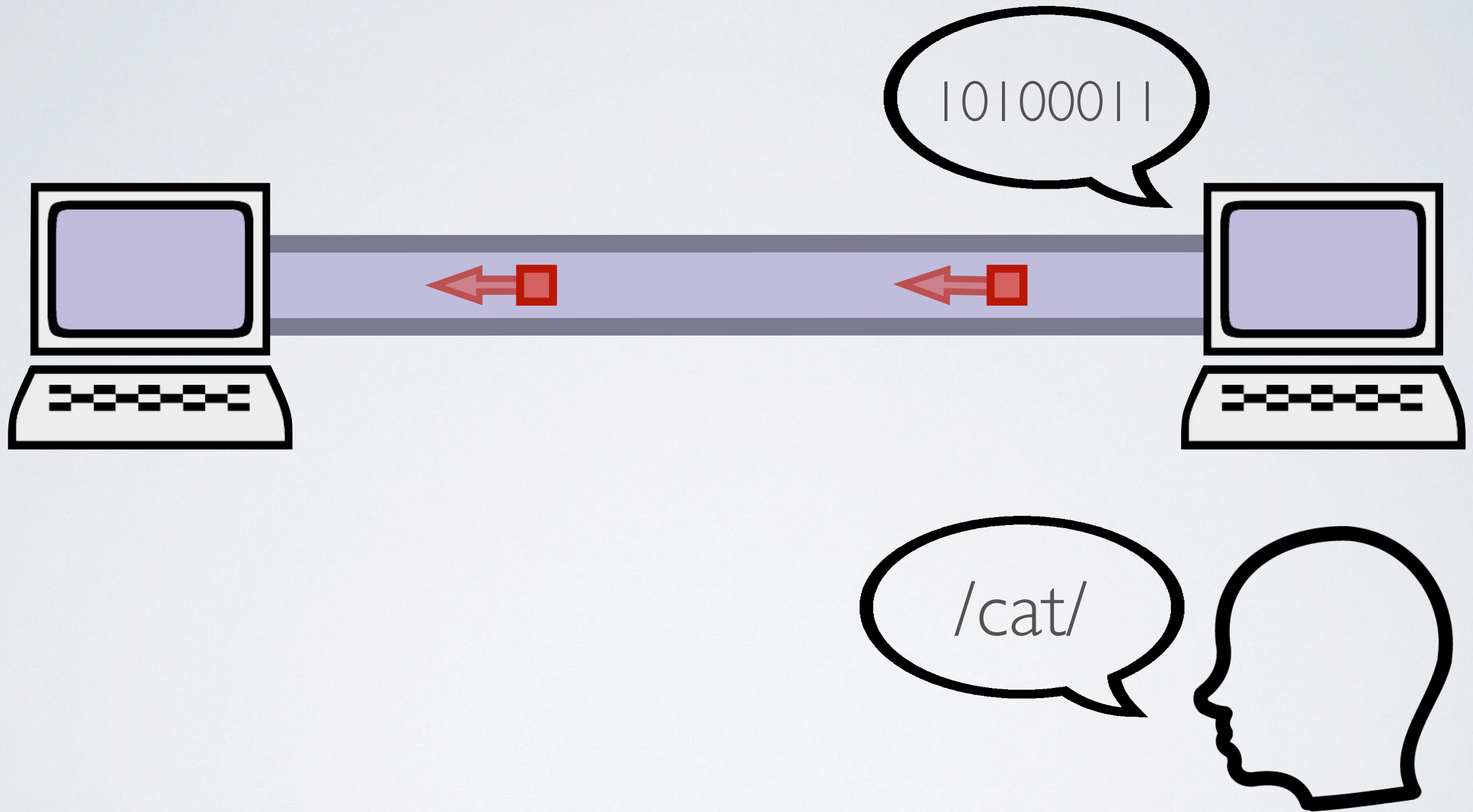
NETWORKING 101



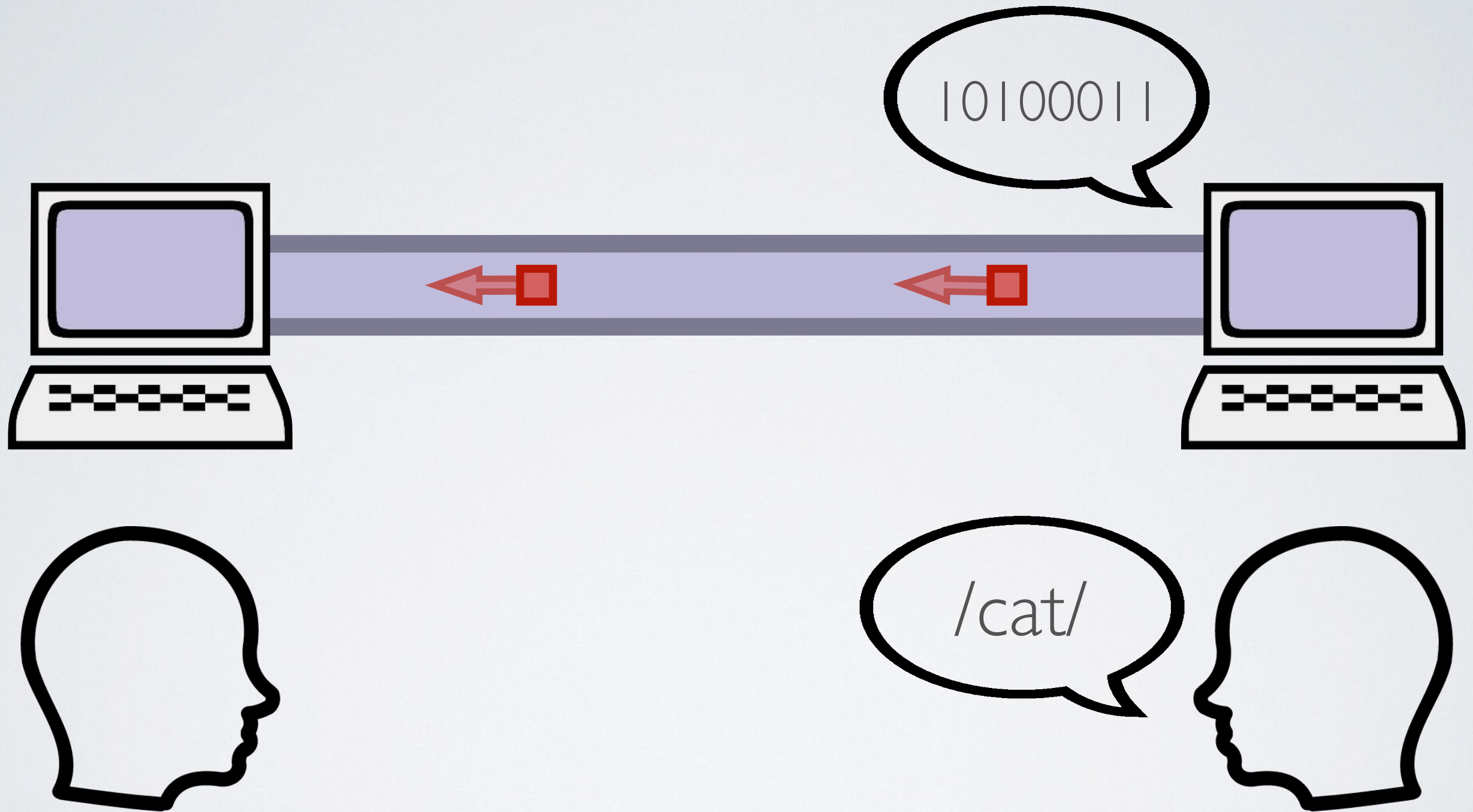
NETWORKING 101



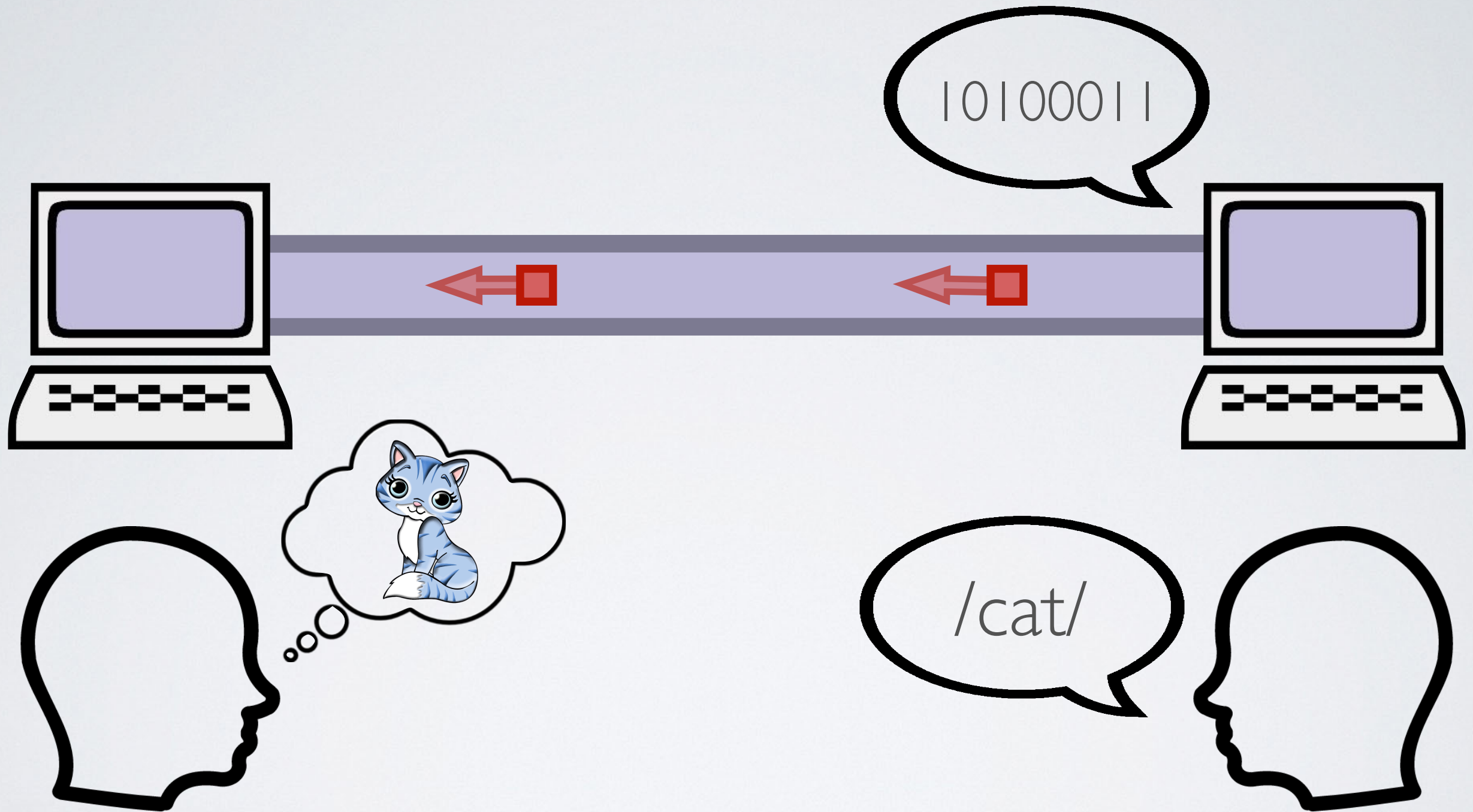
NETWORKING 101



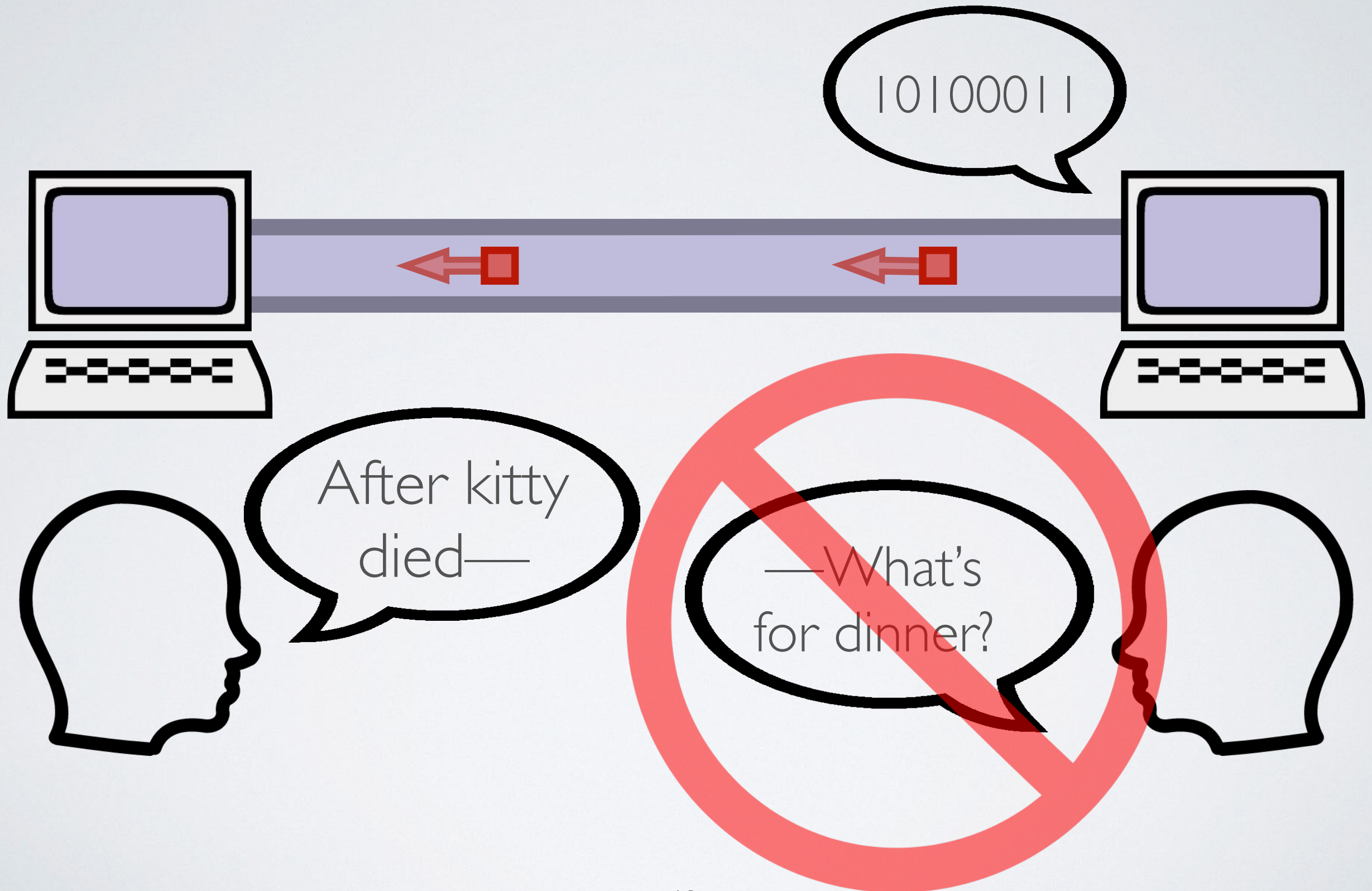
NETWORKING 101



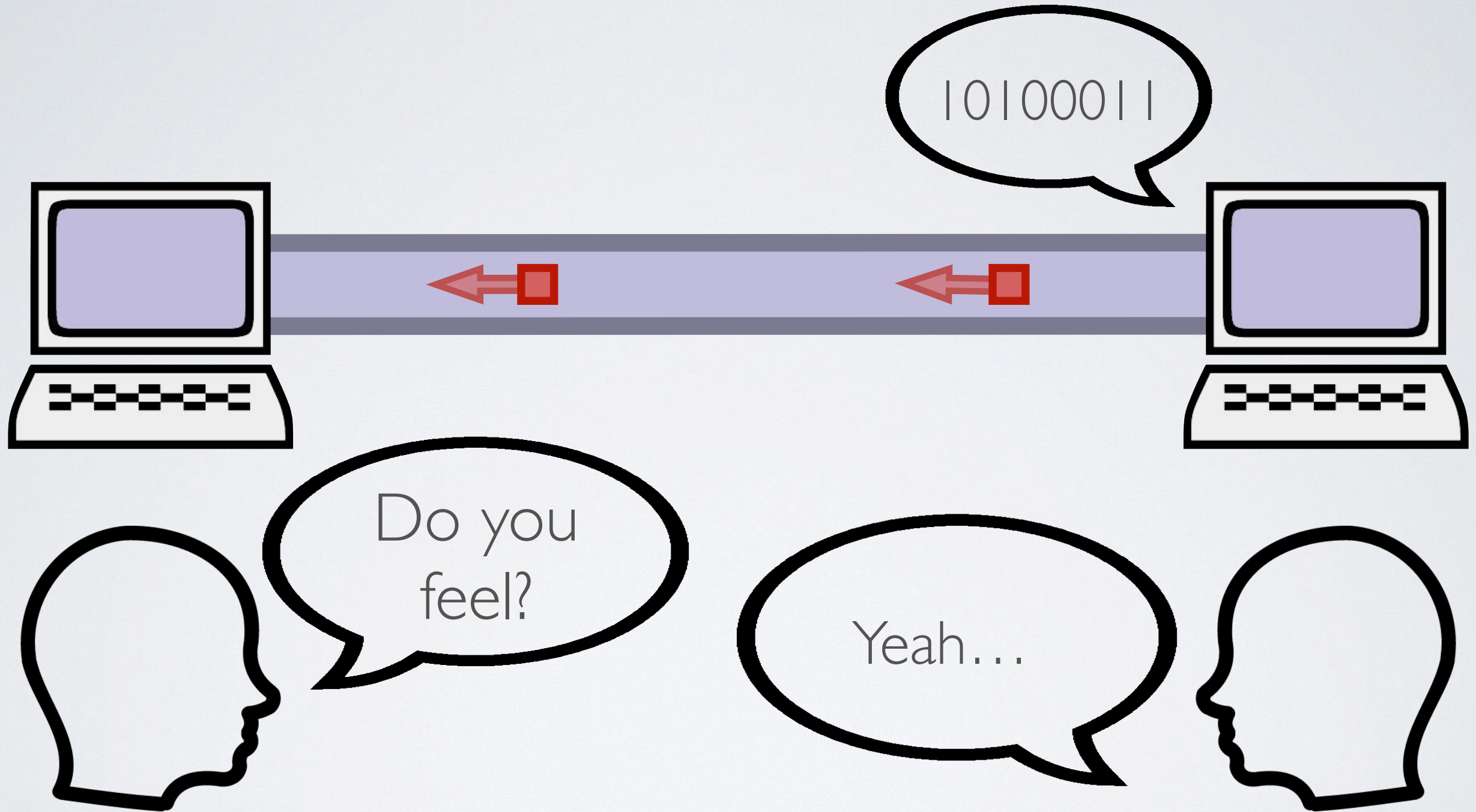
NETWORKING 101



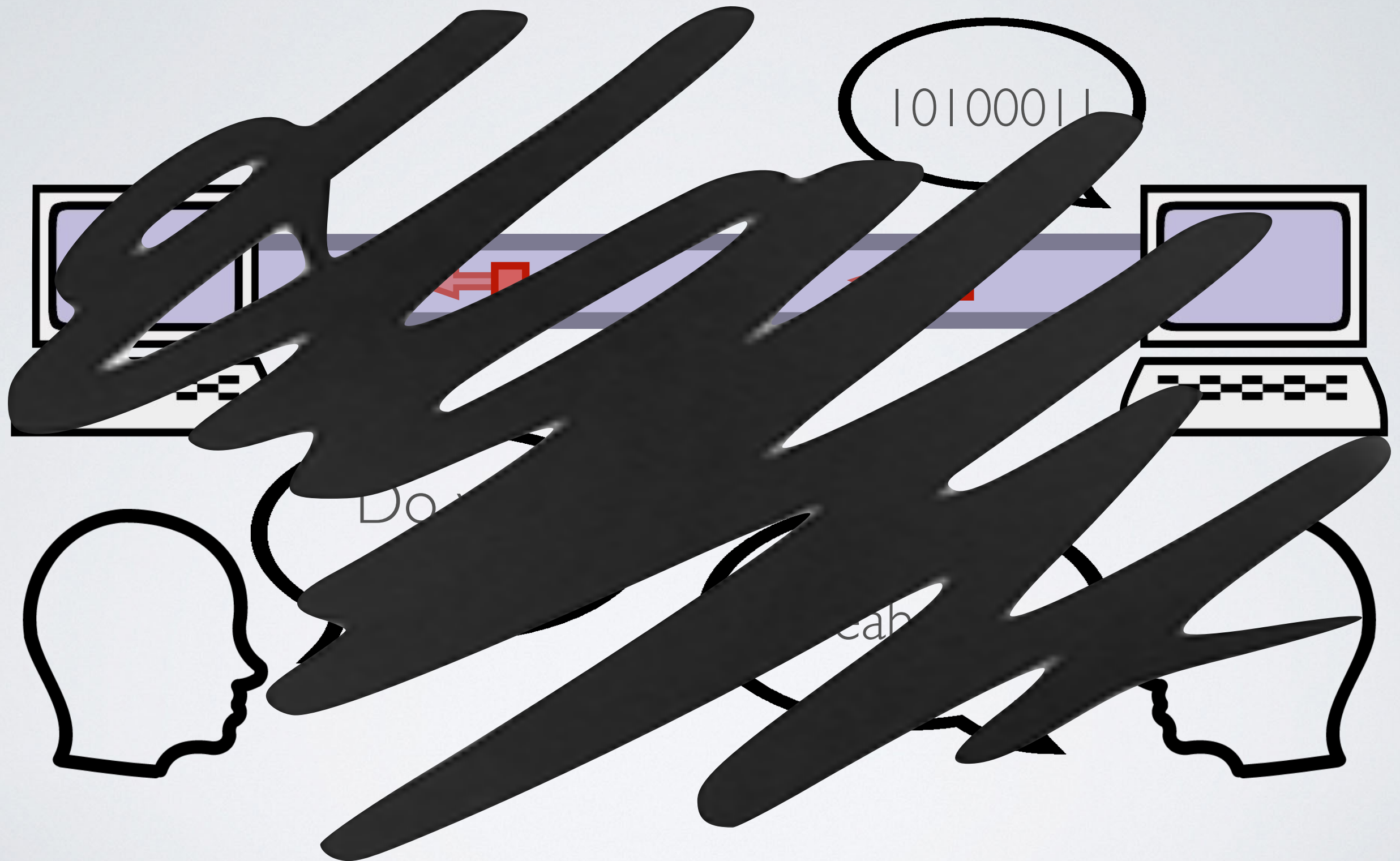
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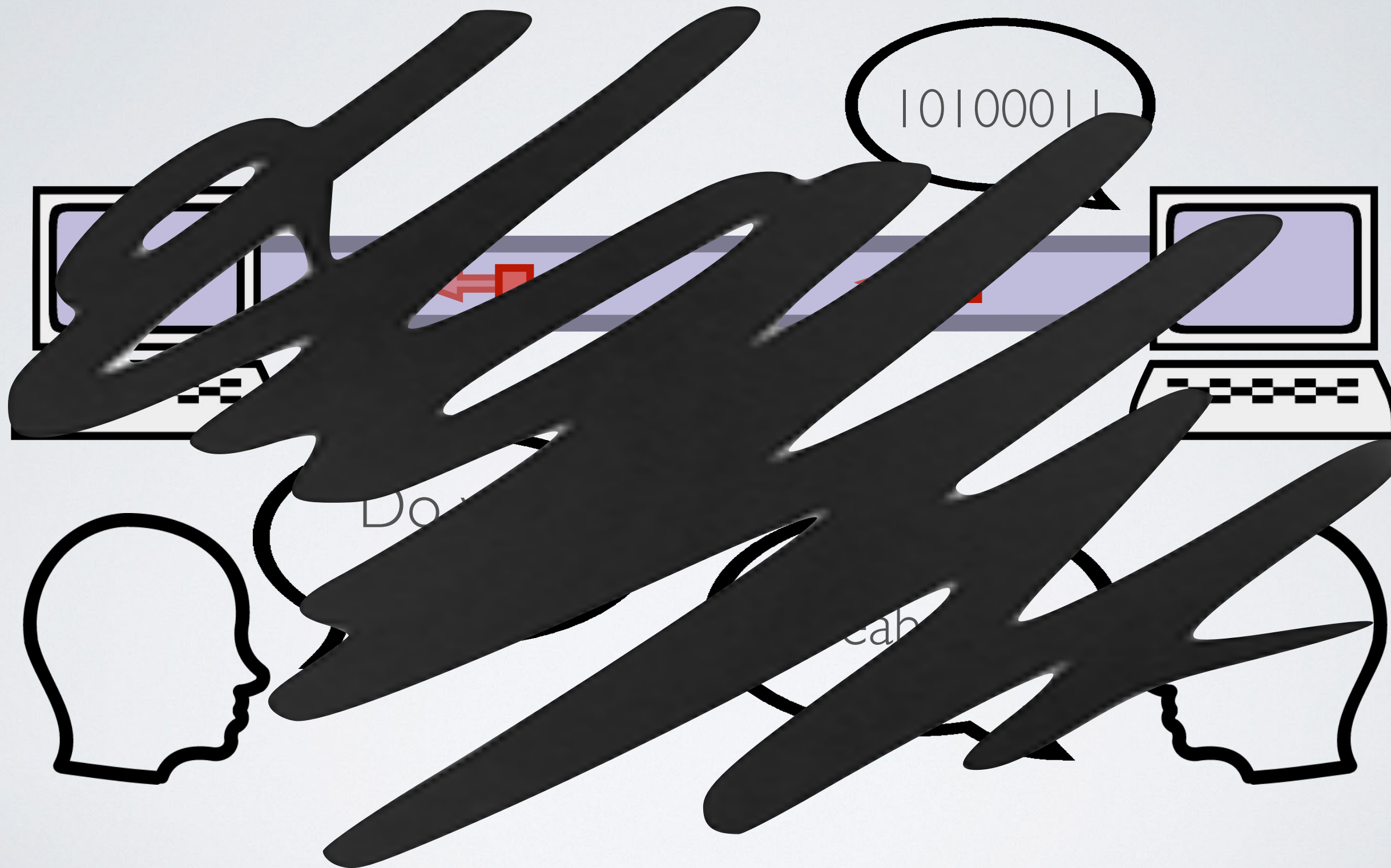
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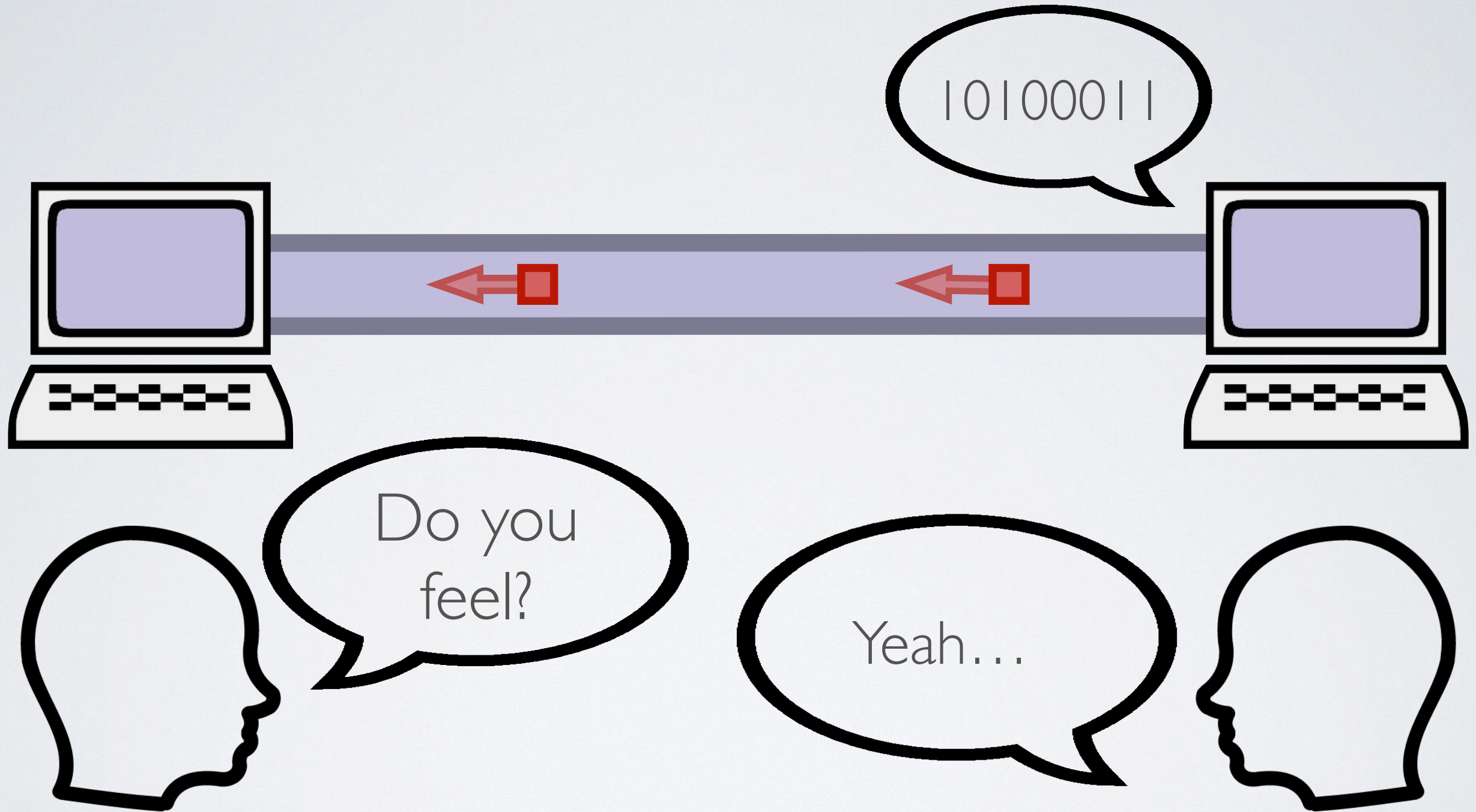
NETWORKING 101



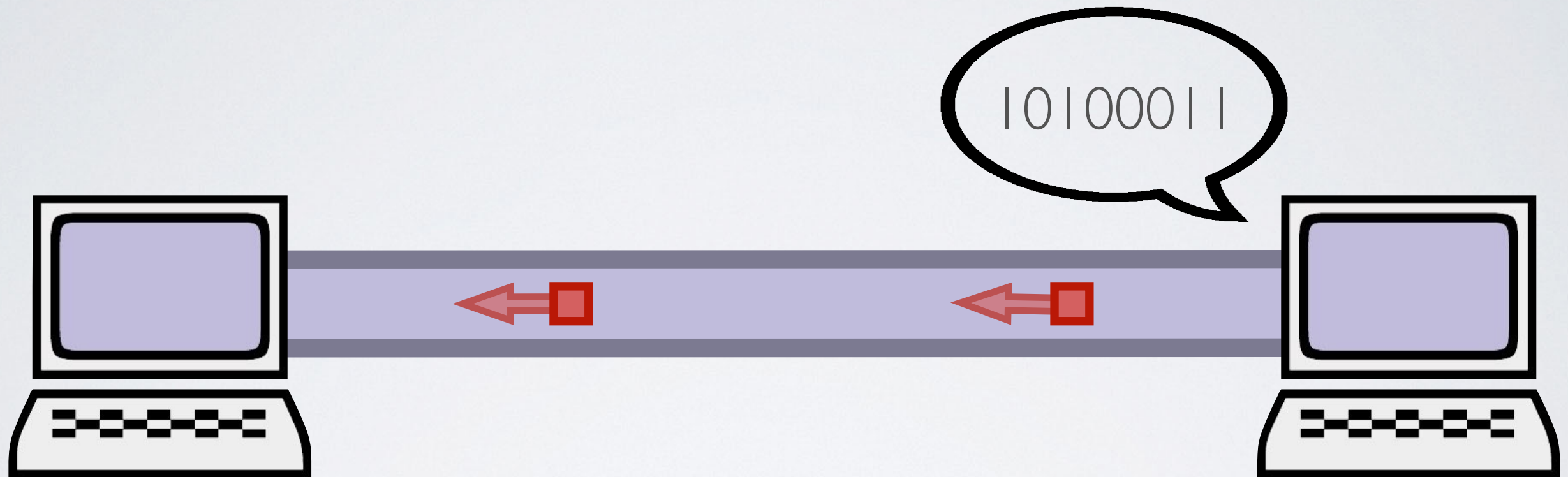
PROTOCOLS



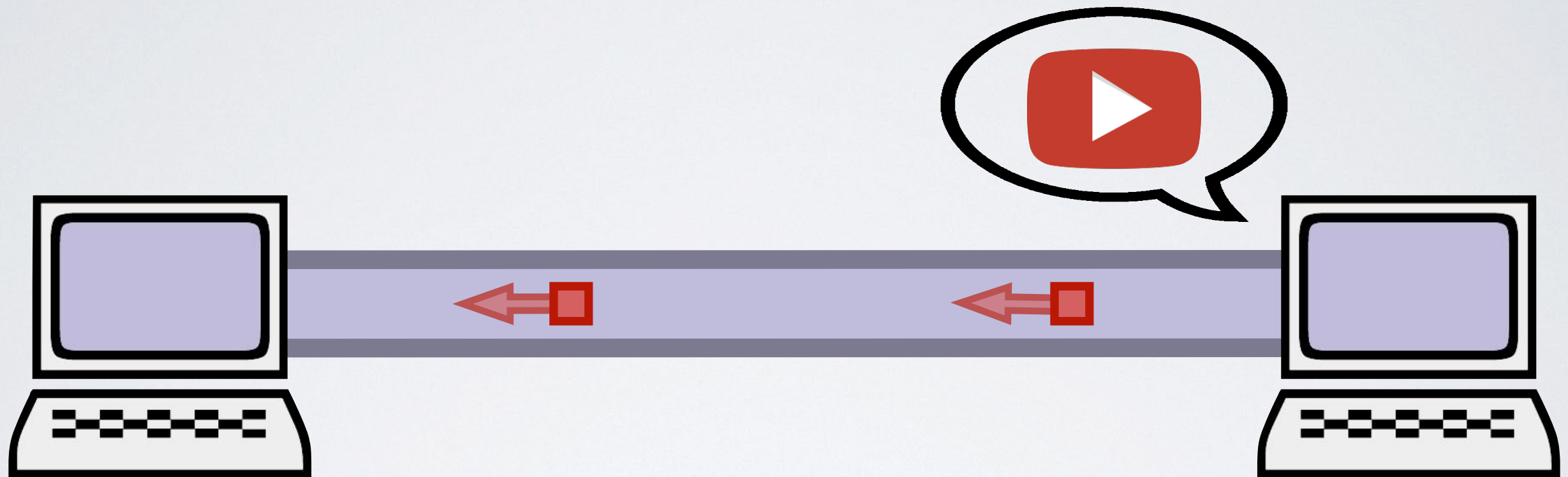
PROTOCOLS



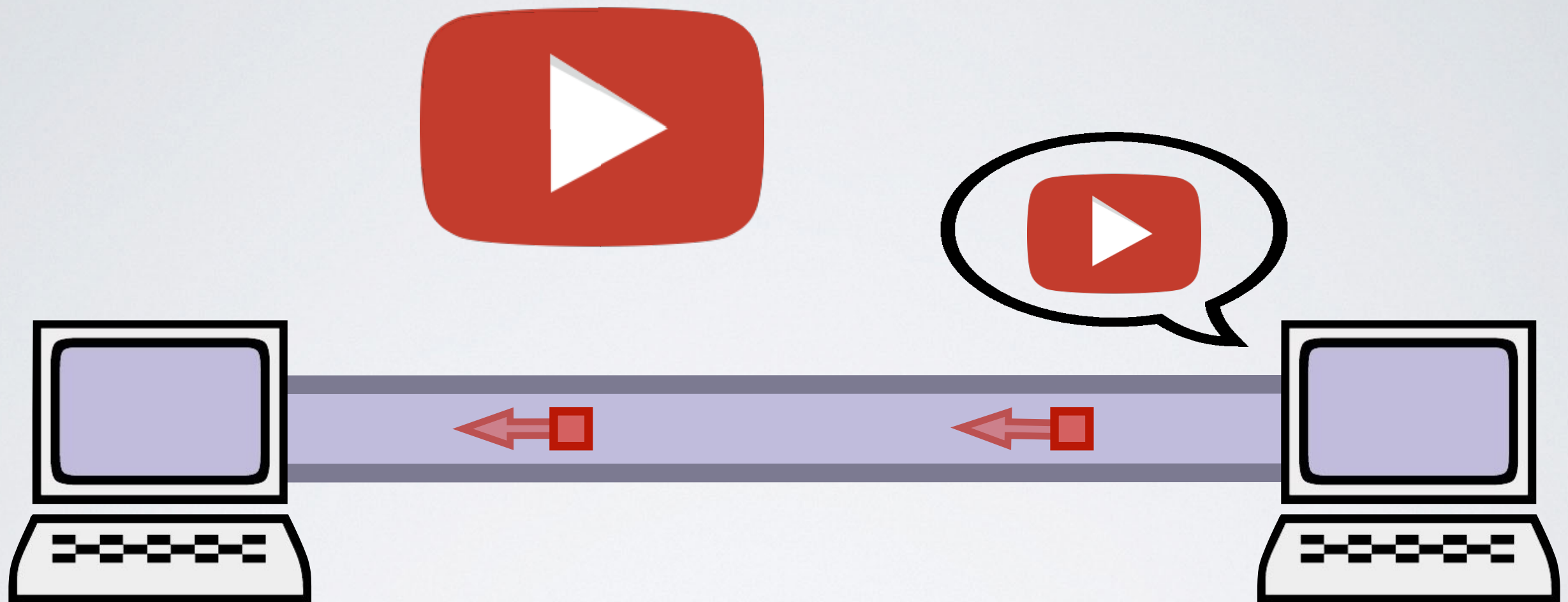
PROTOCOLS



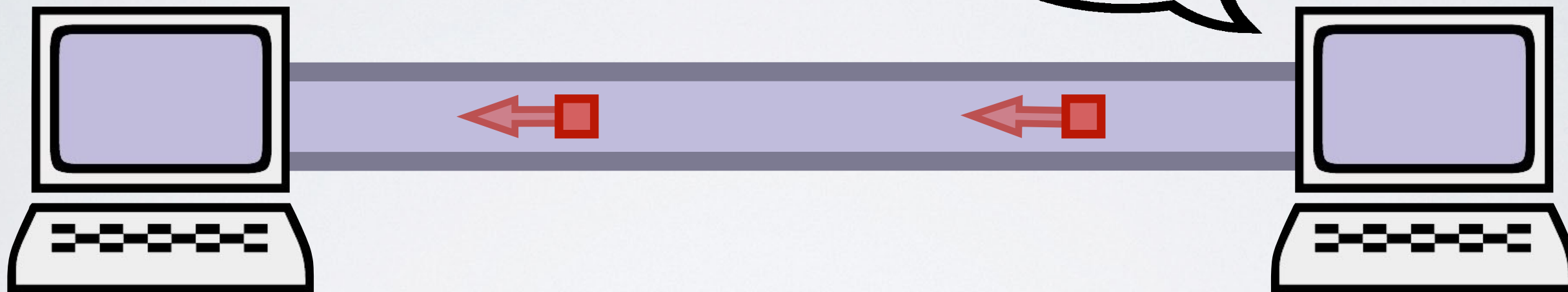
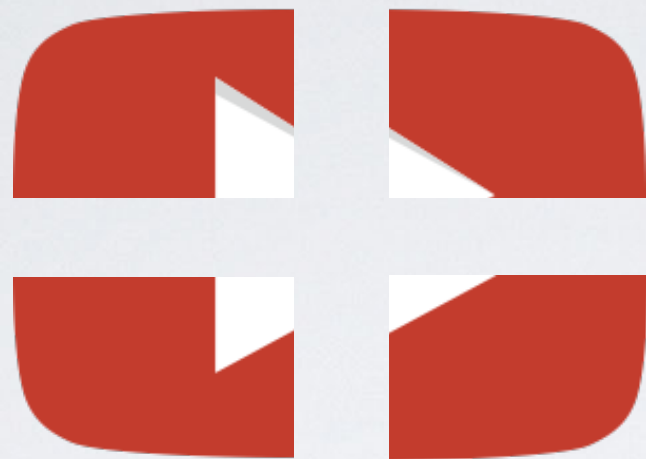
PROTOCOLS



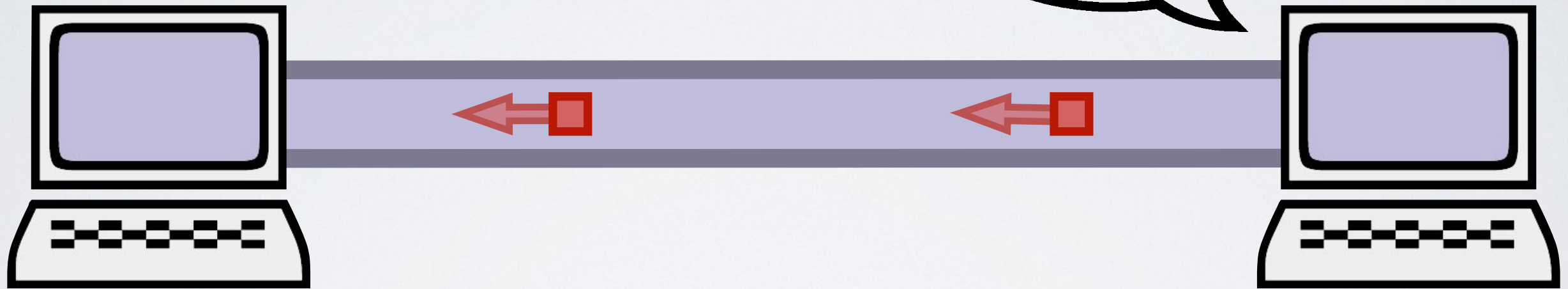
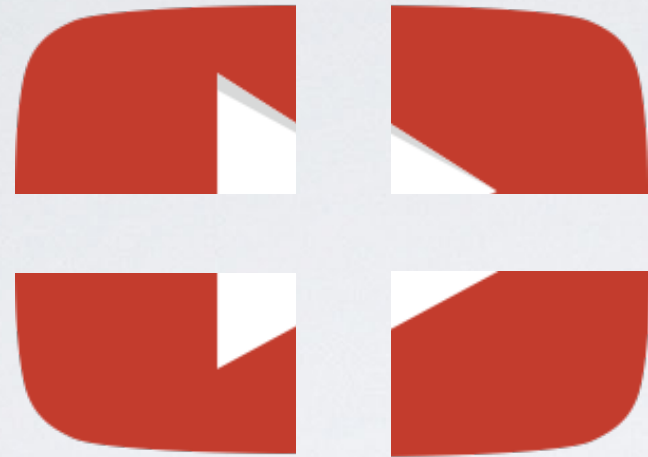
PROTOCOLS



PROTOCOLS

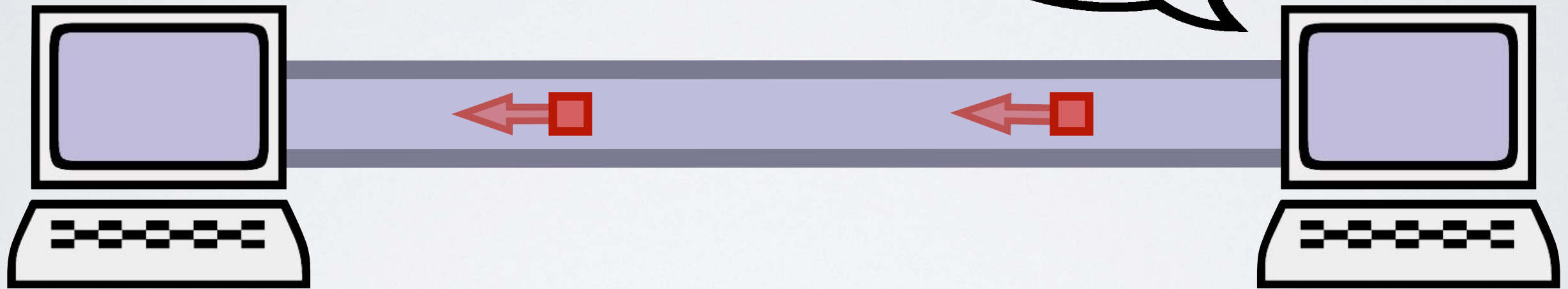
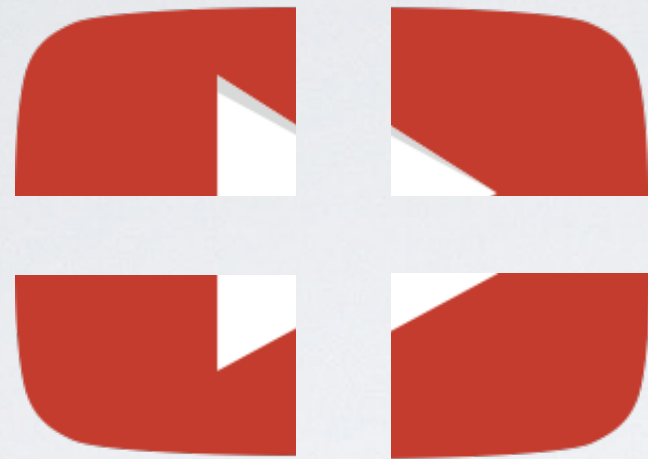


PROTOCOLS



Fragmentation

PROTOCOLS



Fragmentation

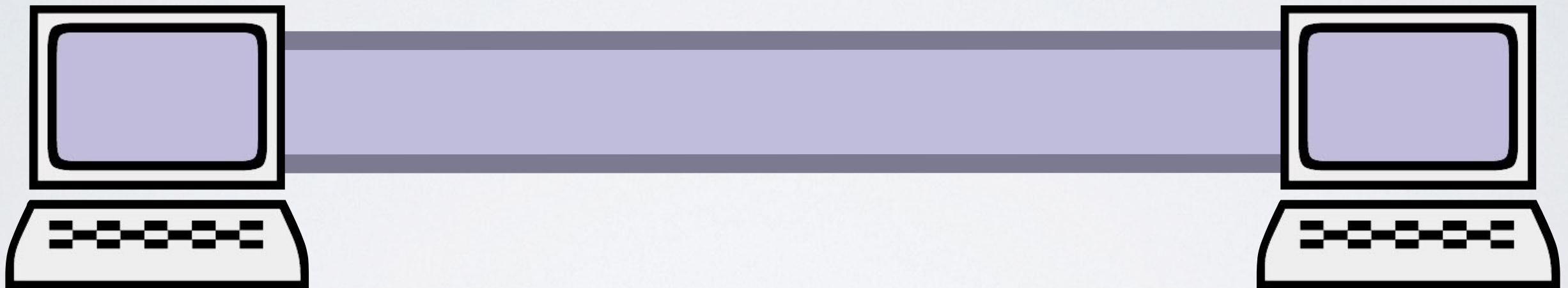
Abstraction

TCP

TCP

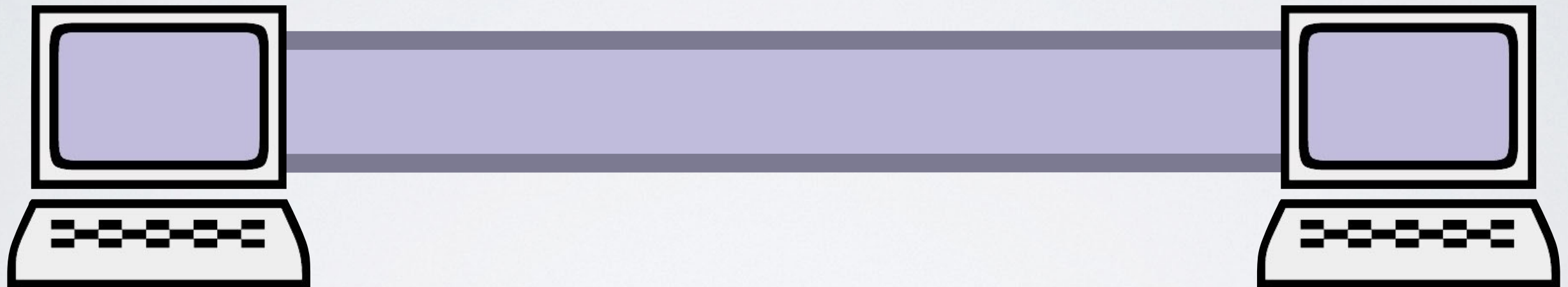
Retransmission

TCP



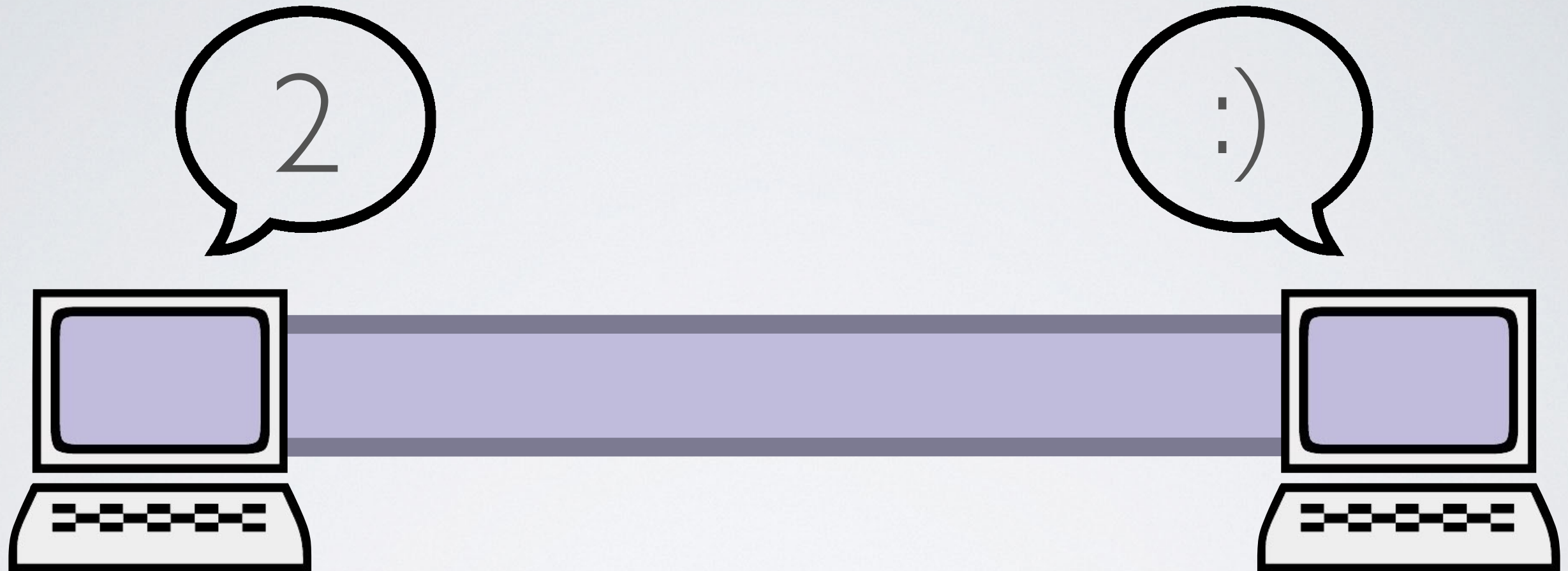
Retransmission

TCP



Retransmission

TCP



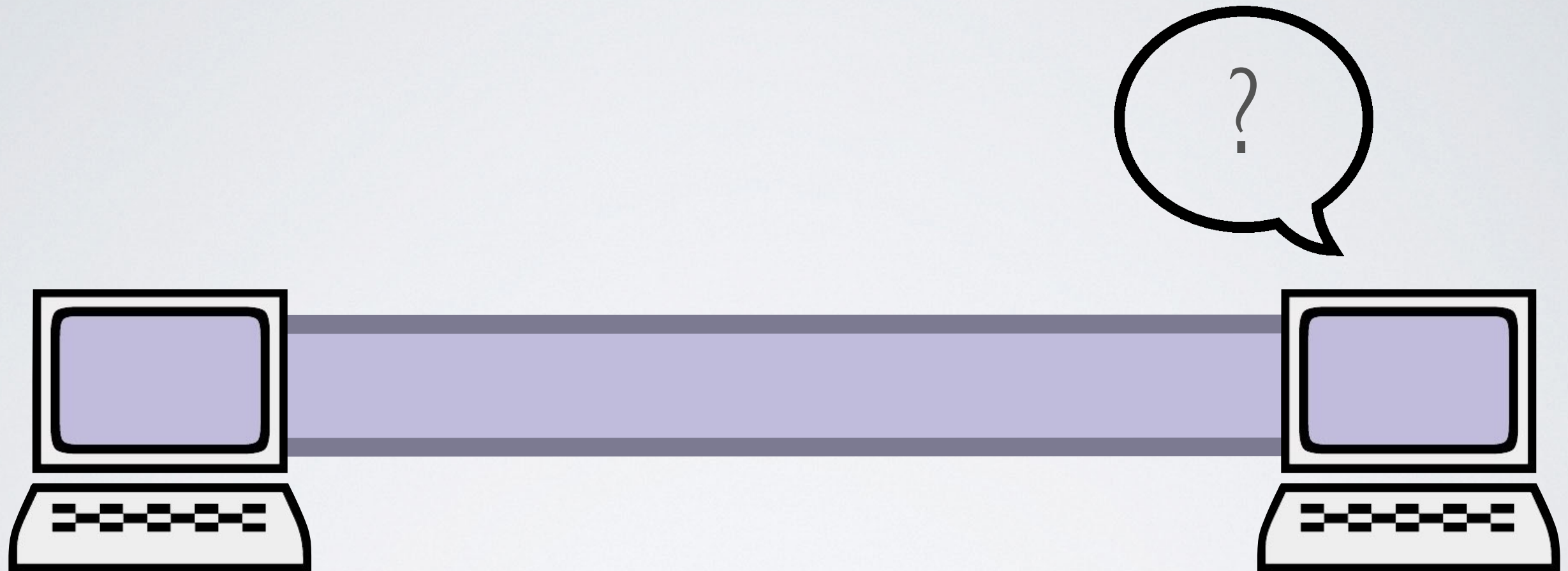
Retransmission

TCP



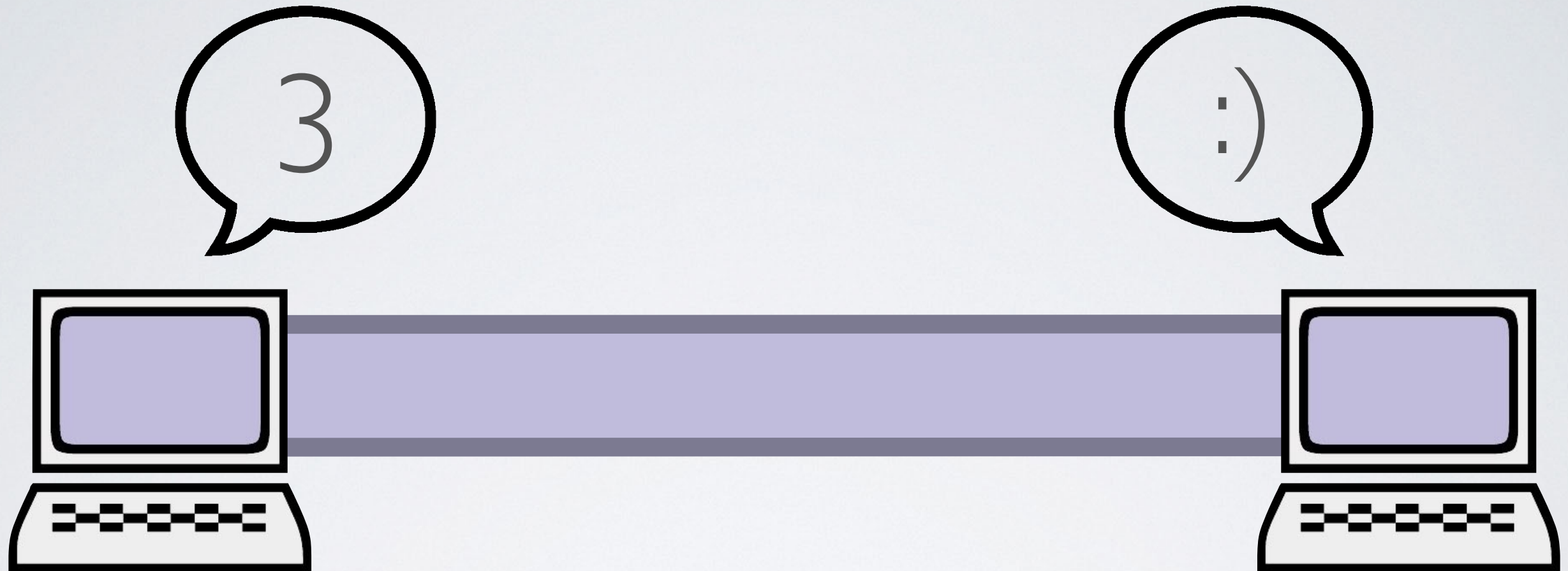
Retransmission

TCP



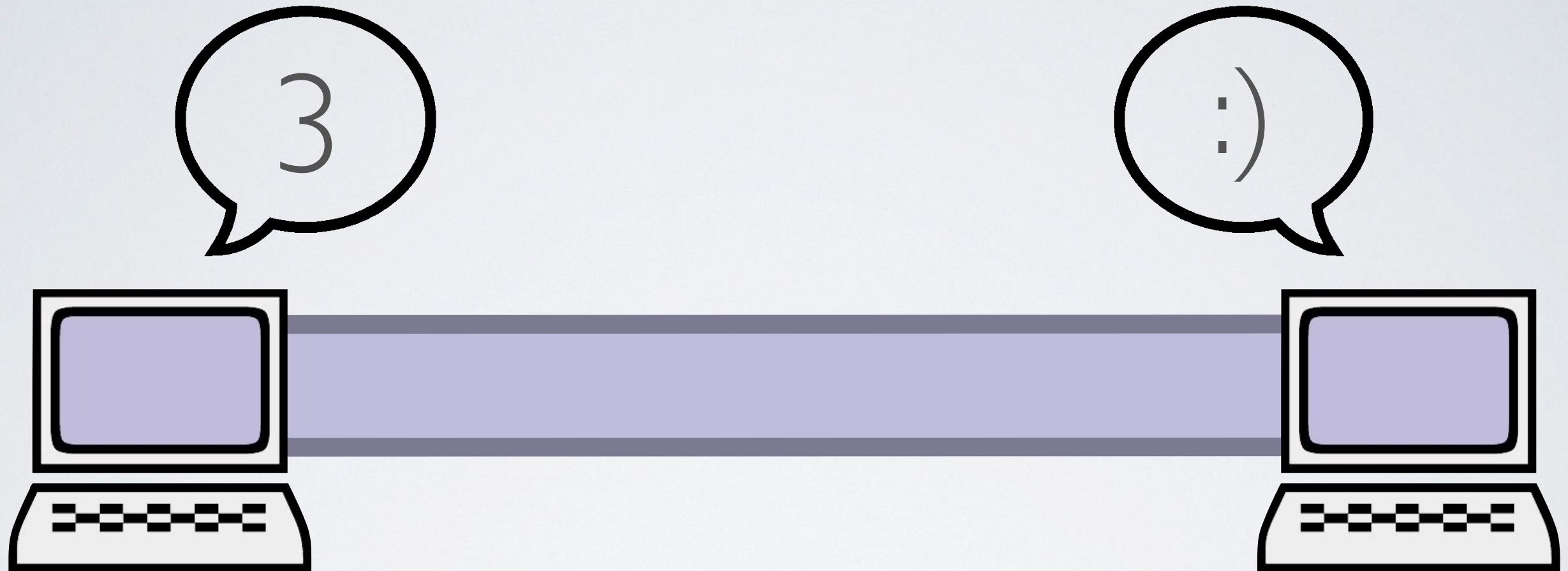
Retransmission

TCP



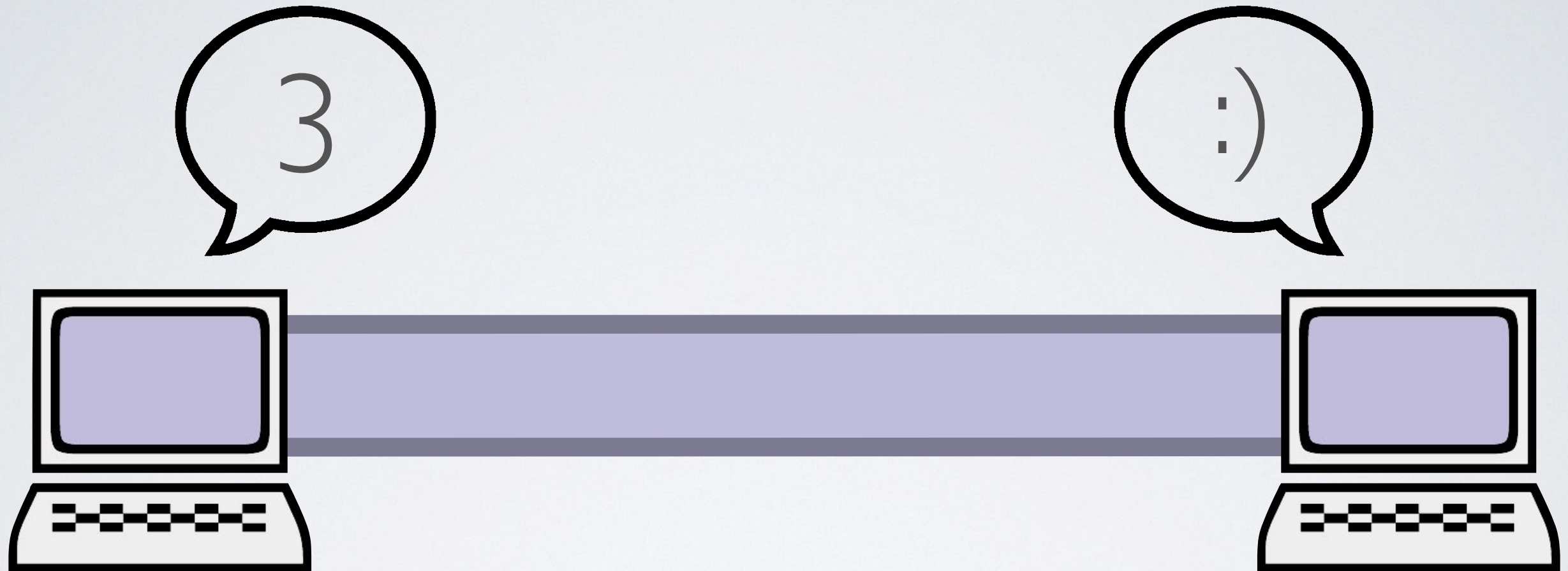
Retransmission

TCP



Retransmission

TCP



Congestion Control

UDP

UDP



UDP



UDP



UDP



METRICS

METRICS

Bandwidth

METRICS

Σ data received

Bandwidth

METRICS

Σ data received

Δ time

Bandwidth

METRICS

packets received

Δ time

Bandwidth

Packet
Loss

METRICS

$\frac{\text{# packets received}^{\text{not}}}{\Delta \text{ time}}$

Bandwidth

Packet Loss

METRICS

$\frac{\# \text{ packets received}^{\text{not}}}{\# \text{ packets sent}}$

Bandwidth

Packet Loss

METRICS

$\frac{\# \text{ packets received}^{\text{not}}}{\# \text{ packets sent}}$

Bandwidth

packets sent

Packet Loss

NETWORKING 101



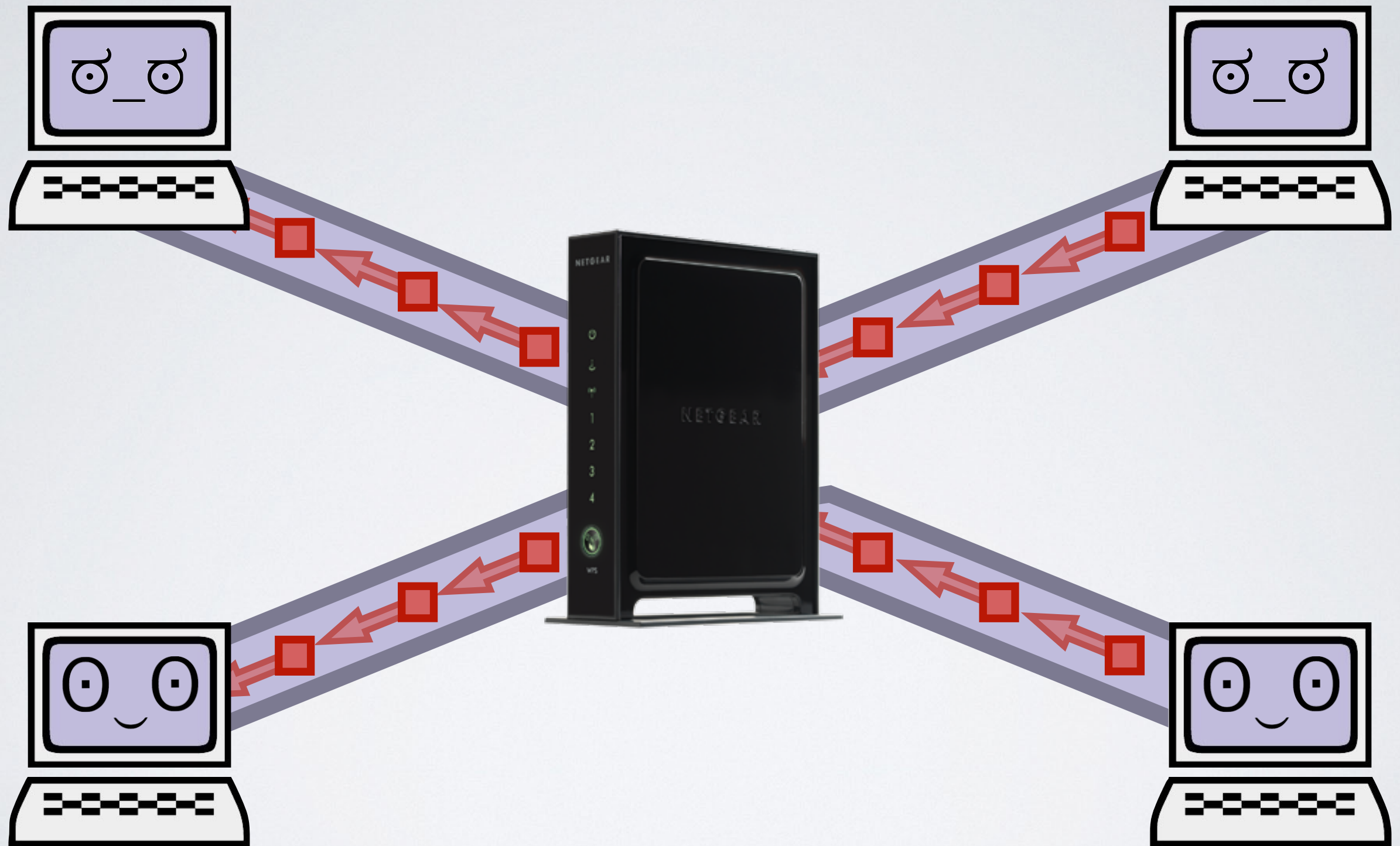
NETWORKING 101



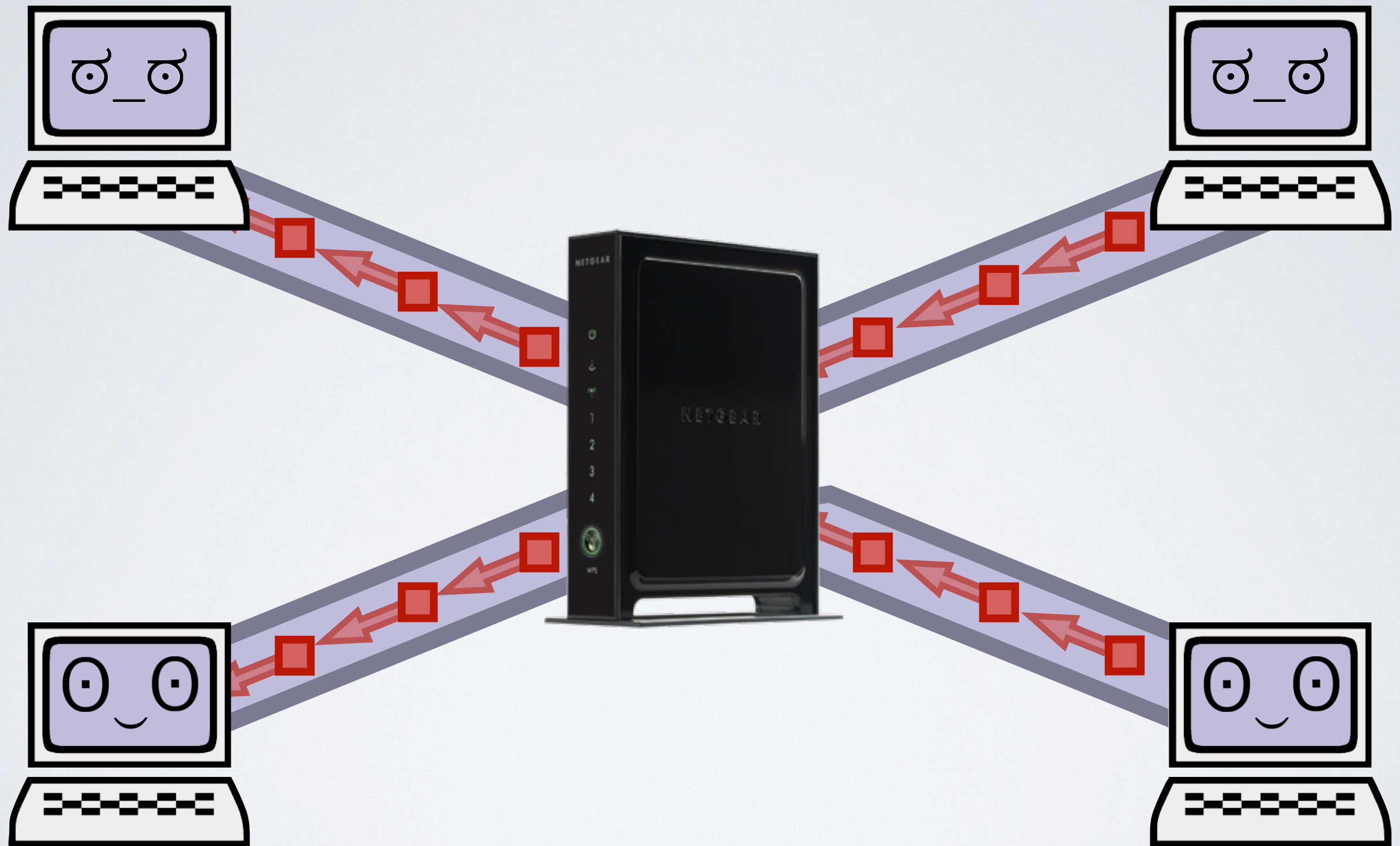
NETWORKING 101

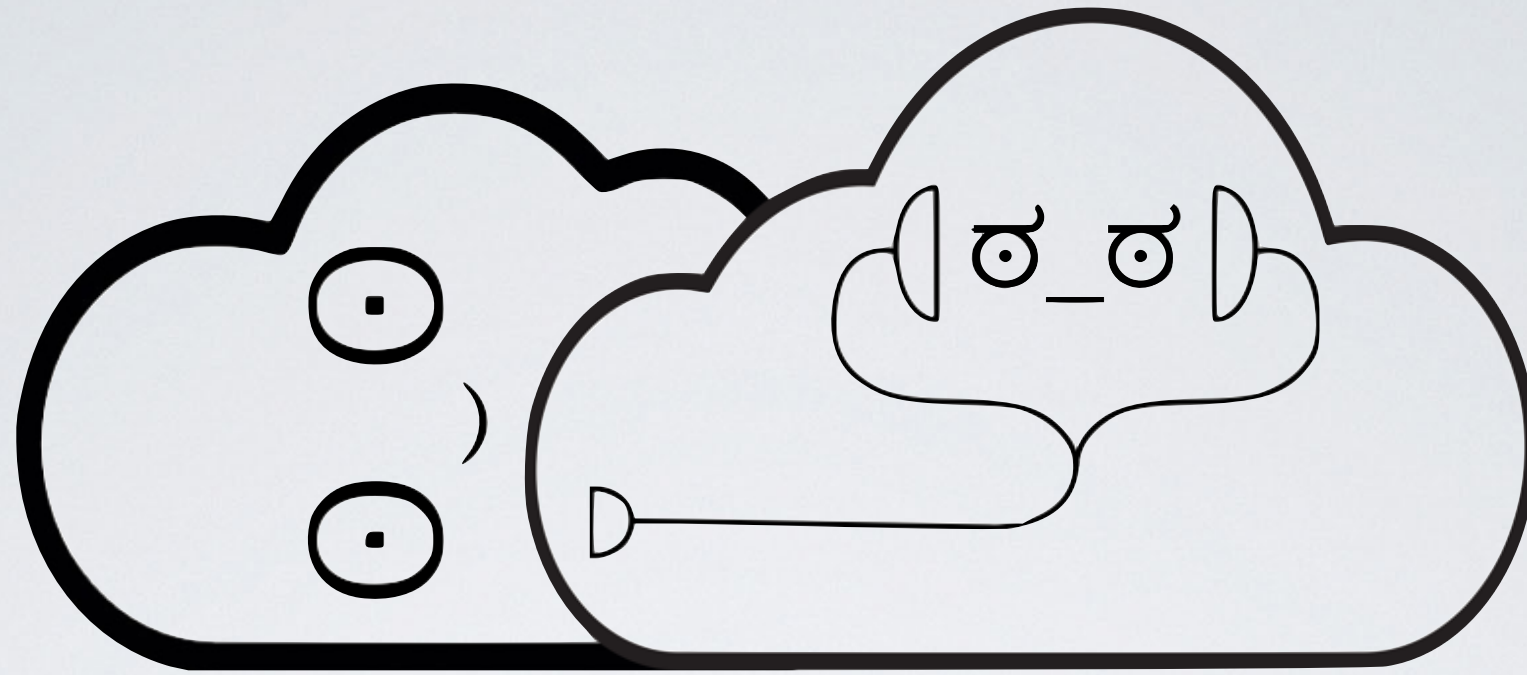


NETWORK FLOODING



NETWORK FLOODING





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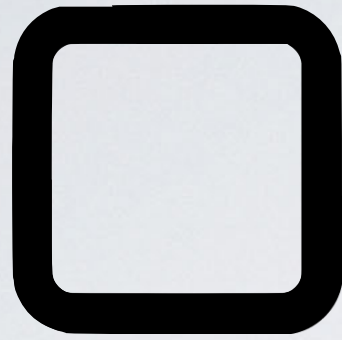
Network Flooding



Side Channel



Cloud Environments



Network Flooding



Side Channel



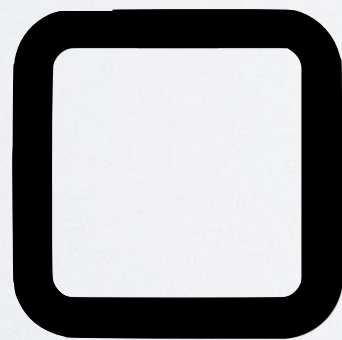
Cloud Environments



Network Flooding



Side Channel



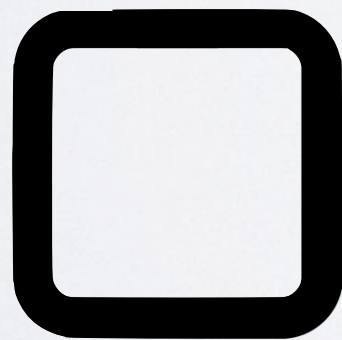
Cloud Environments



Network Flooding

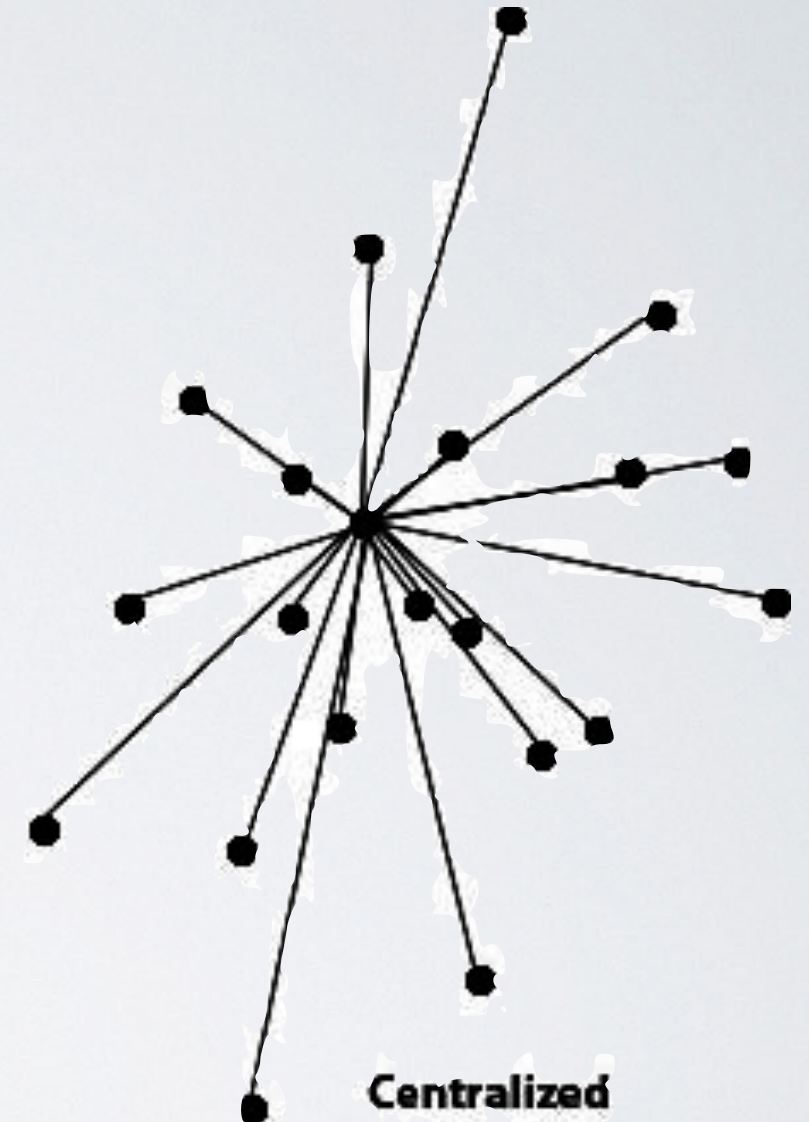


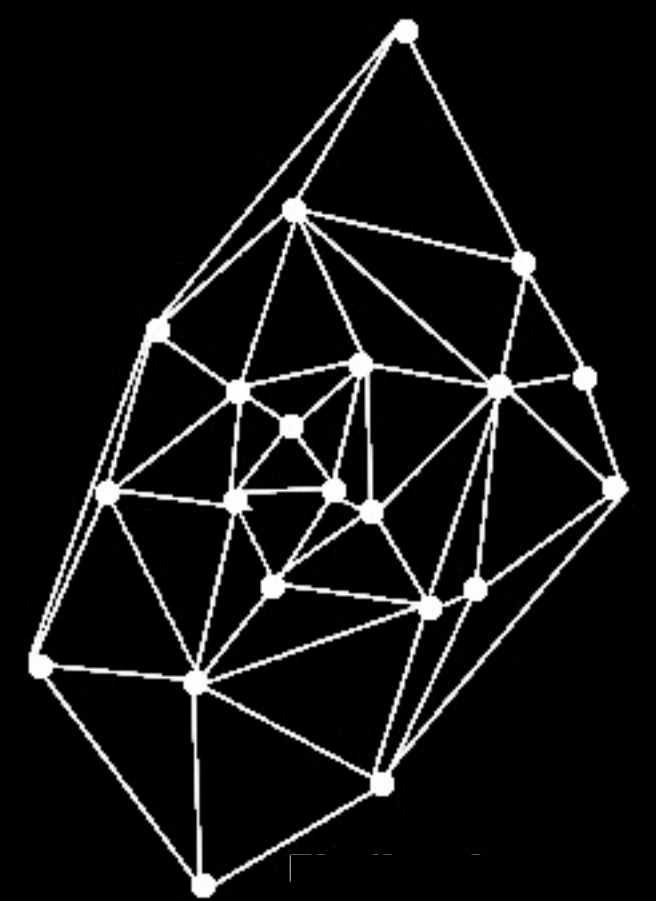
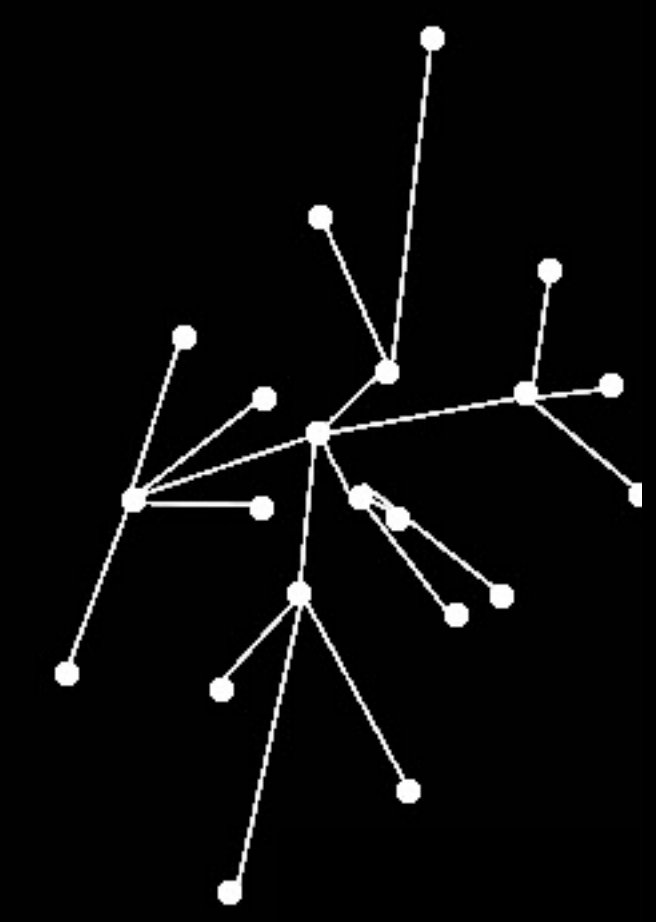
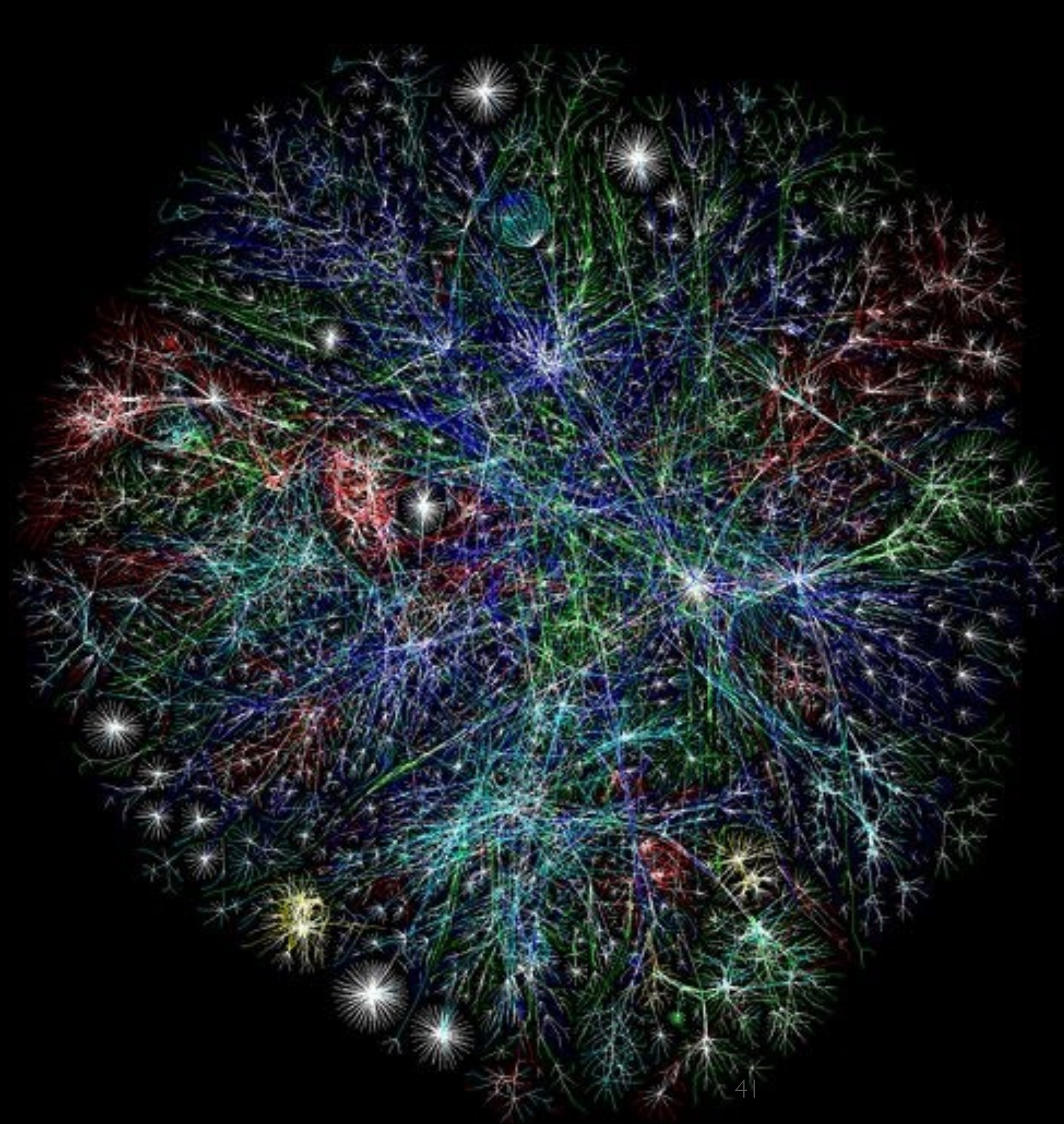
Side Channel



Cloud Environments

NETWORKING 101





CLOUD

CLOUD



CLOUD



CLOUD

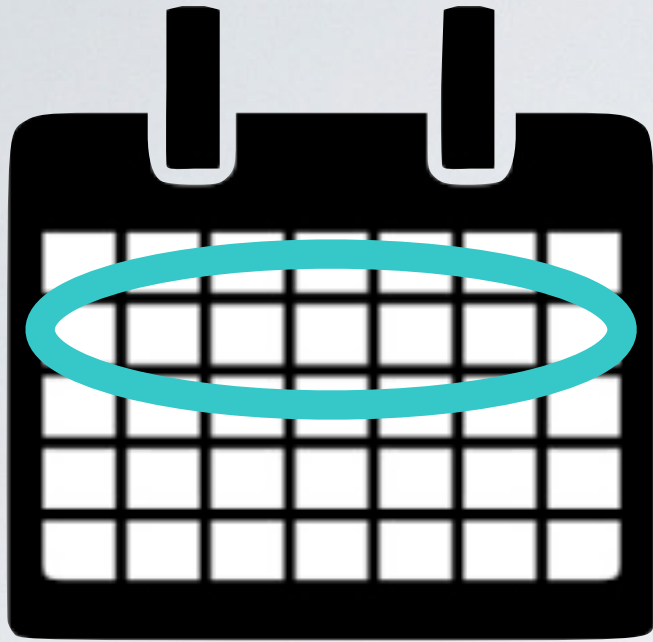


CLOUD

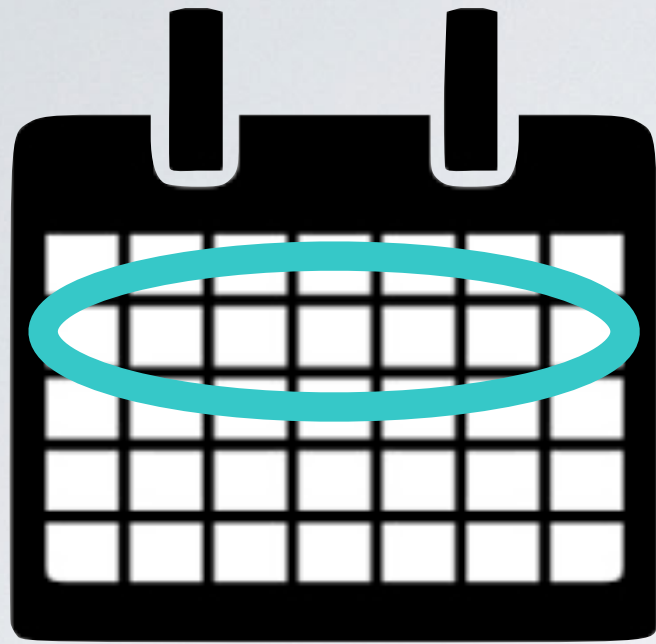
CLOUD

CLOUD

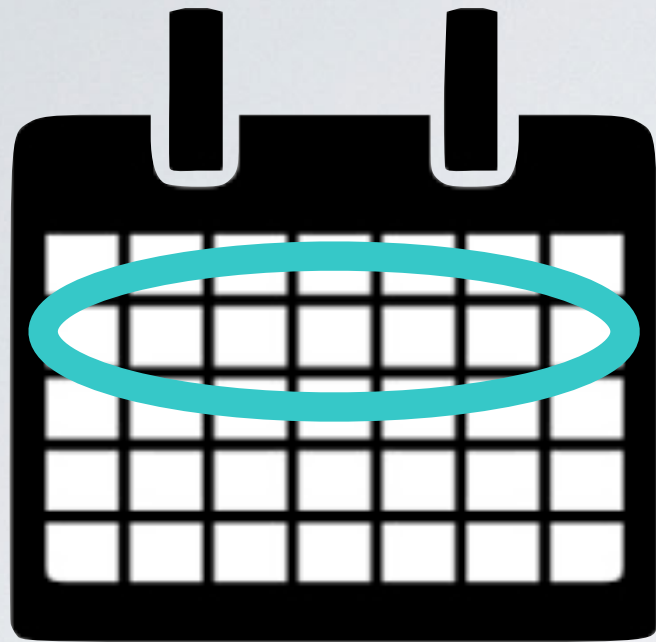
CLOUD



CLOUD



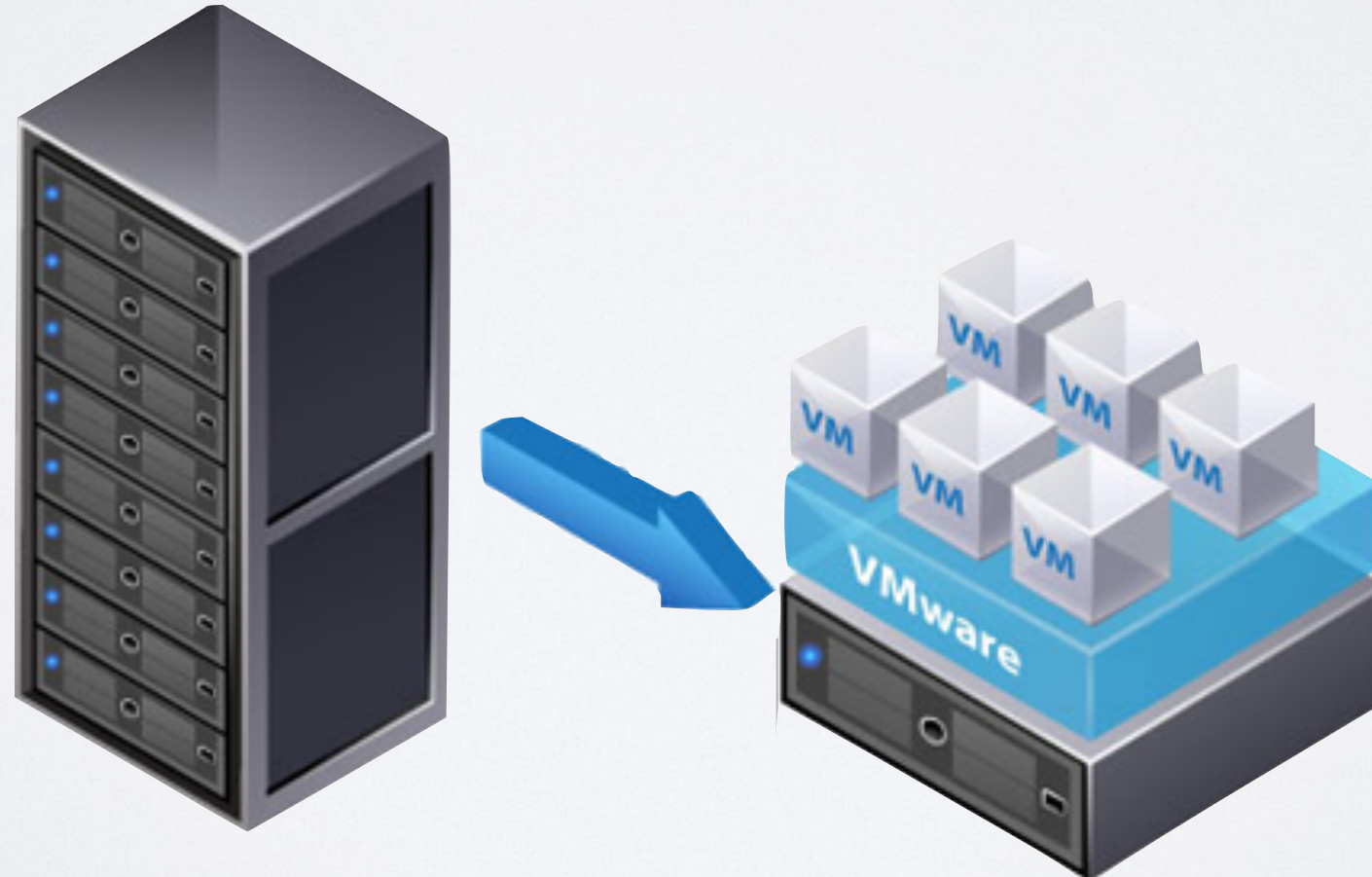
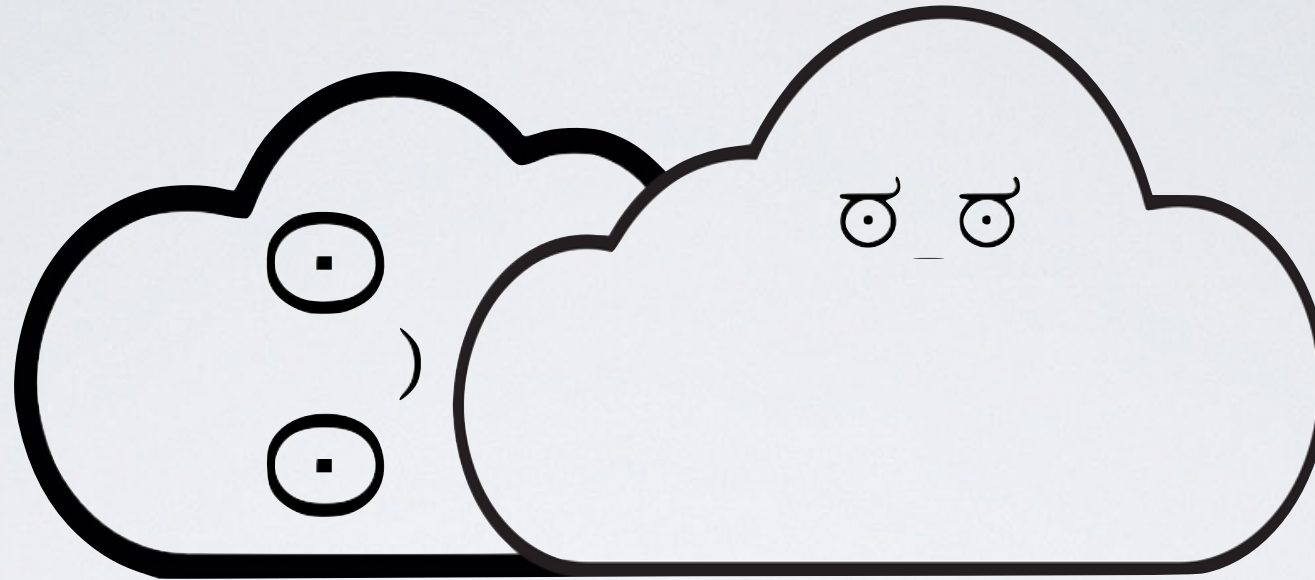
CLOUD



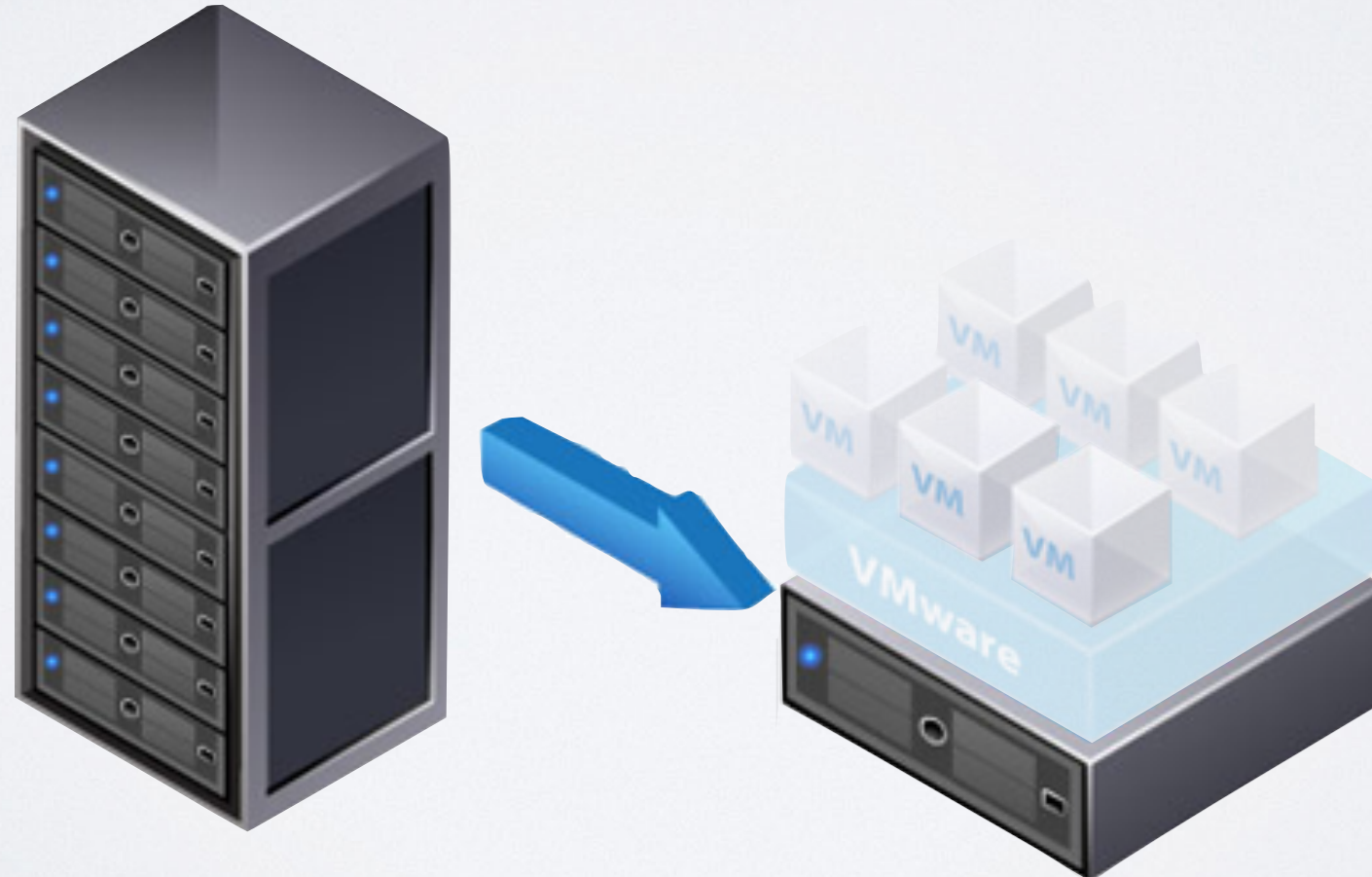
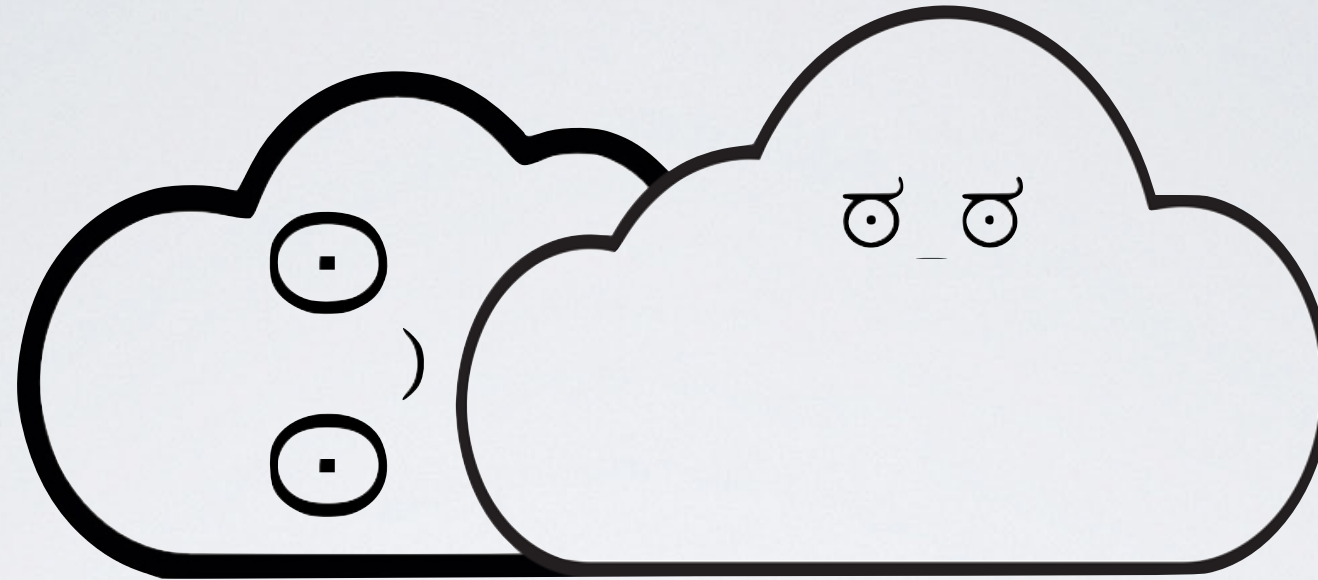
CLOUD



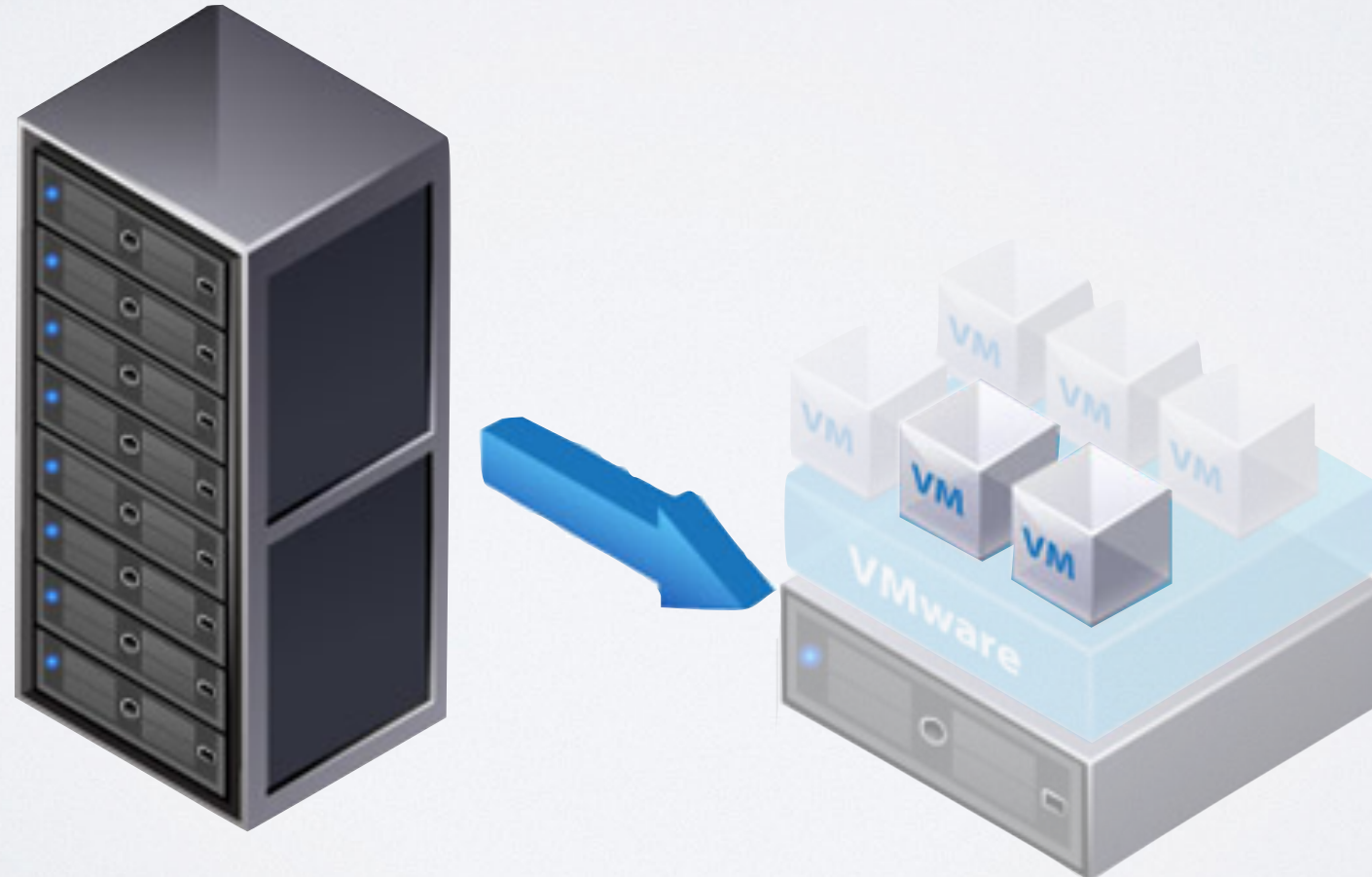
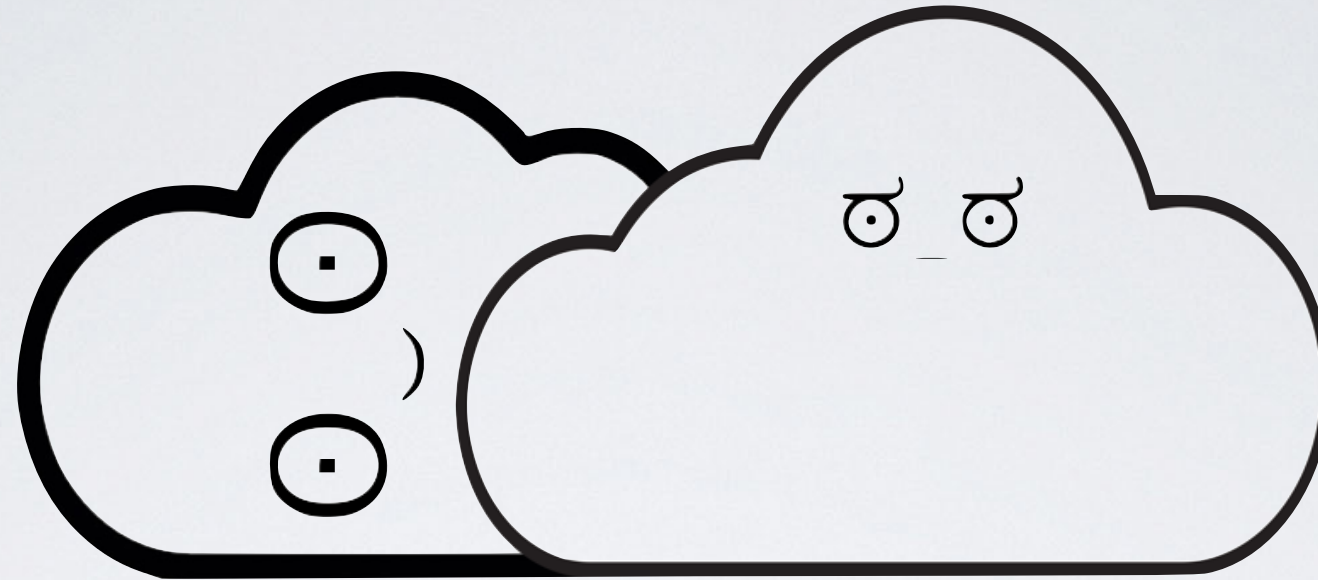
CLOUD



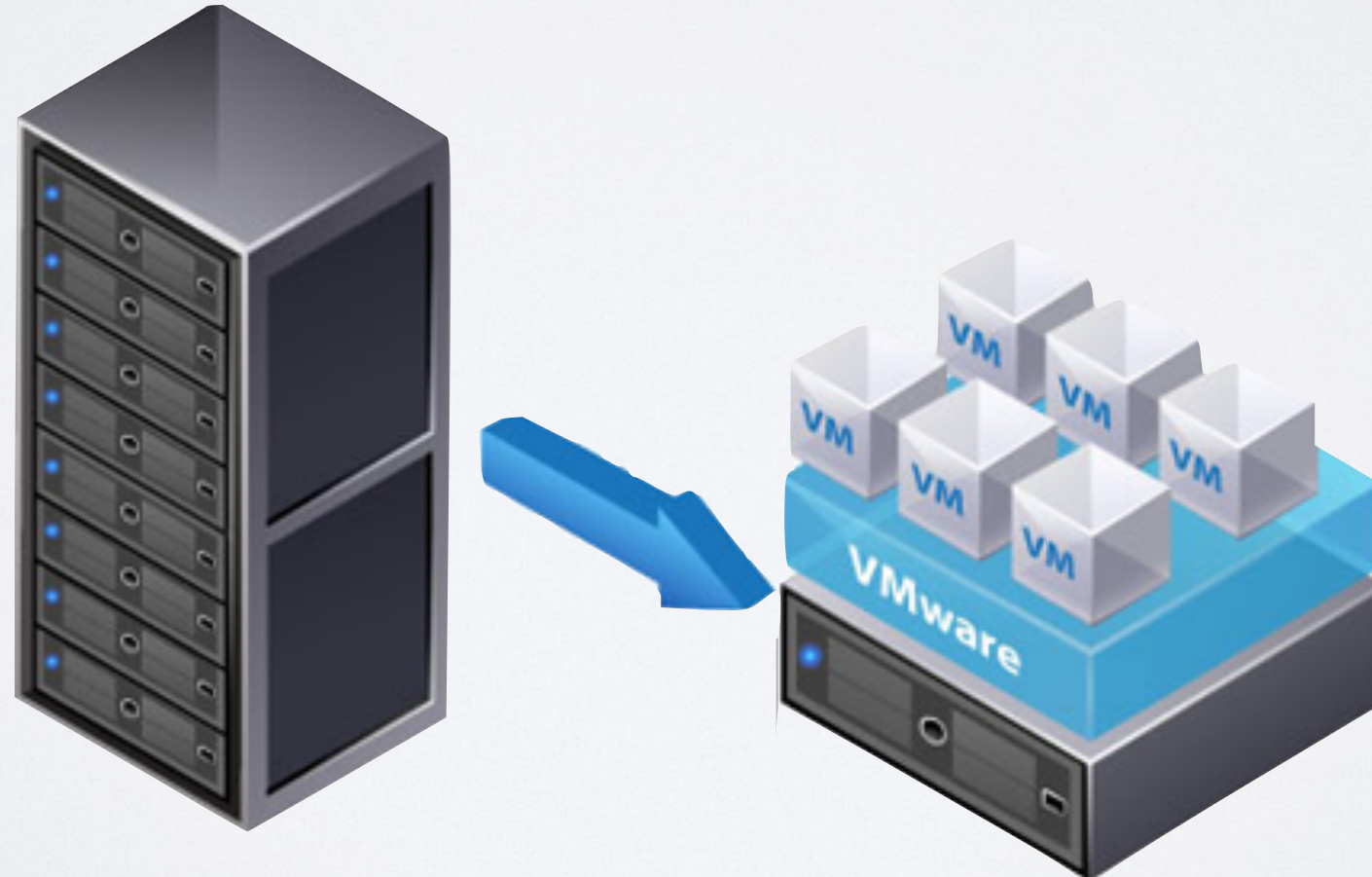
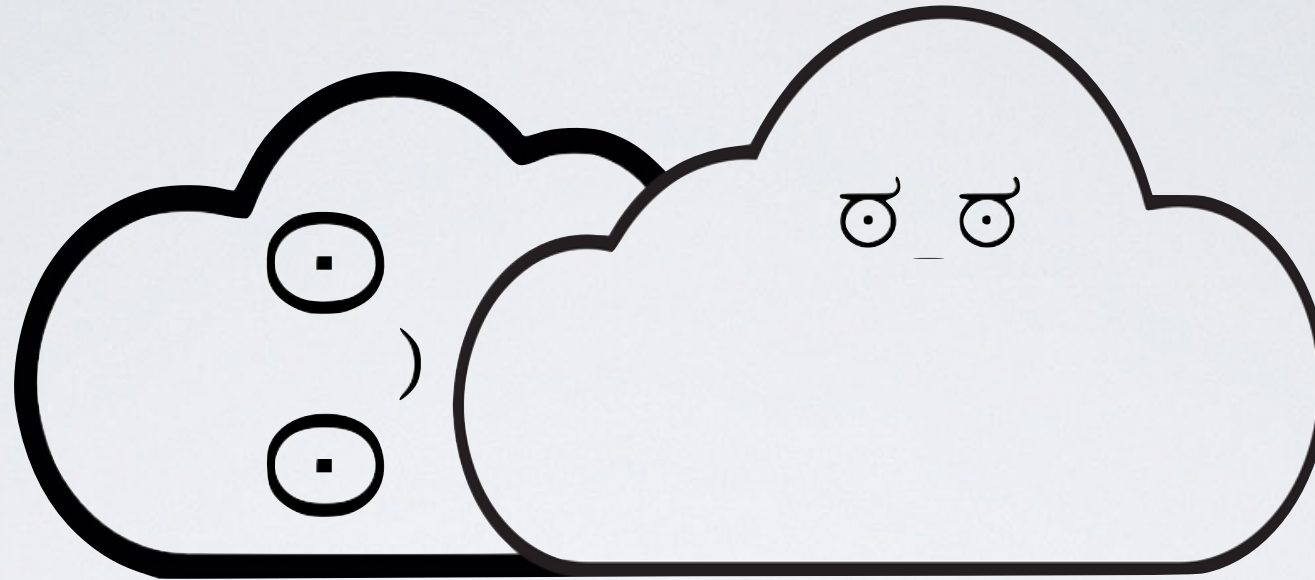
CLOUD



CLOUD



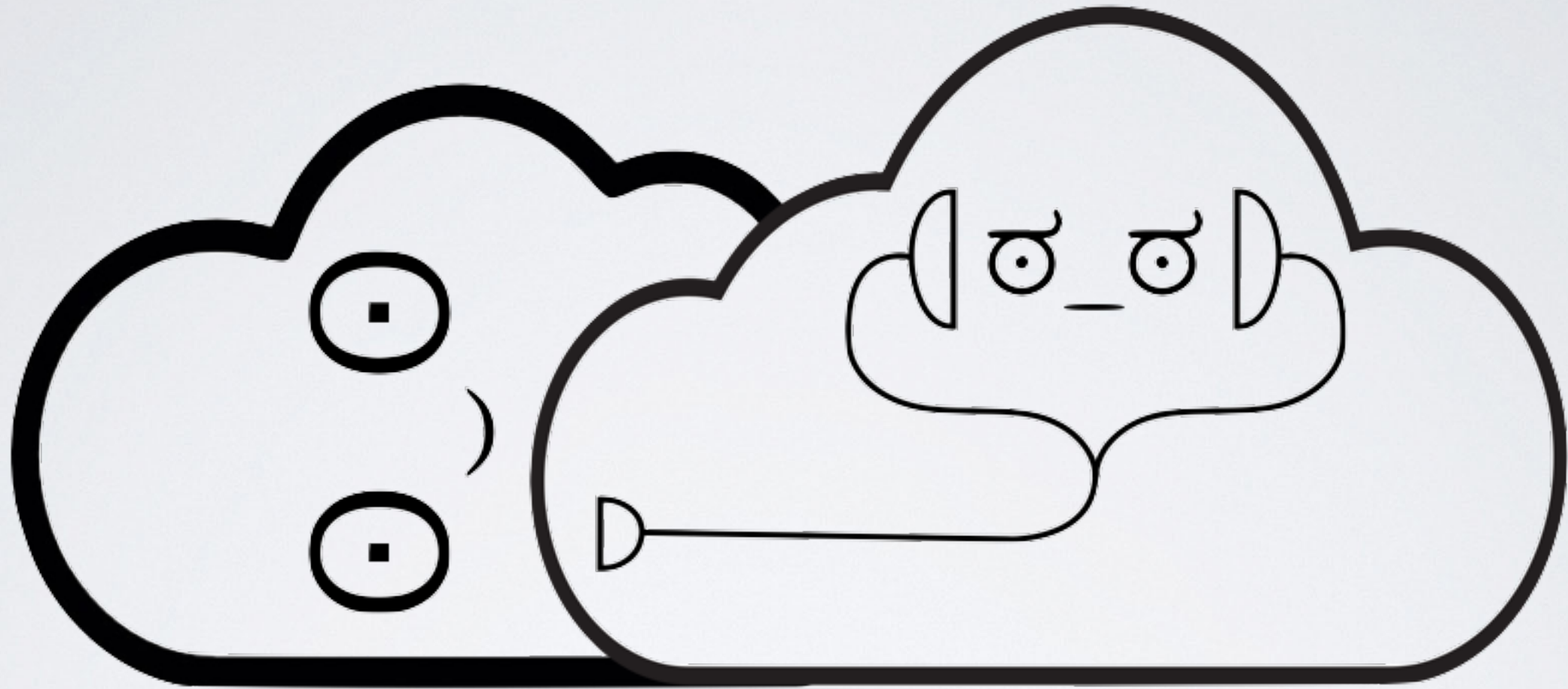
CLOUD



CLOUD

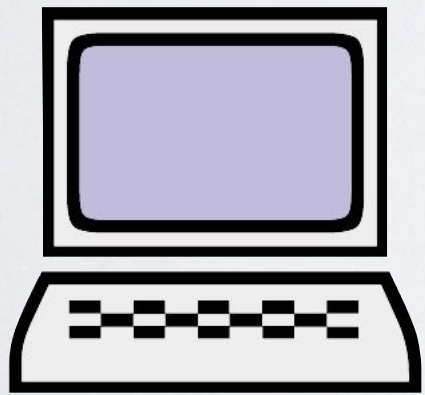
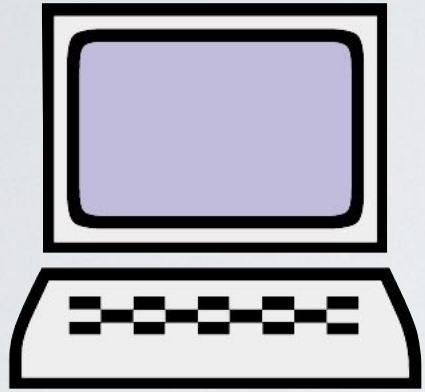


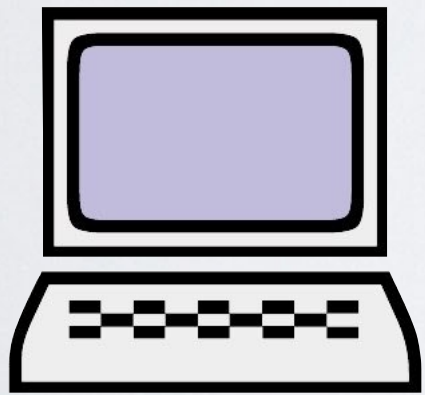
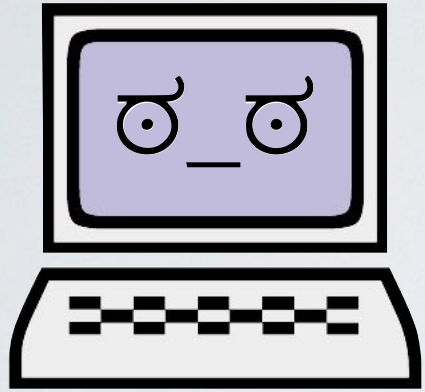
CLOUD

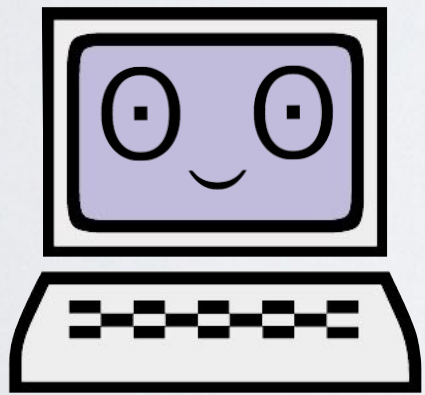
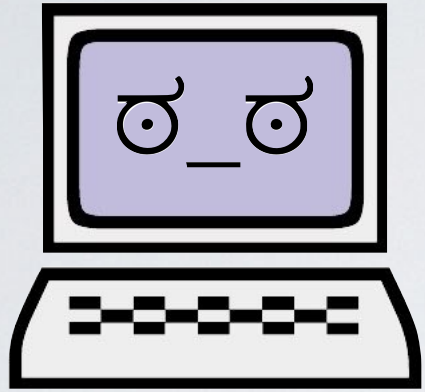


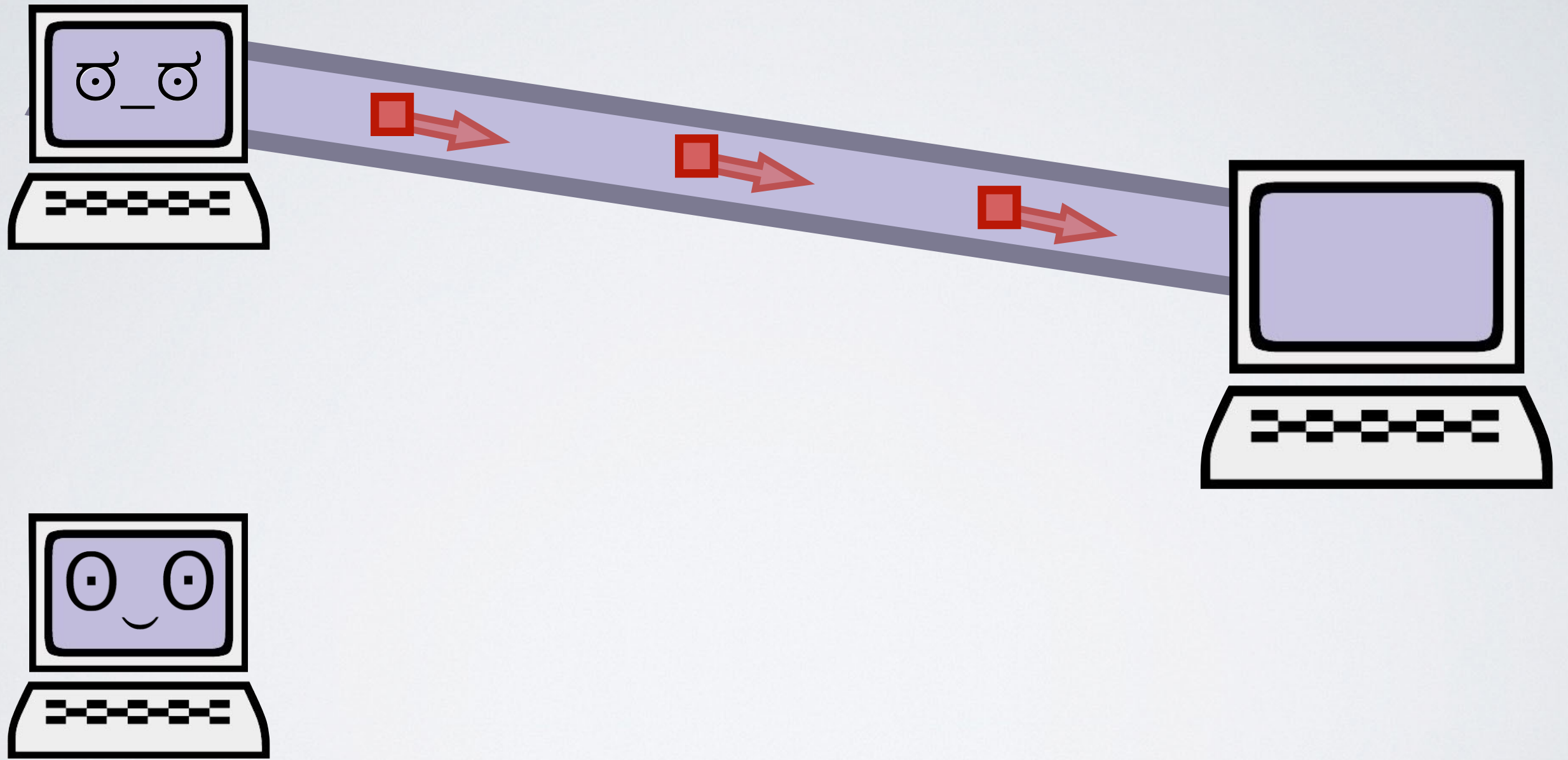
slido.com/primes

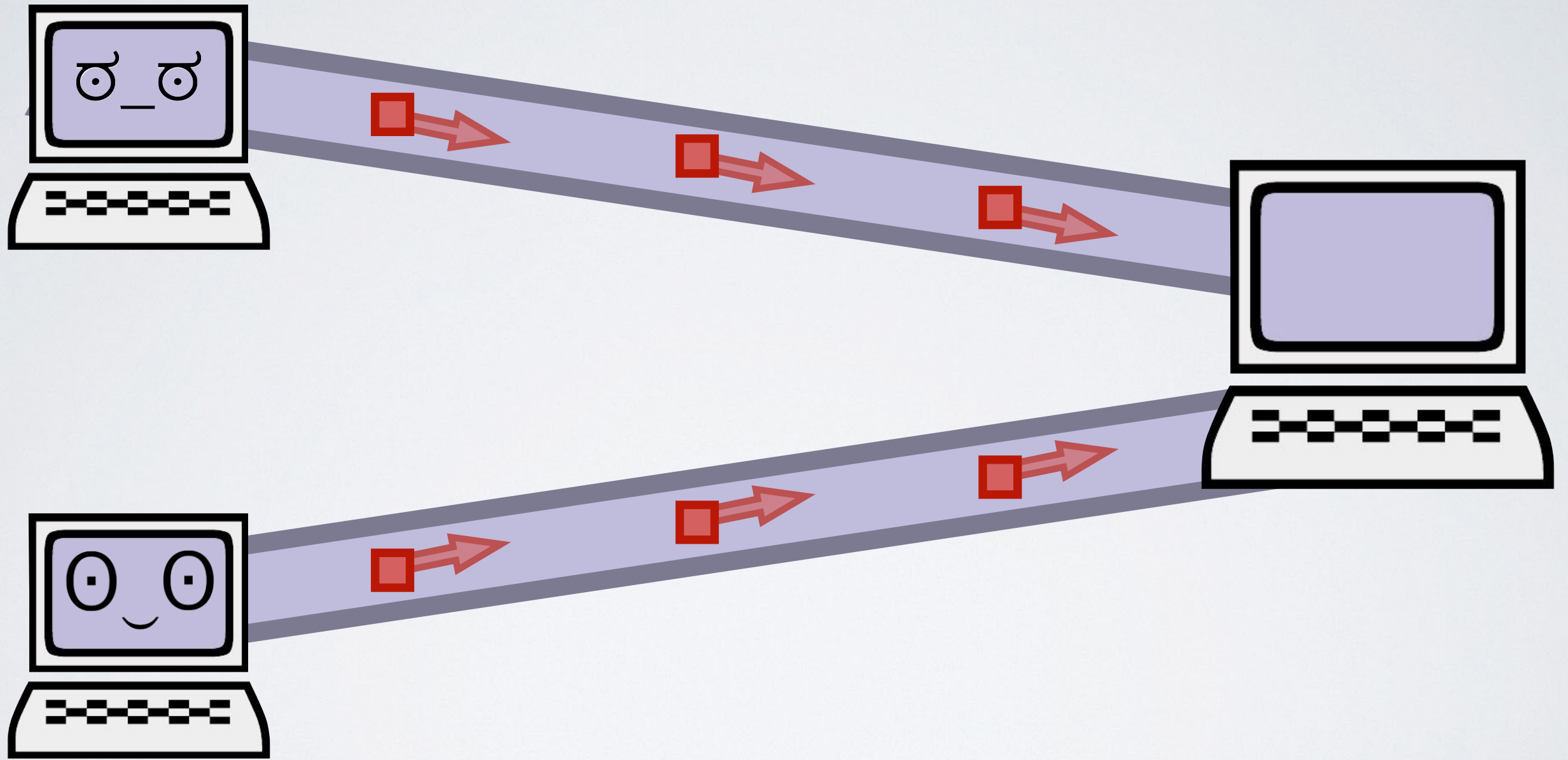
slido.com/primes

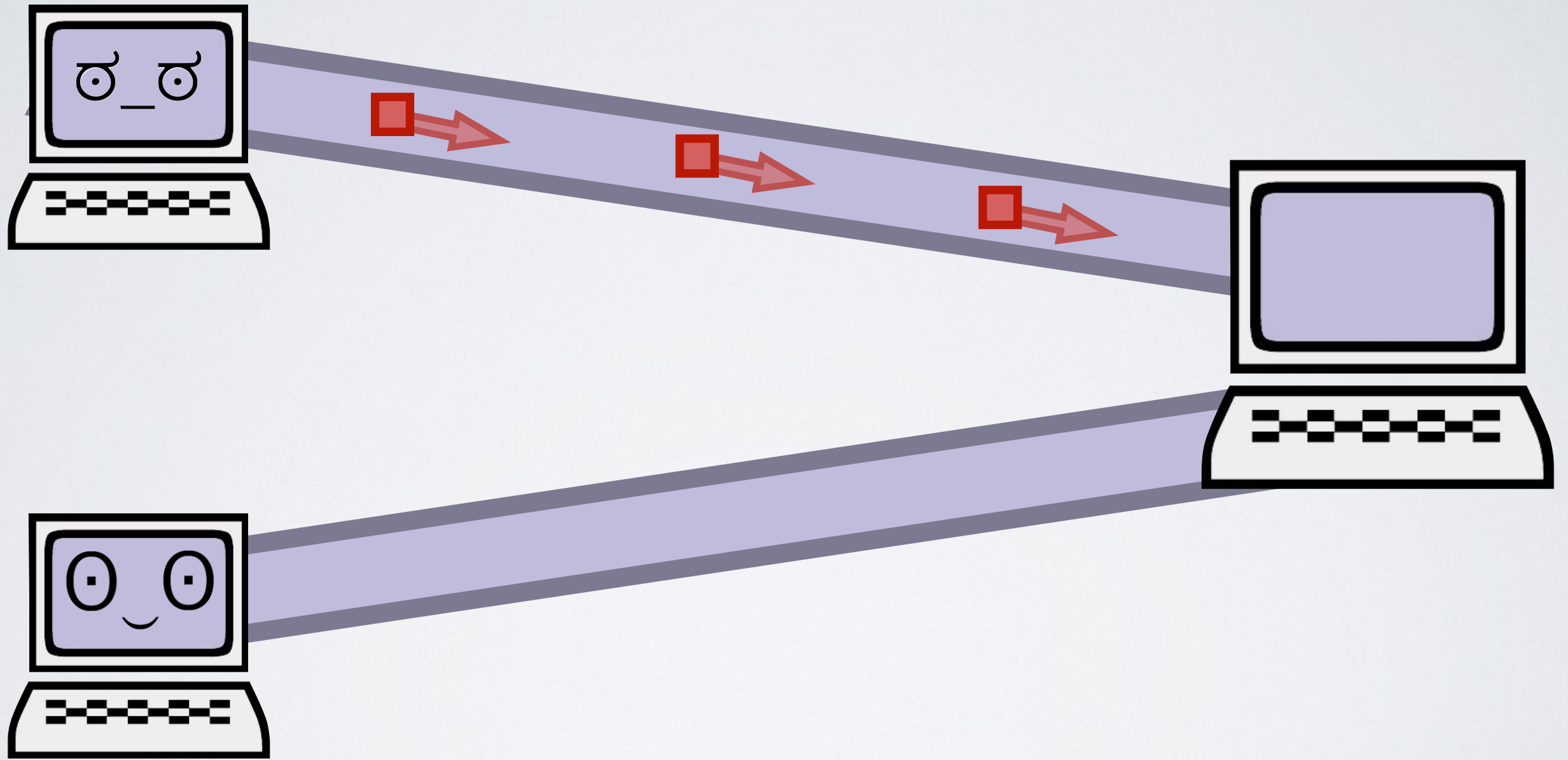






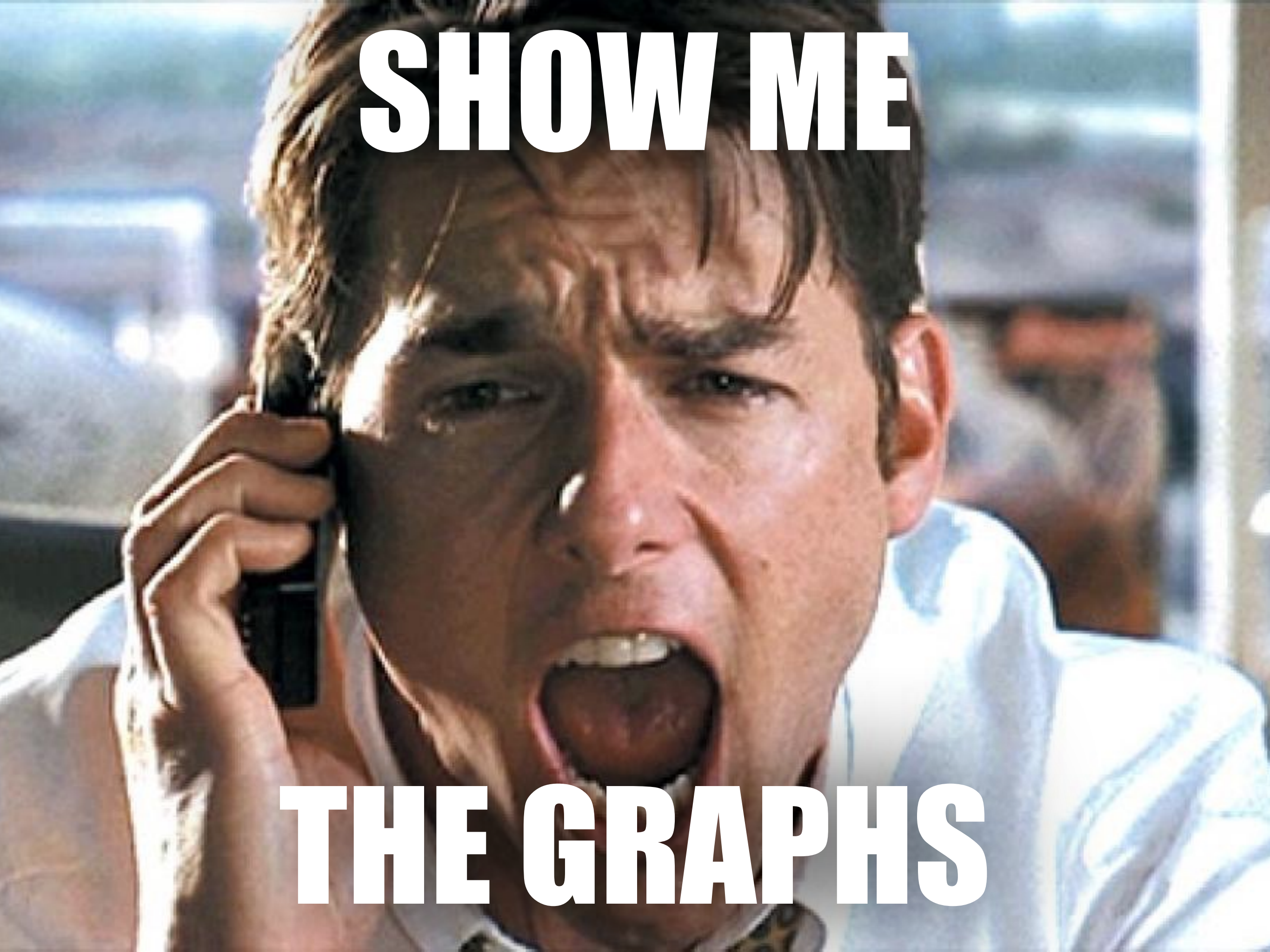




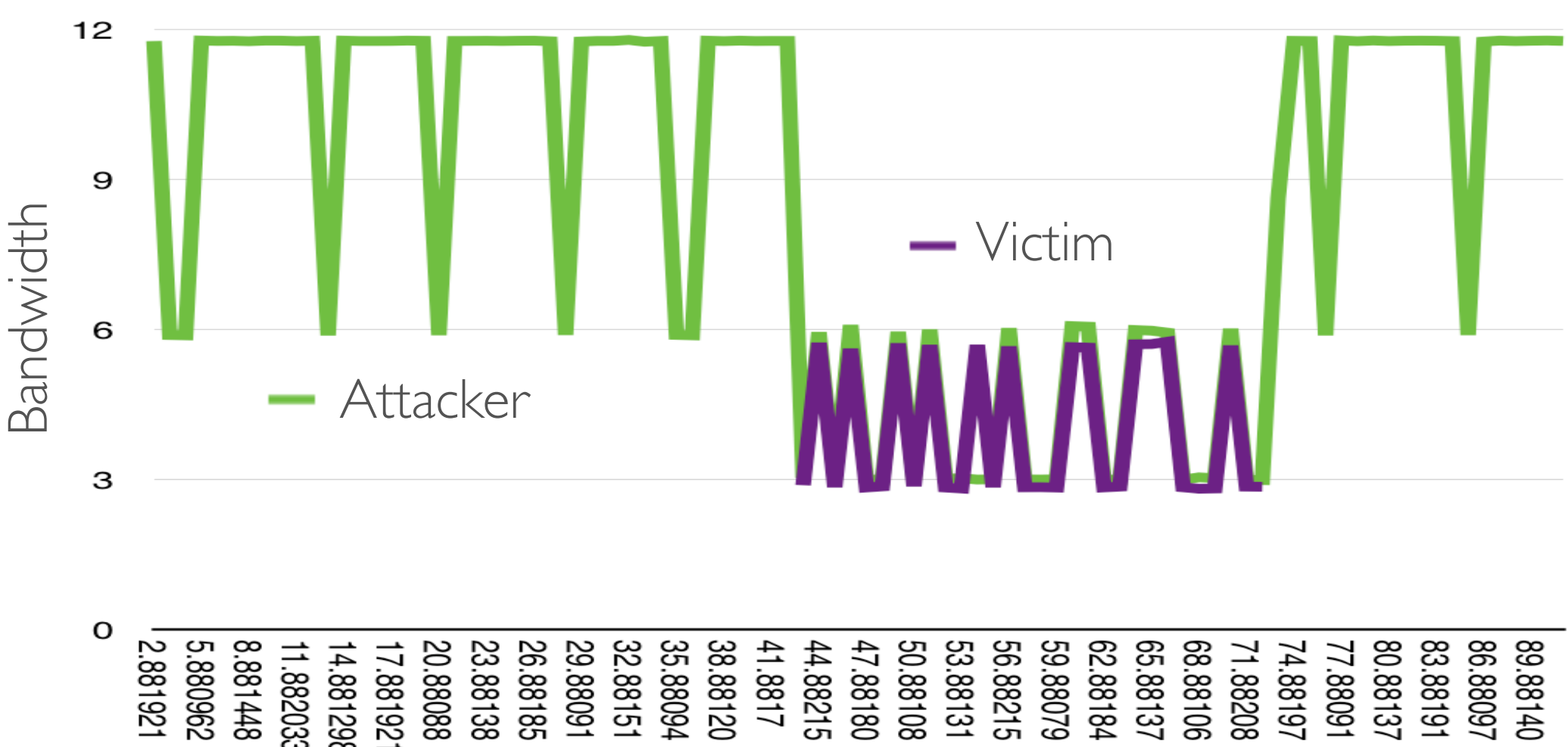


SHOW ME

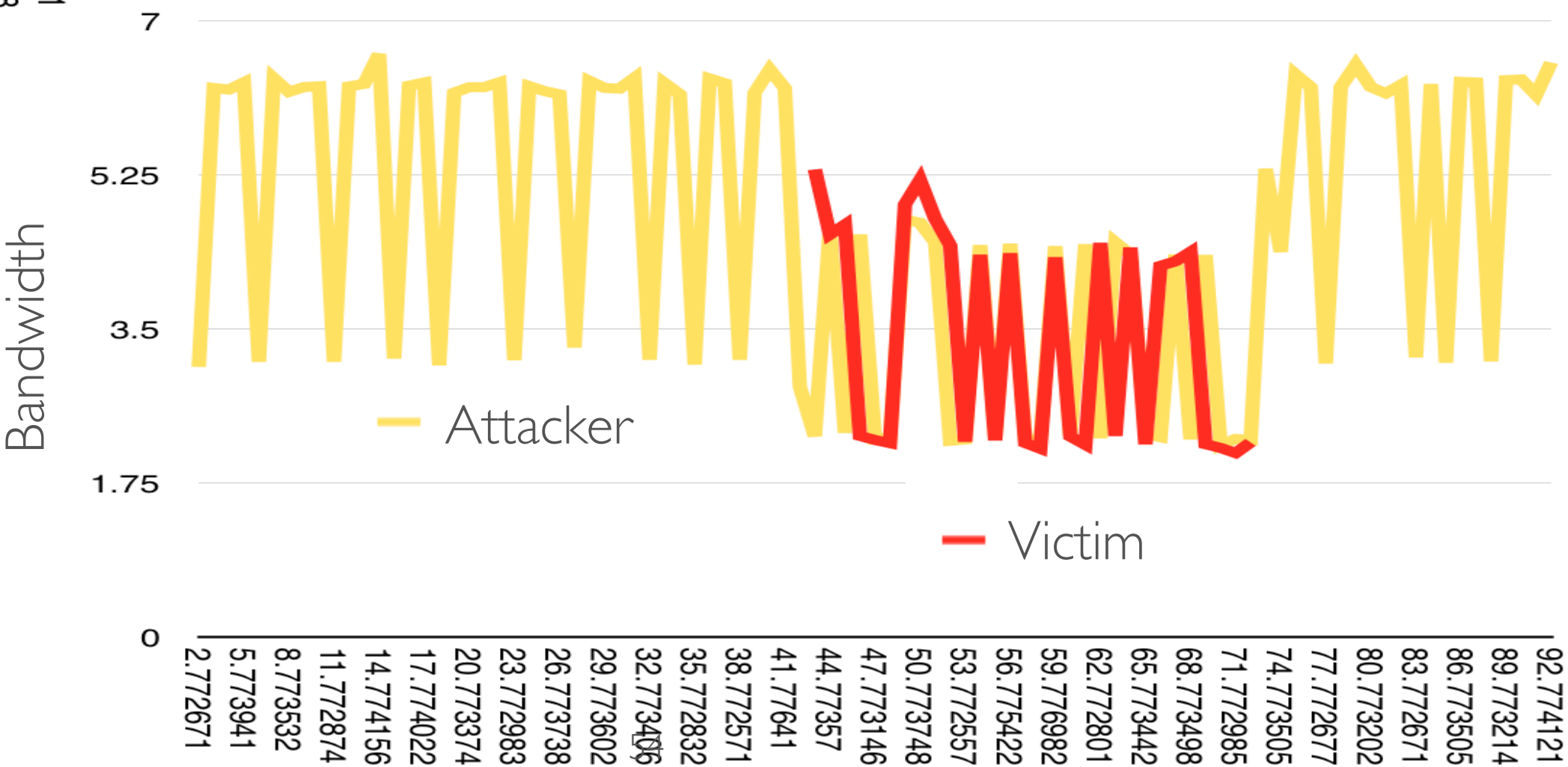
THE GRAPHS



TCP

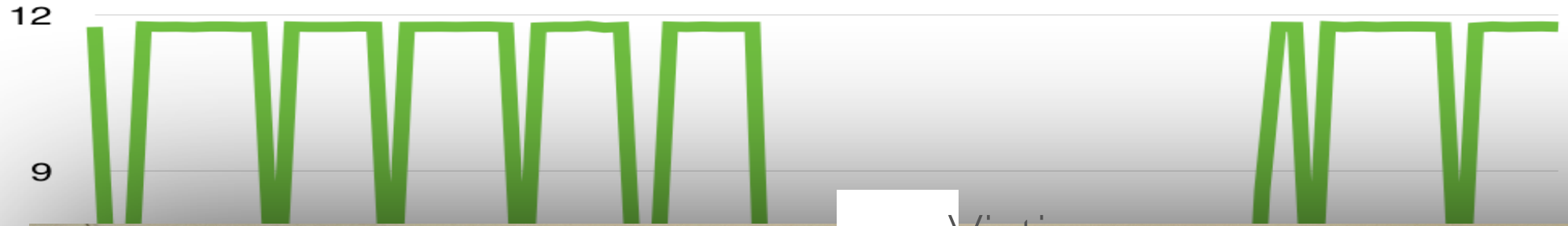


UDP



TCP

Bandwidth



Victim

Attacker

Server

Attacker

Victim

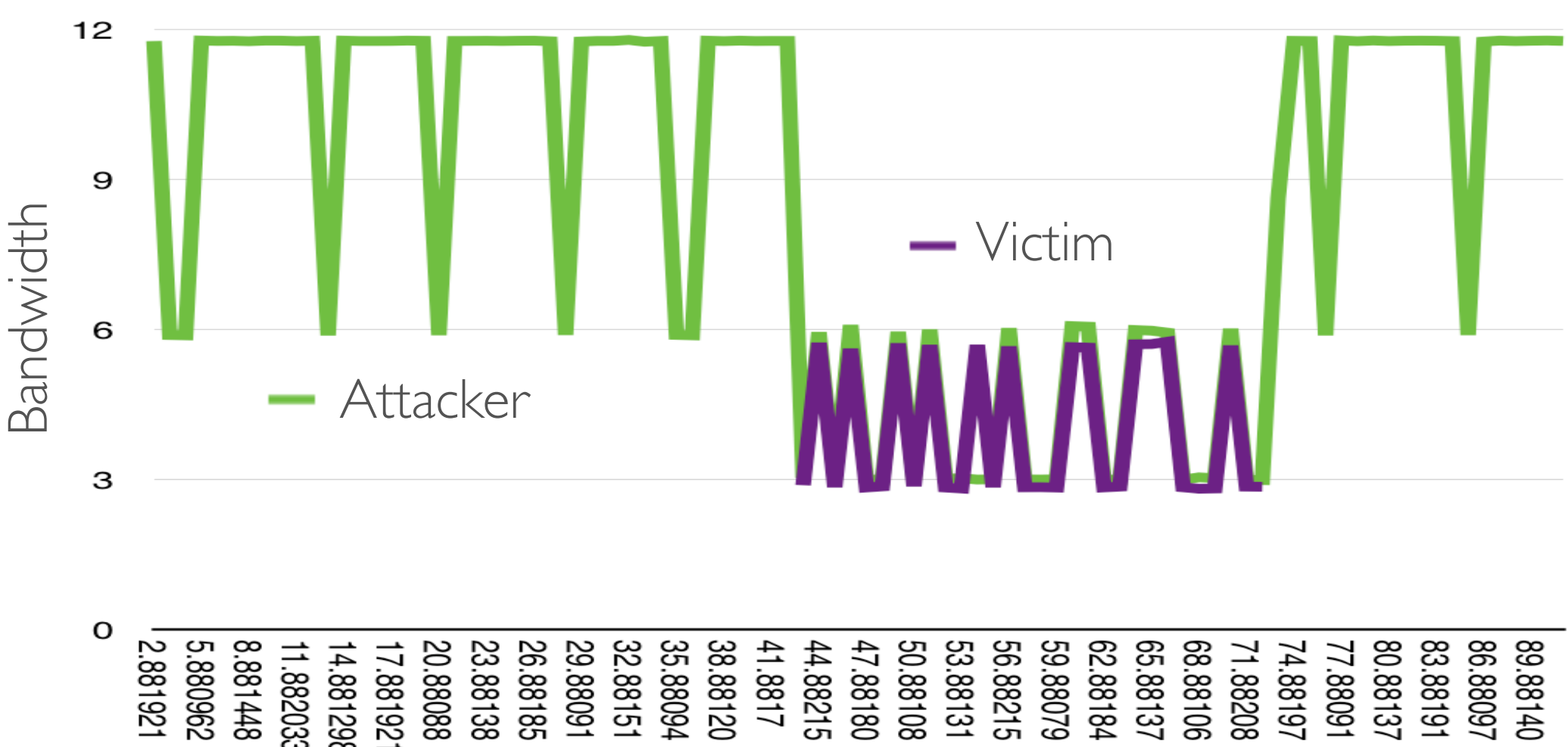
Attacker

Victim

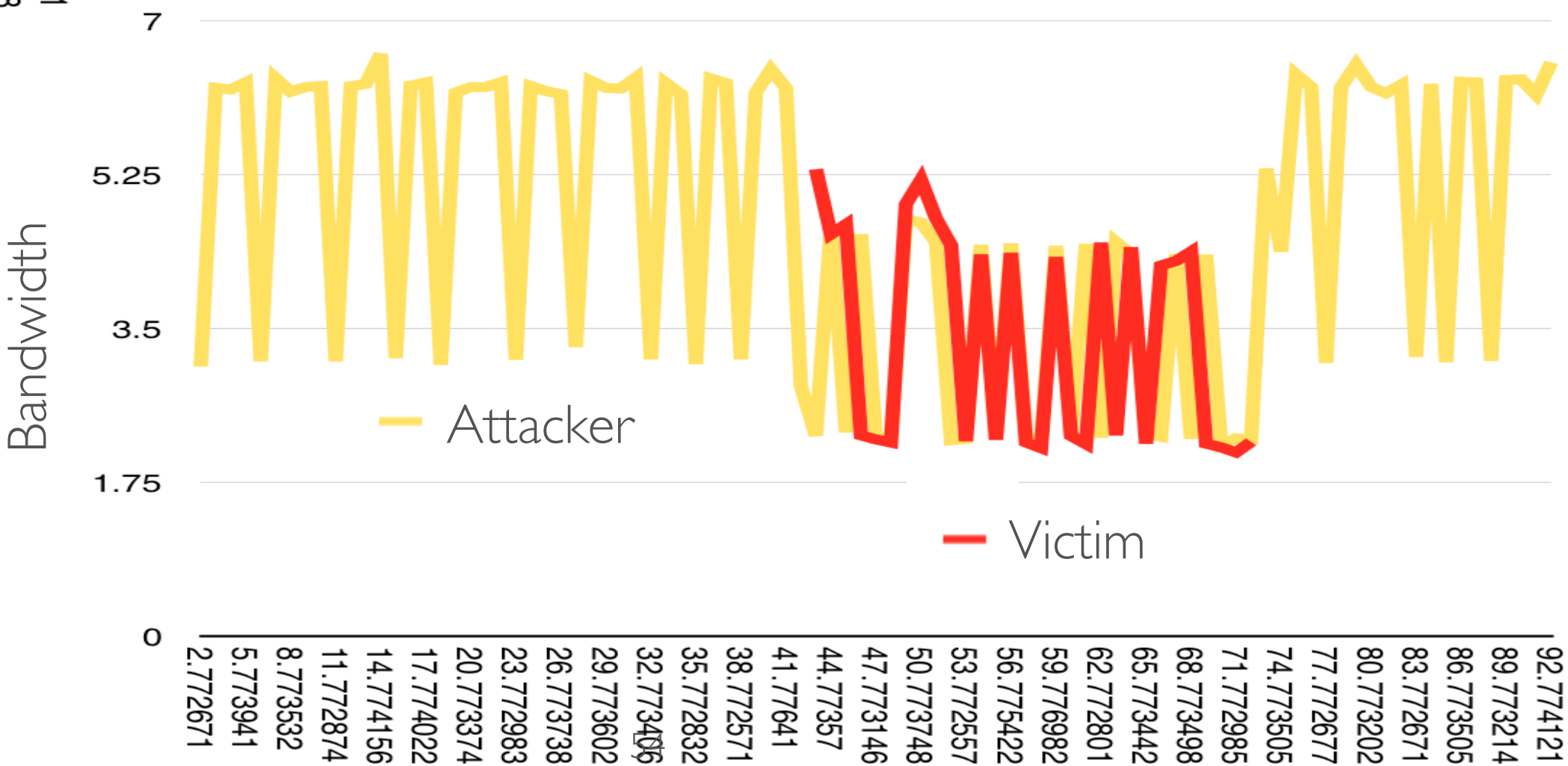
UDP

- 92.774121
- 89.773214
- 86.773505
- 83.772671
- 80.773202
- 77.772677
- 74.773505
- 71.772985
- 68.773498
- 65.773442
- 62.772801
- 59.776982
- 56.775422
- 53.772557
- 50.773748
- 47.773146
- 44.77357
- 41.77641
- 38.772571
- 35.772832
- 32.773406
- 29.773602
- 26.773738
- 23.772983
- 20.773374
- 17.774022
- 14.774156
- 11.772874
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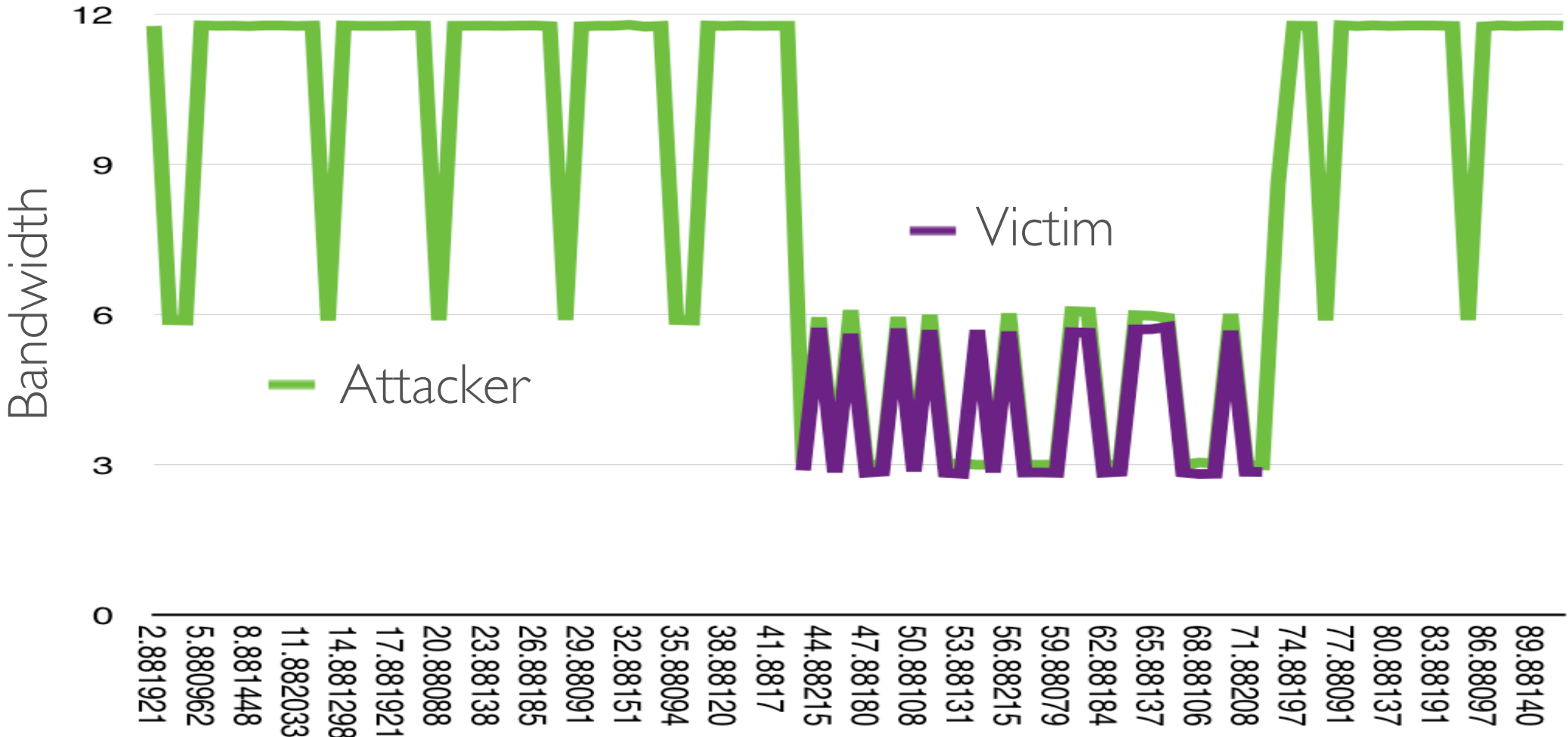
TCP



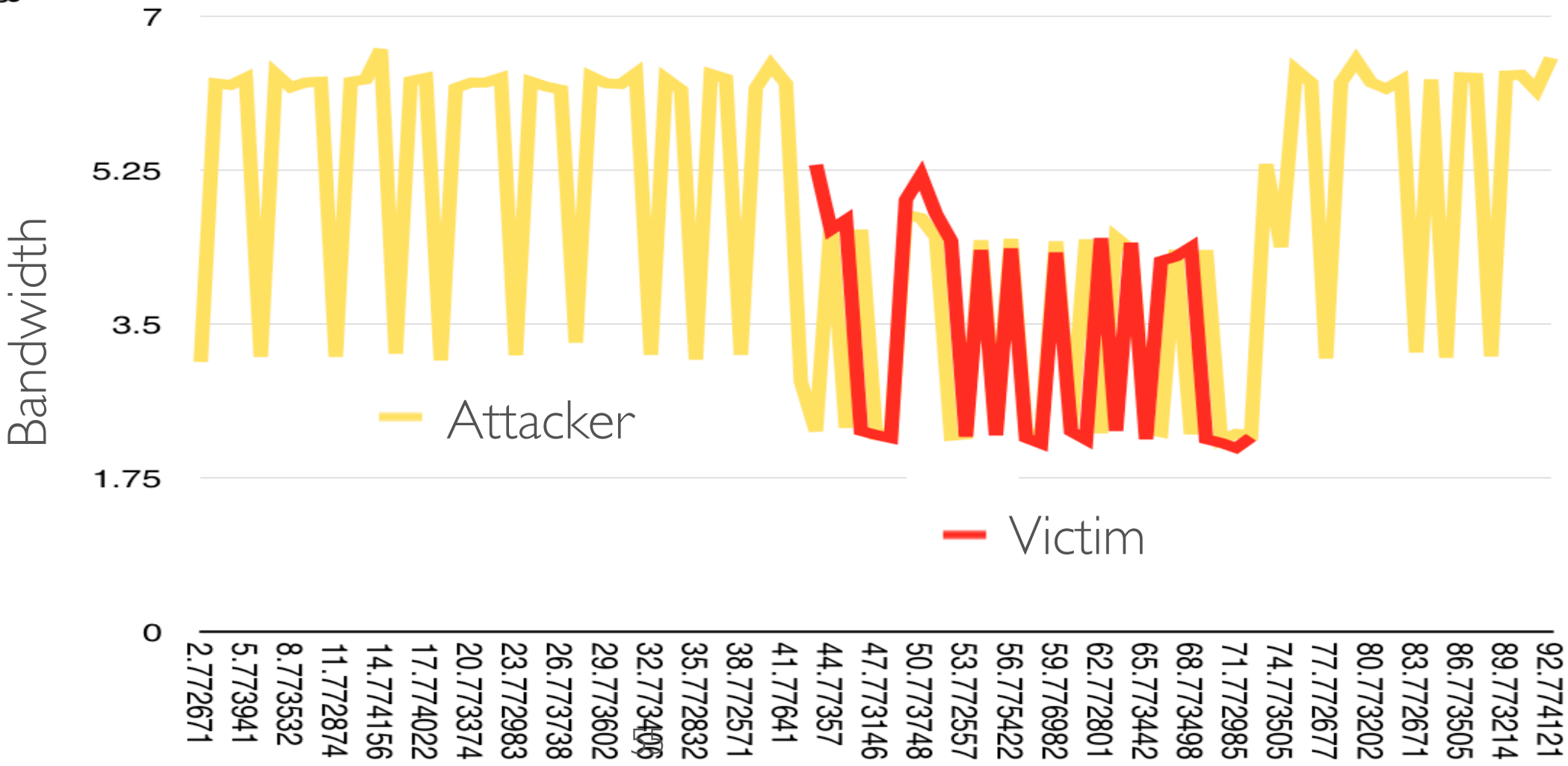
UDP



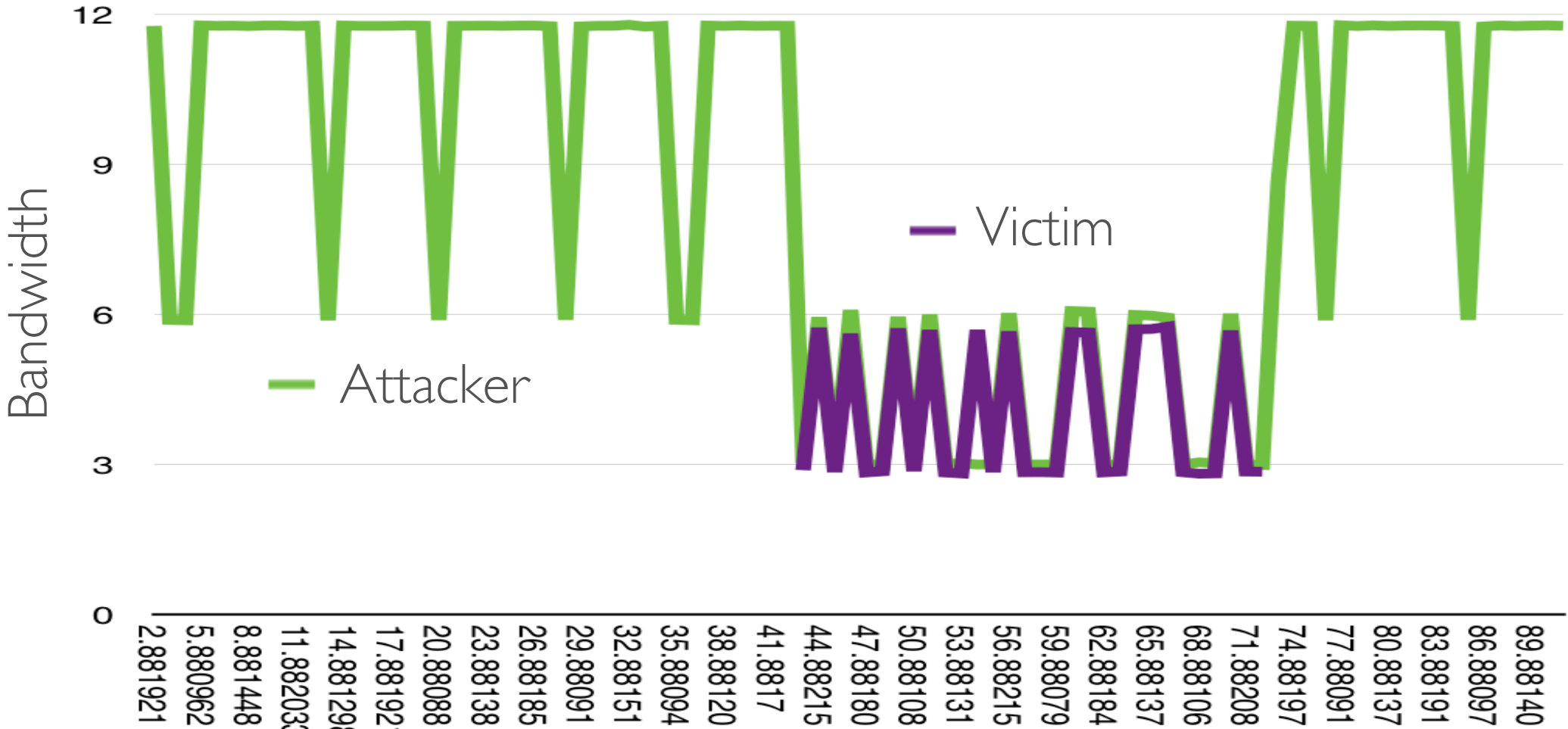
TCP



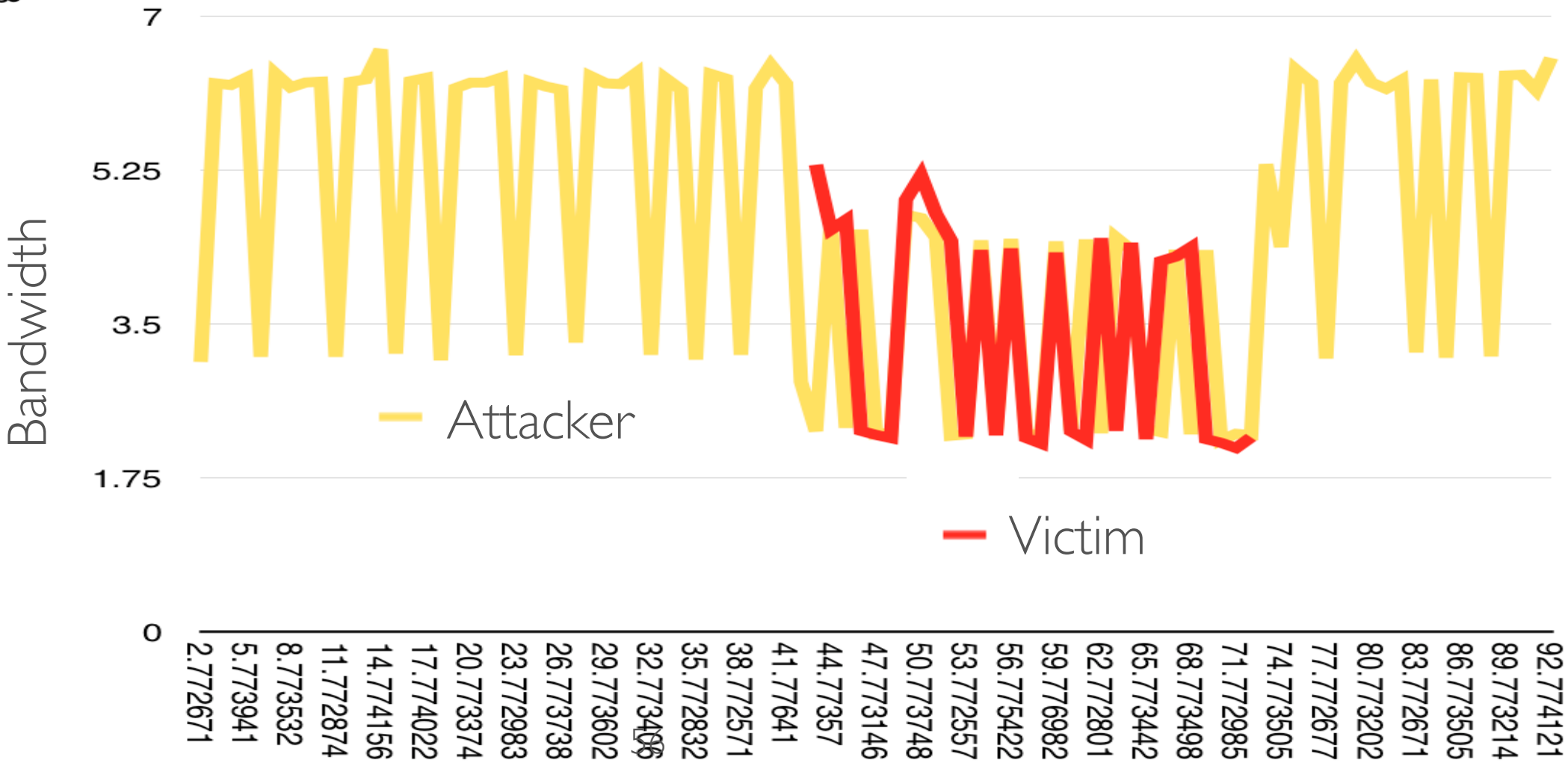
UDP



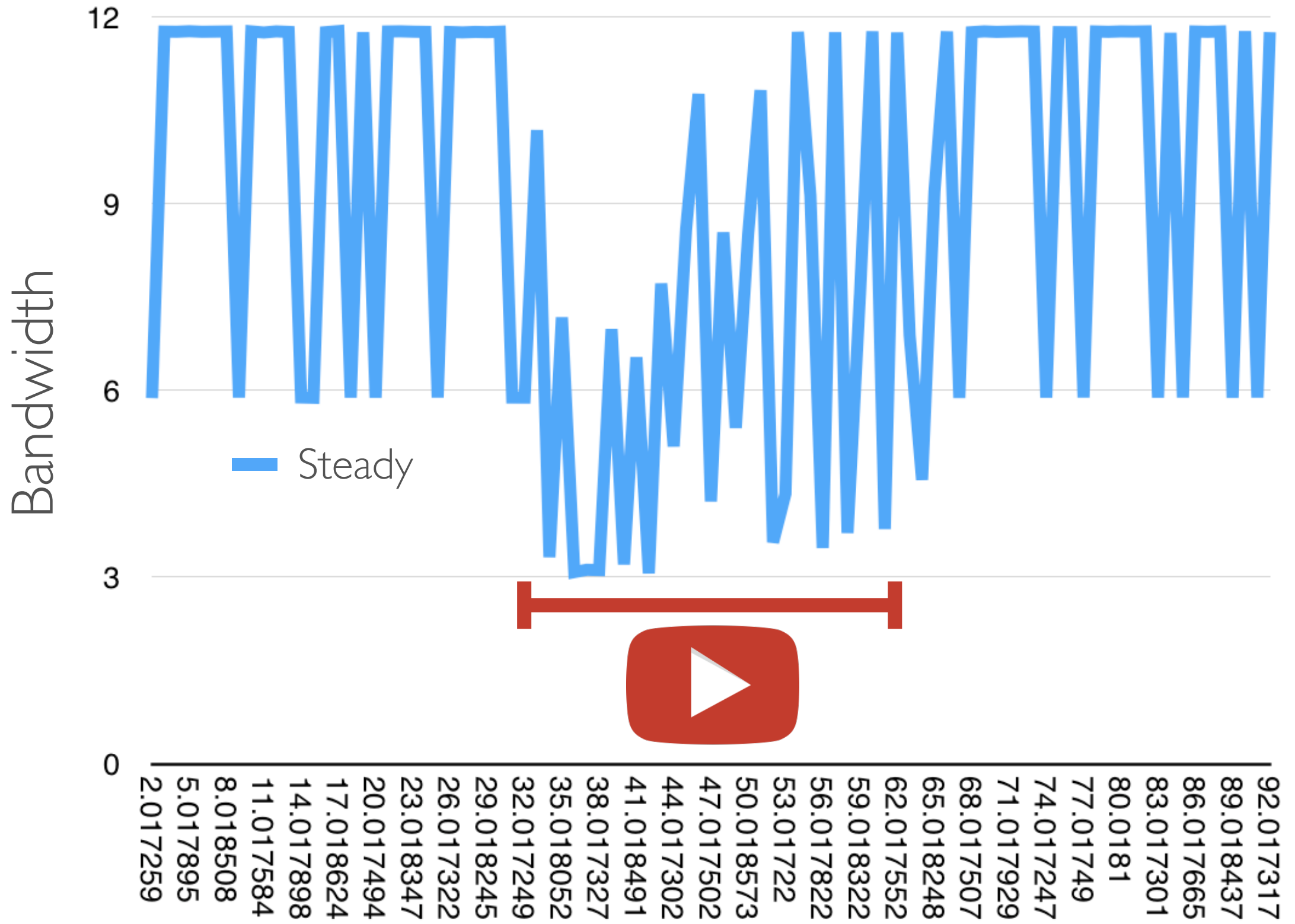
TCP



UDP

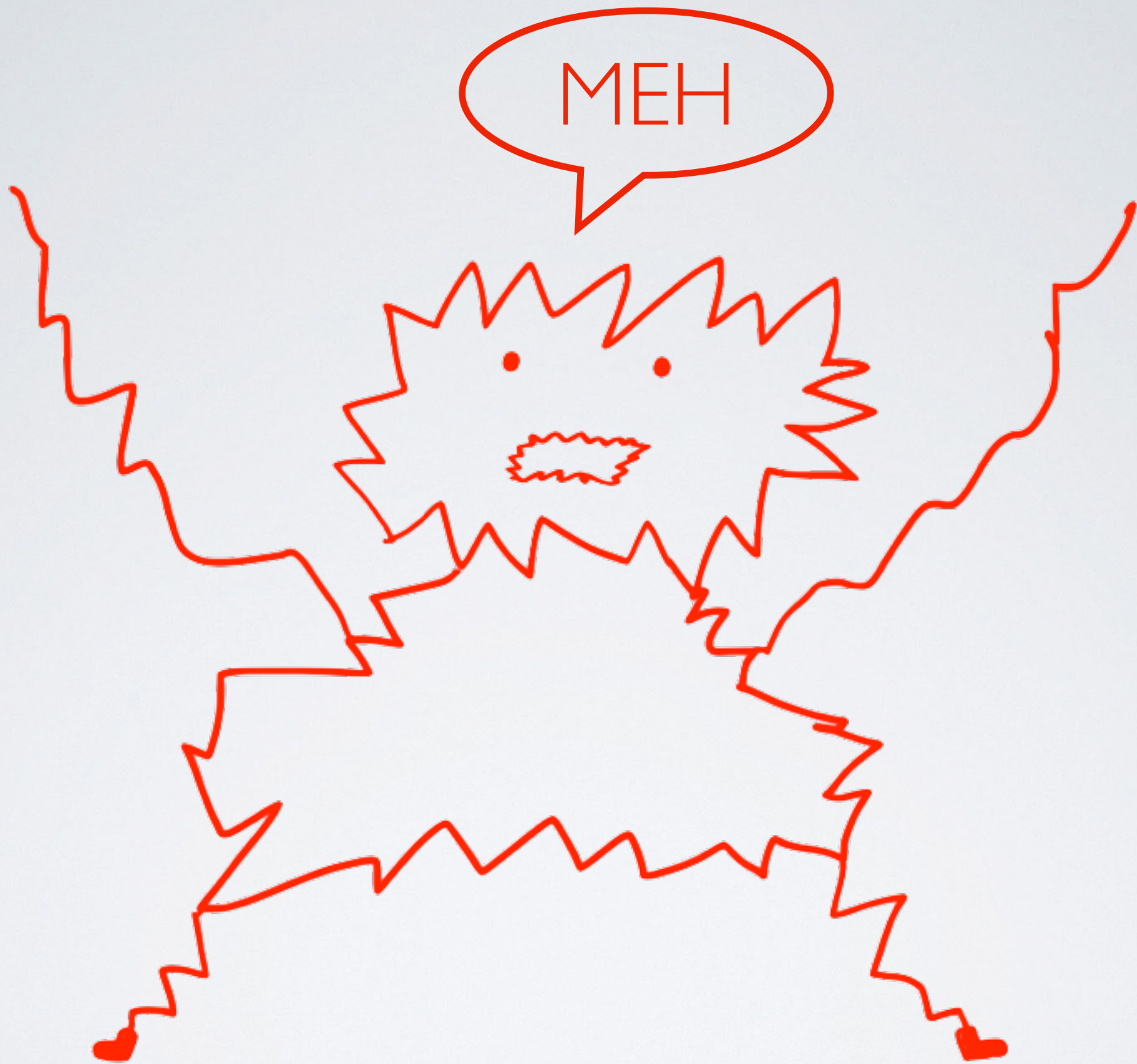


YOUTUBE IN 4K



MEH



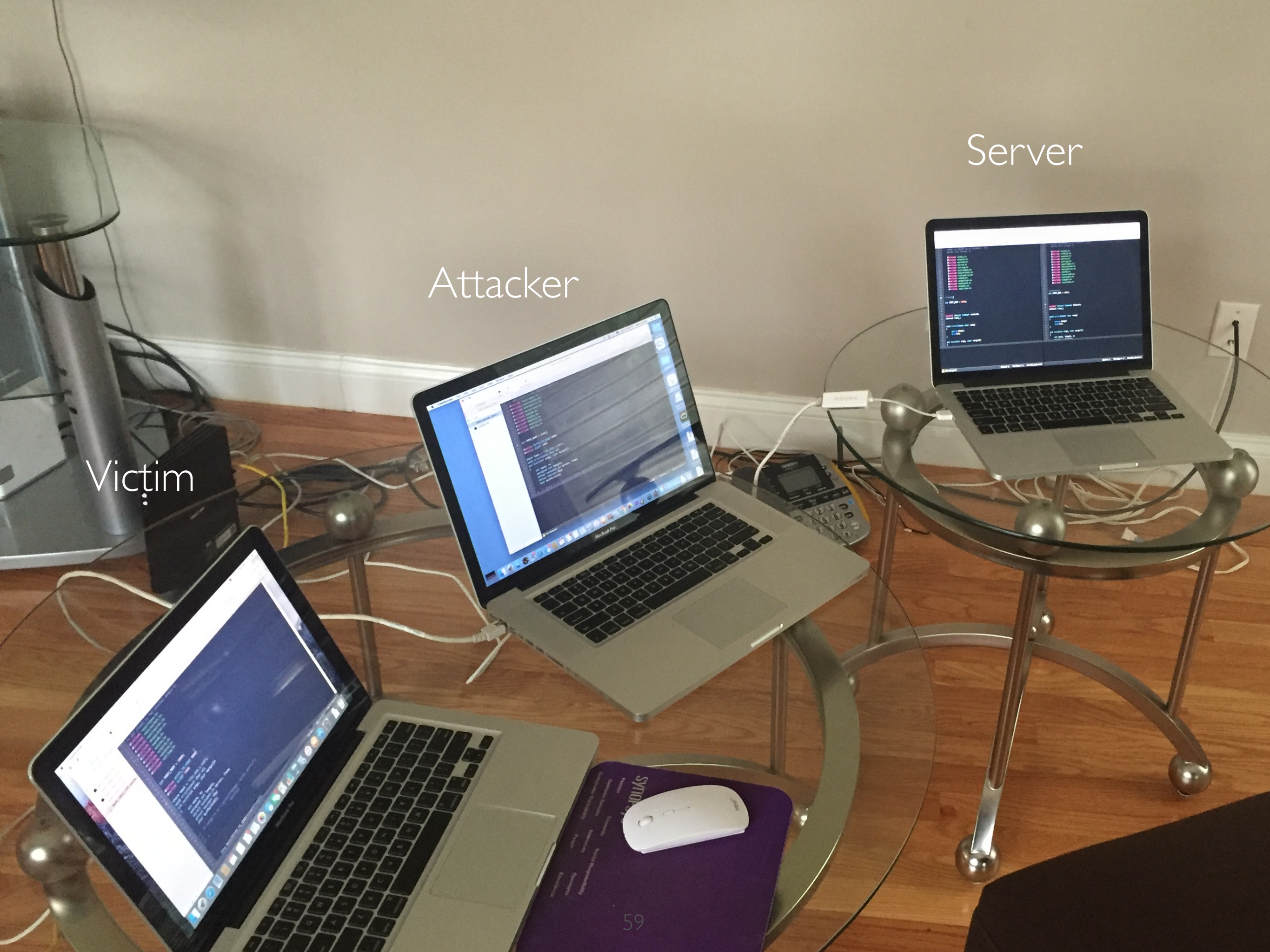


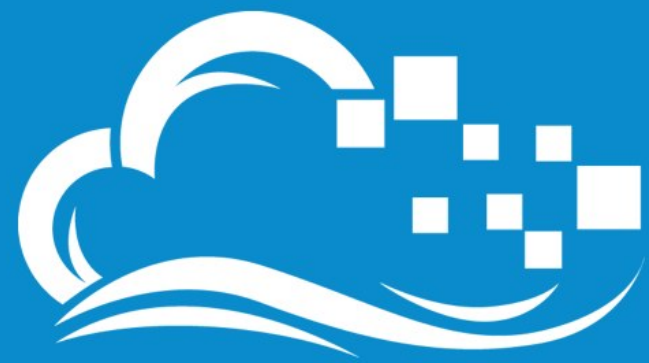
SHOW ME A REAL CLOUD

Server

Attacker

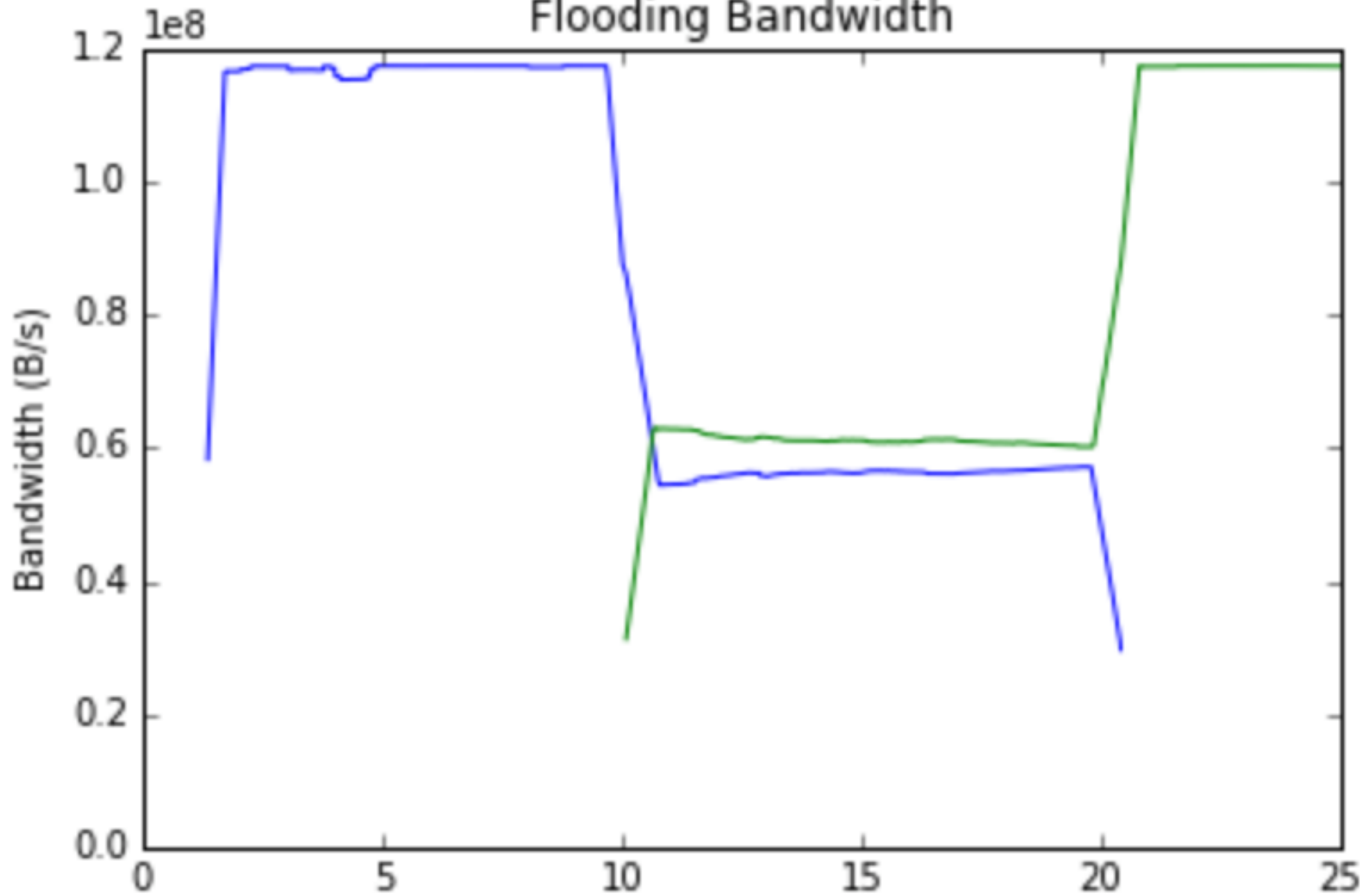
Victim





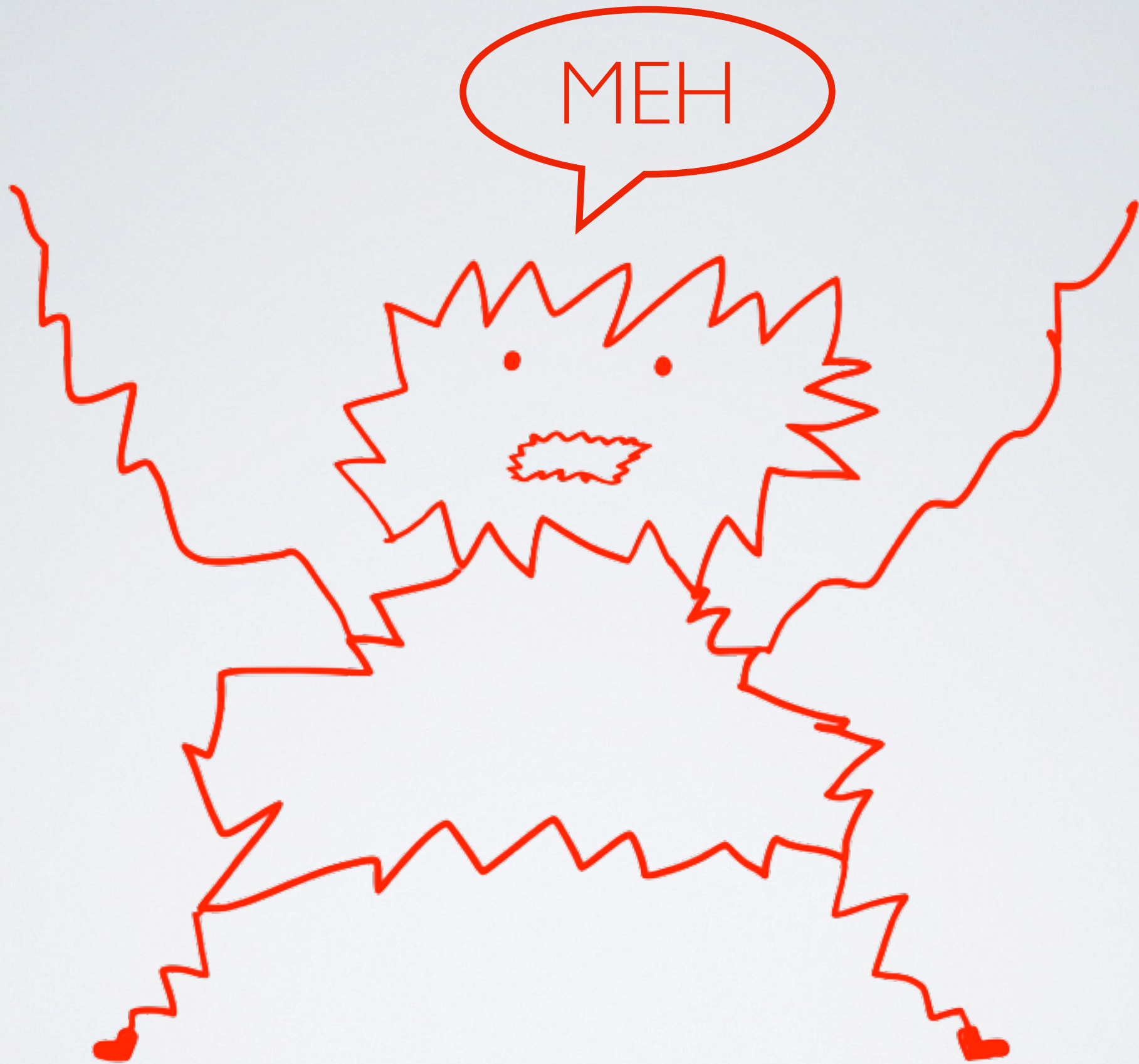
DigitalOcean

Flooding Bandwidth

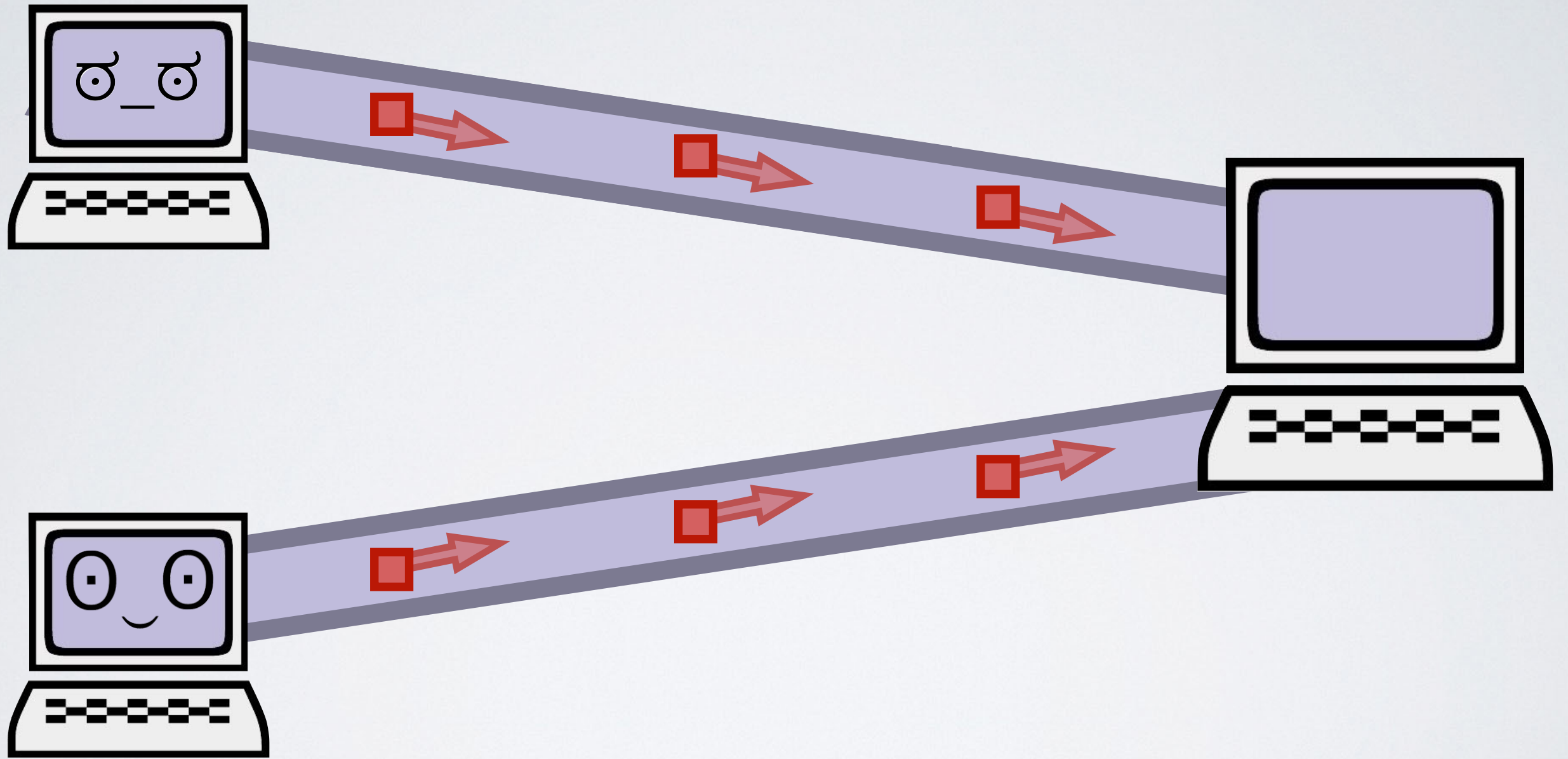


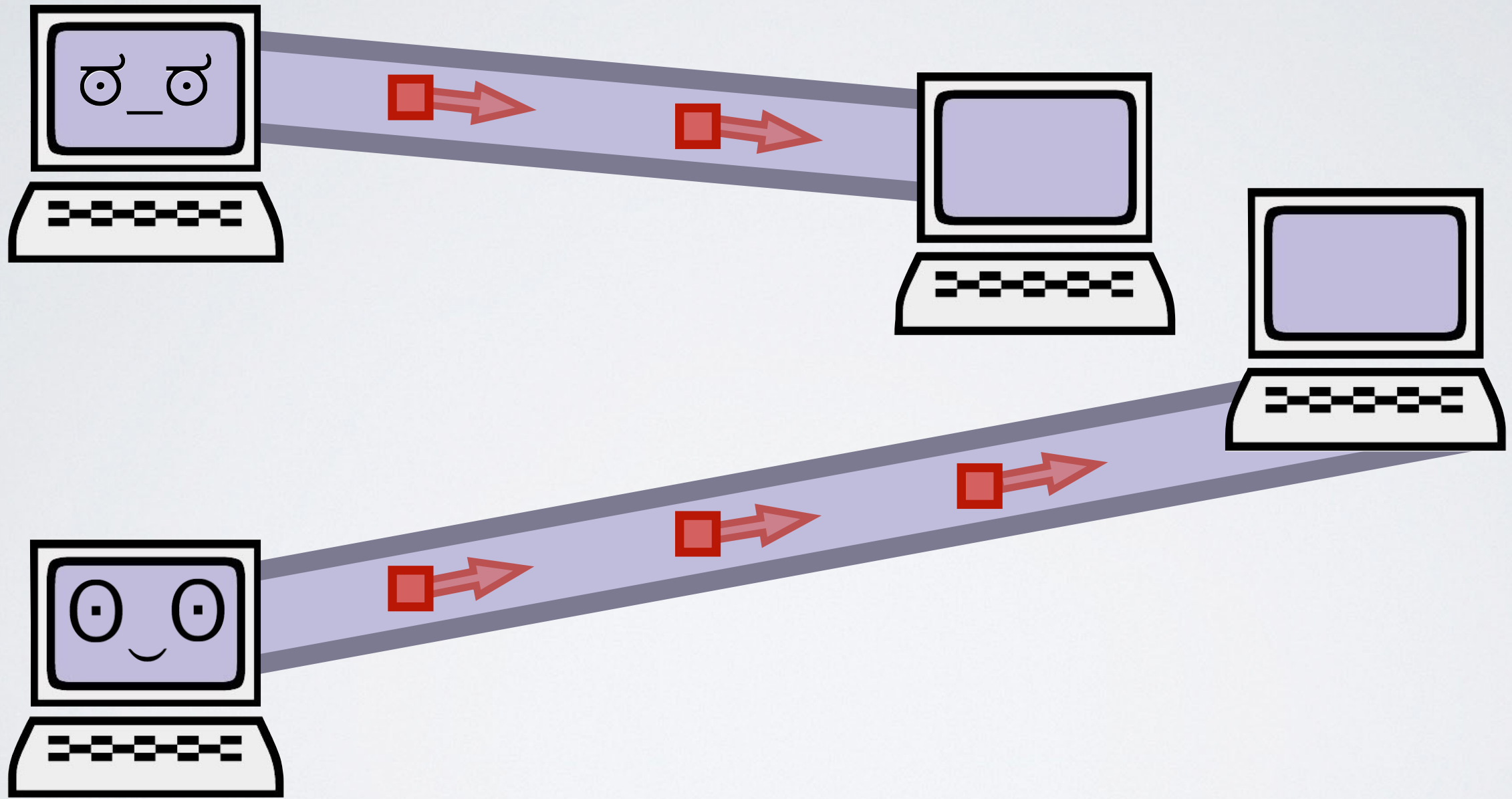
MEH

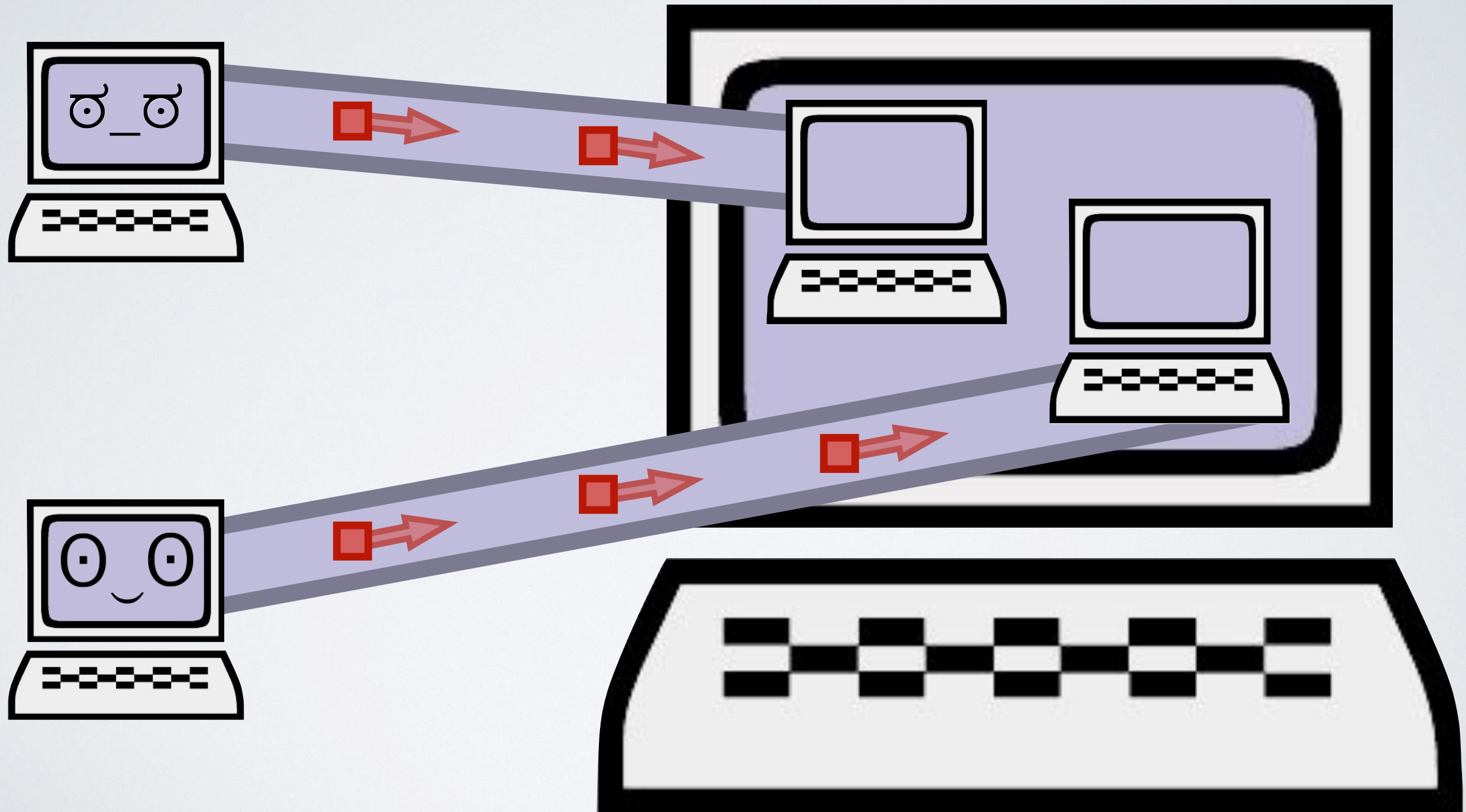


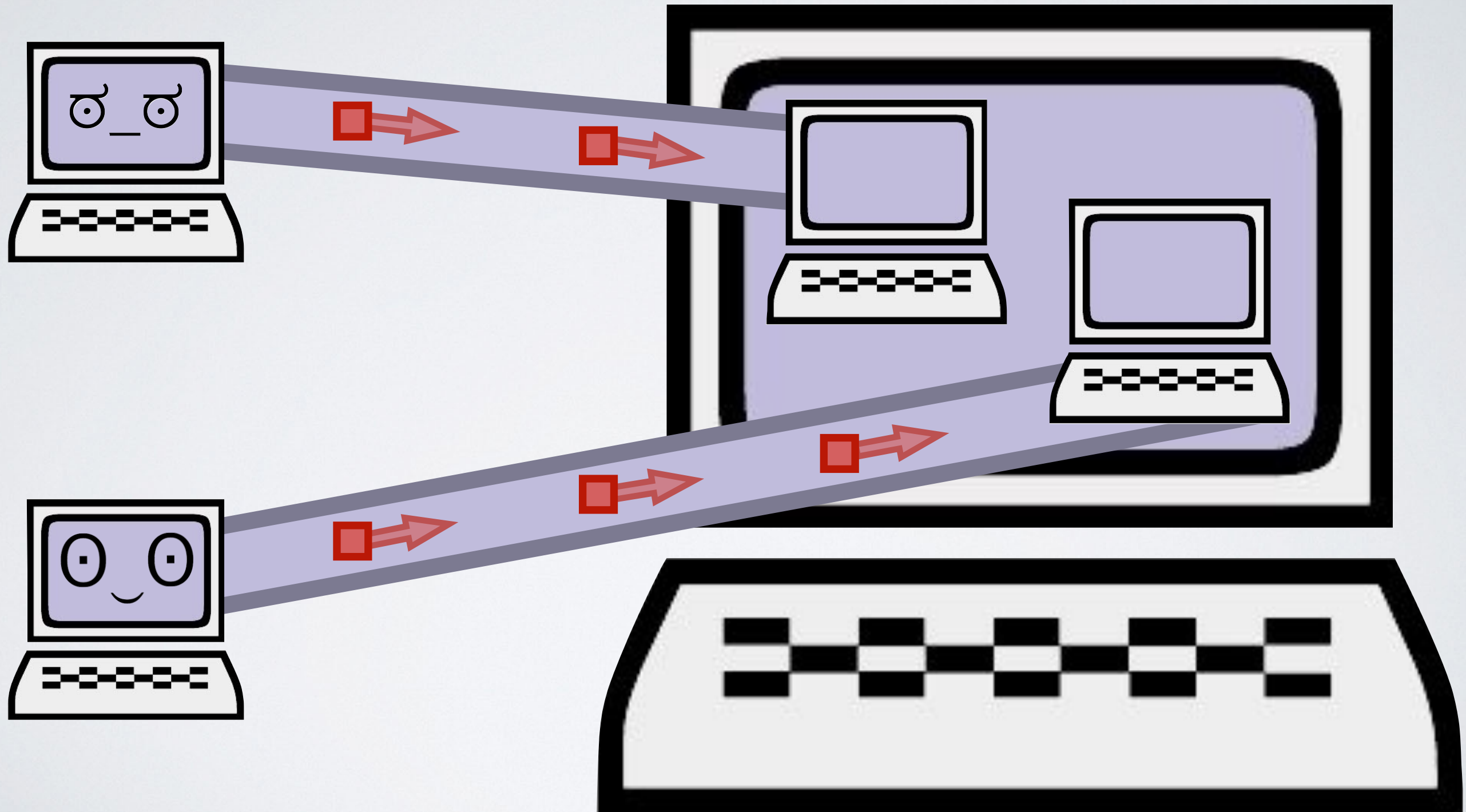


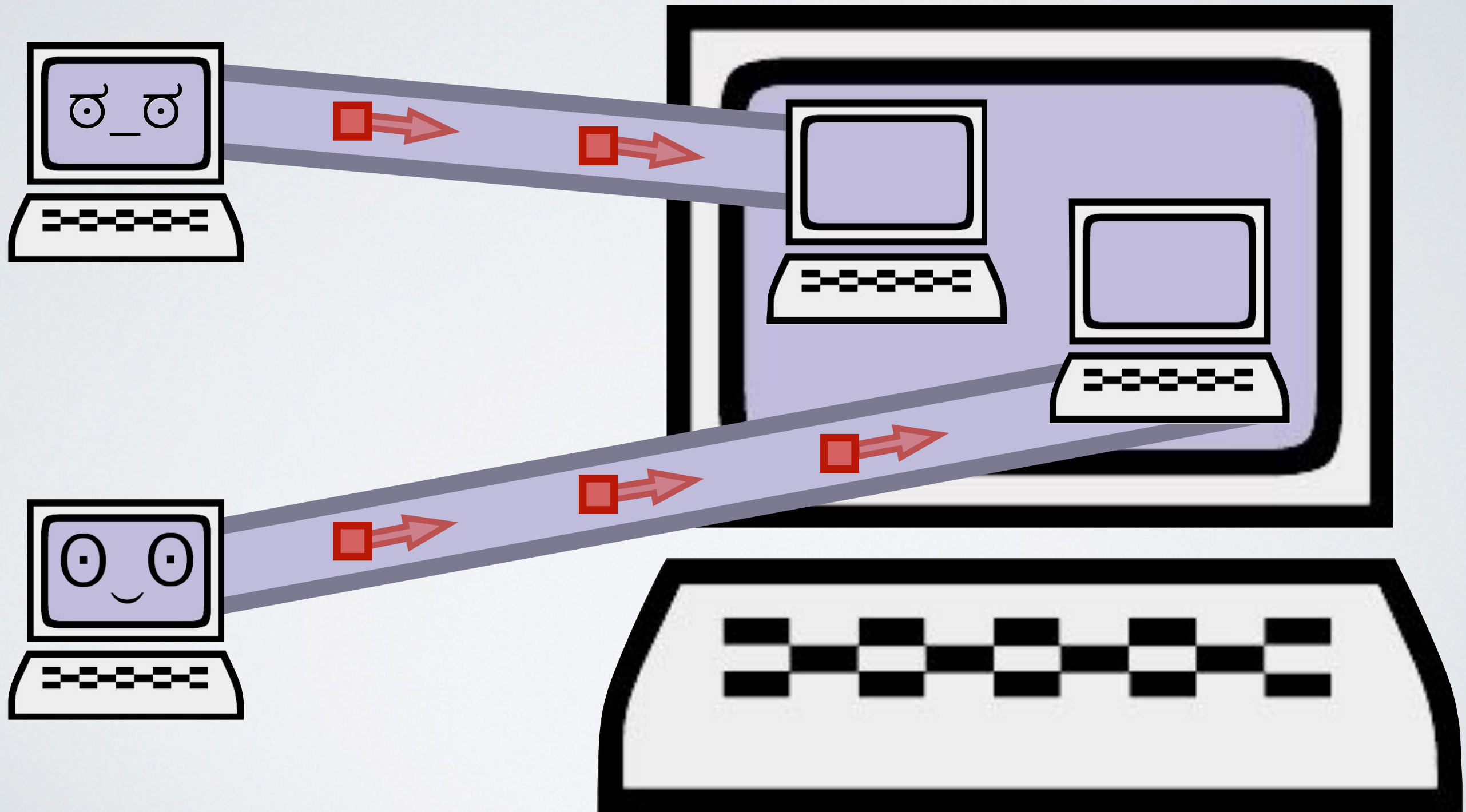
NO POINT ATTACKING YOURSELF





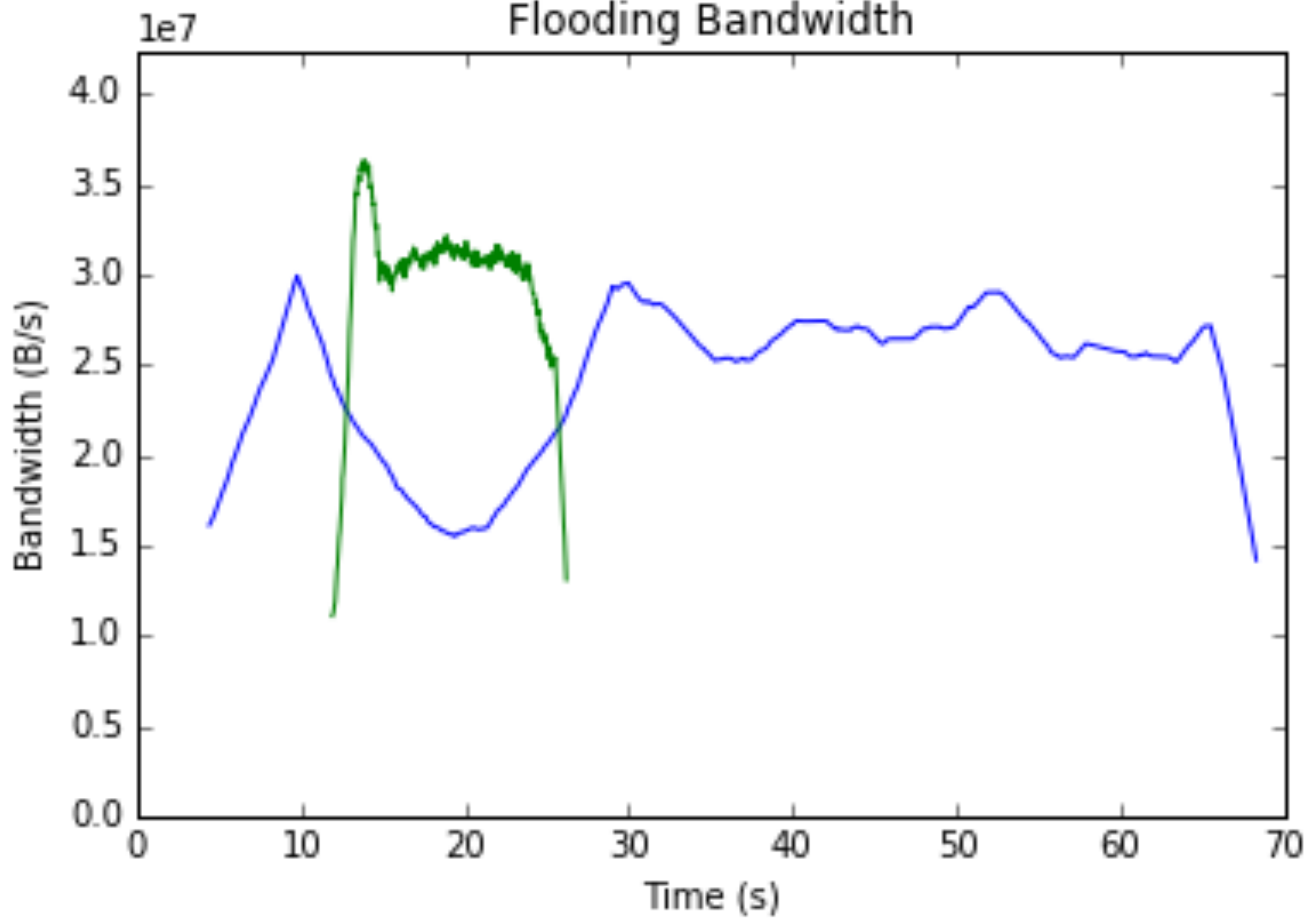






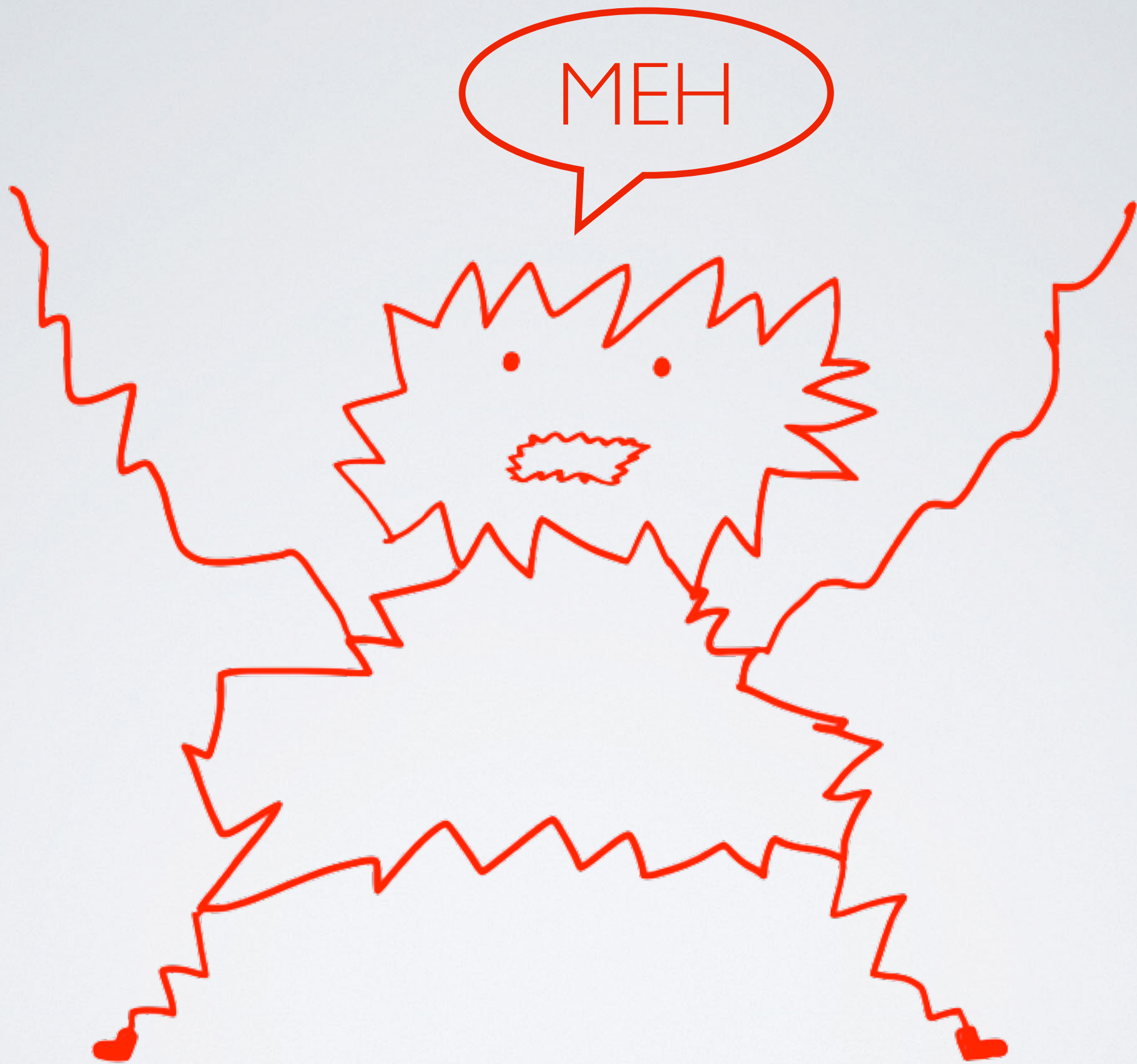
МАС

Flooding Bandwidth



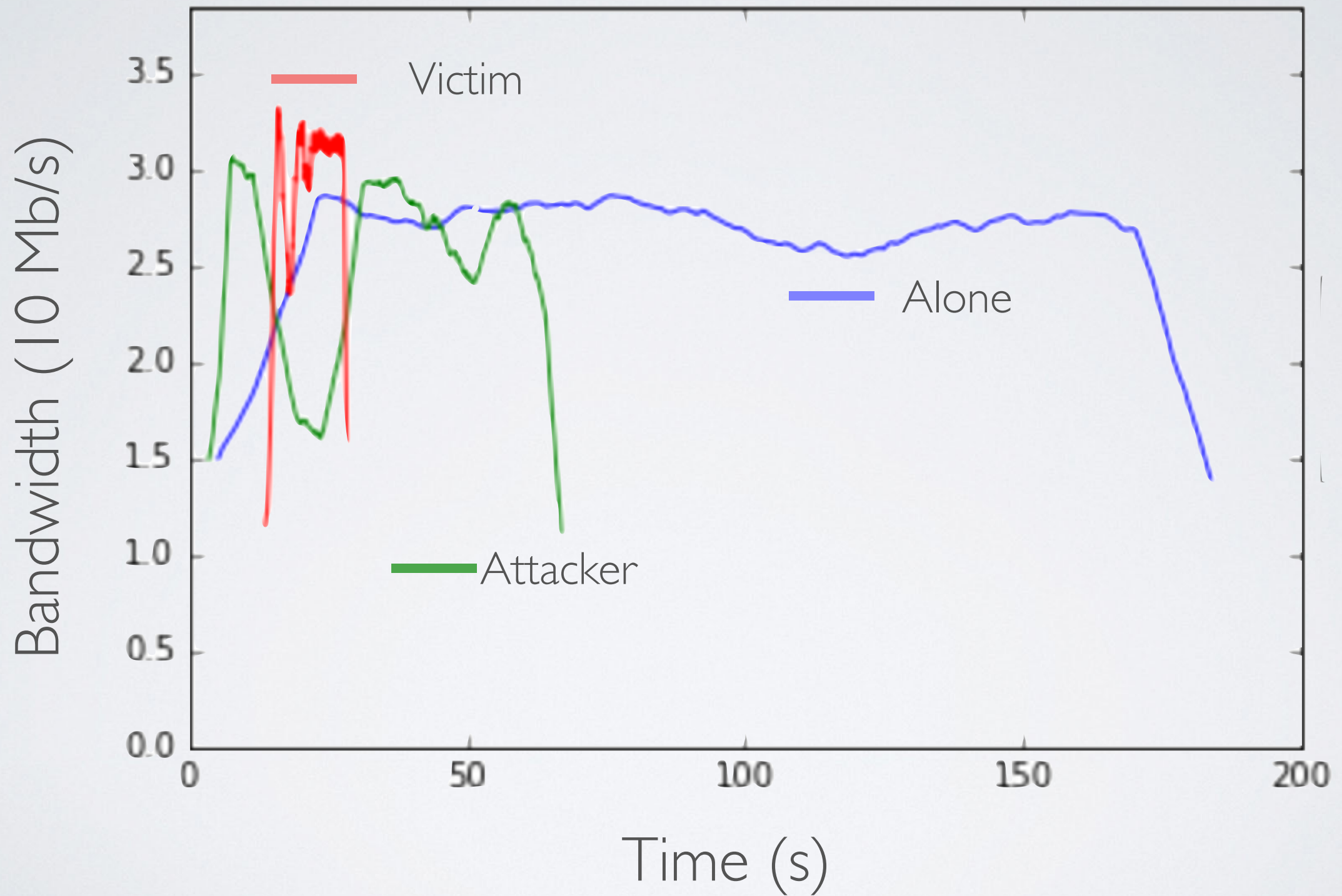
MEH



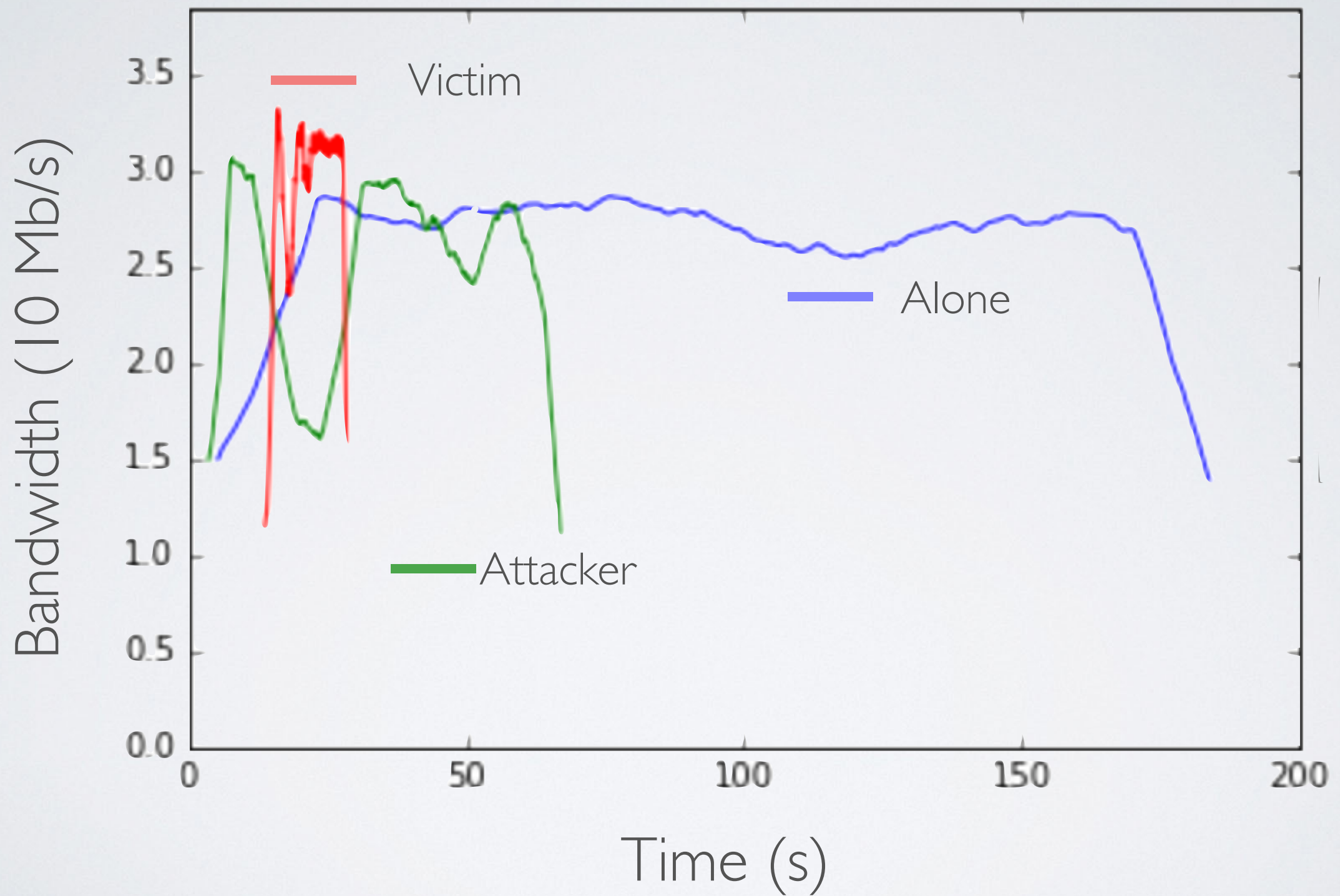


I CAN MAKE A DIP: I JUST WAIT

VIRTUALIZATION

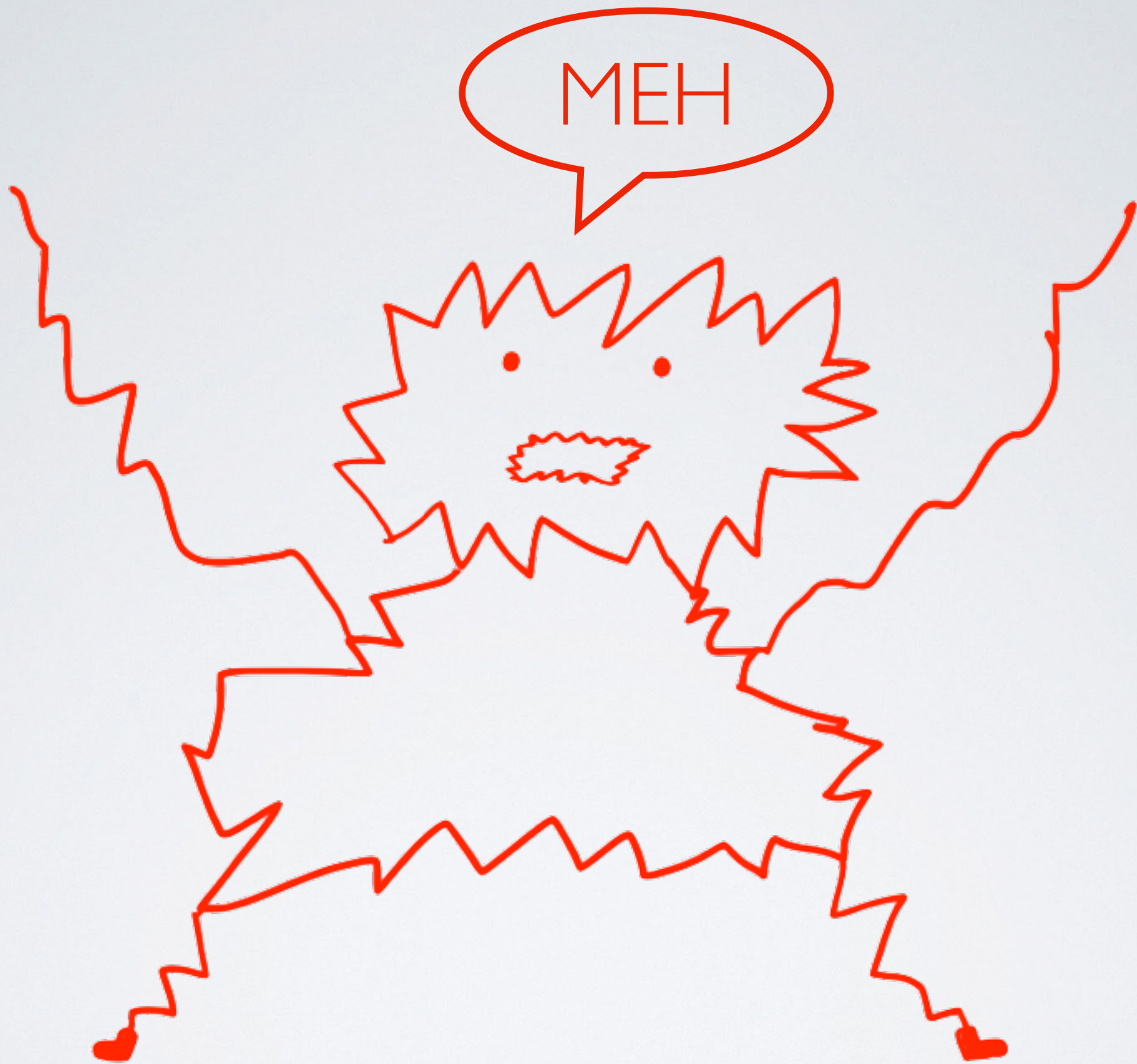


VIRTUALIZATION

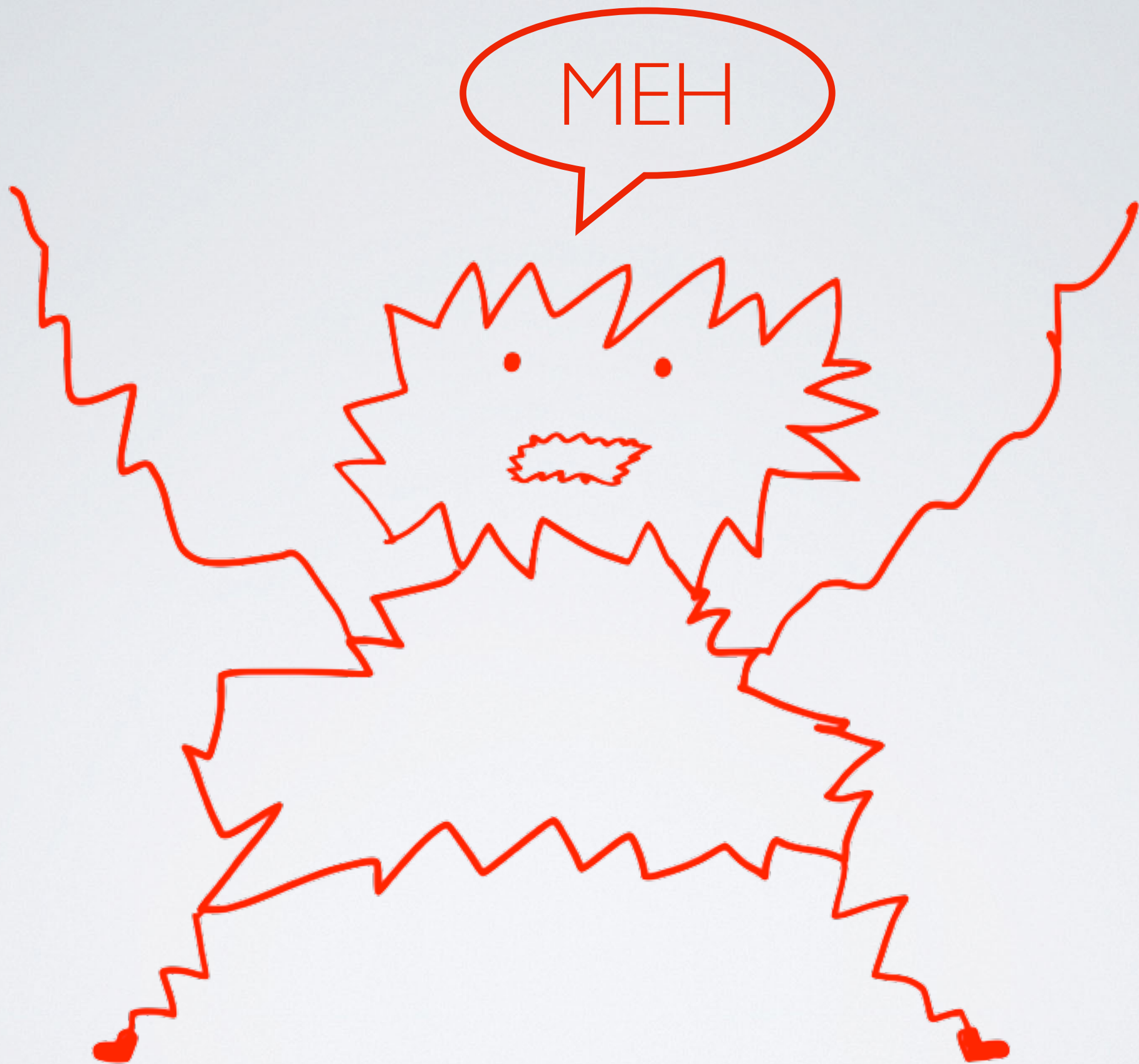


MEH





HOW YOU GONNA GET TO ME ?

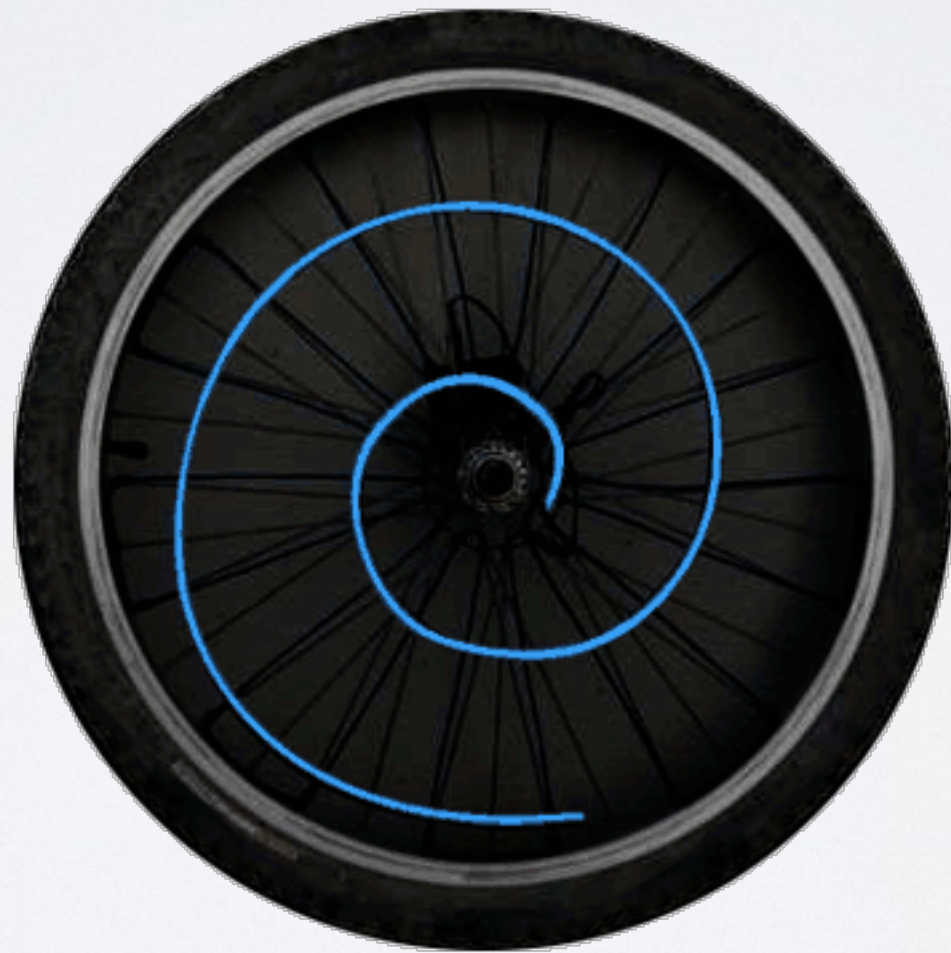


HOW ARE YOU GONNA GET TO ME ?

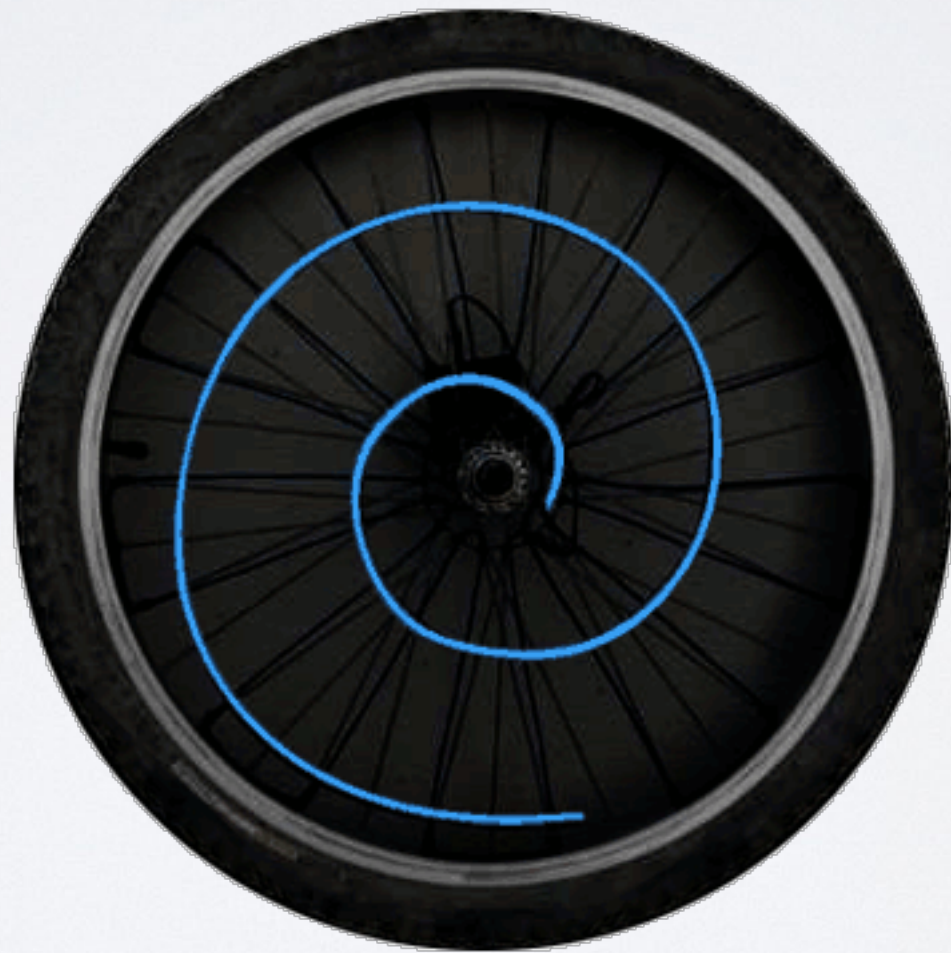
SCHEDULING ALGORITHMS

SCHEDULING ALGORITHMS

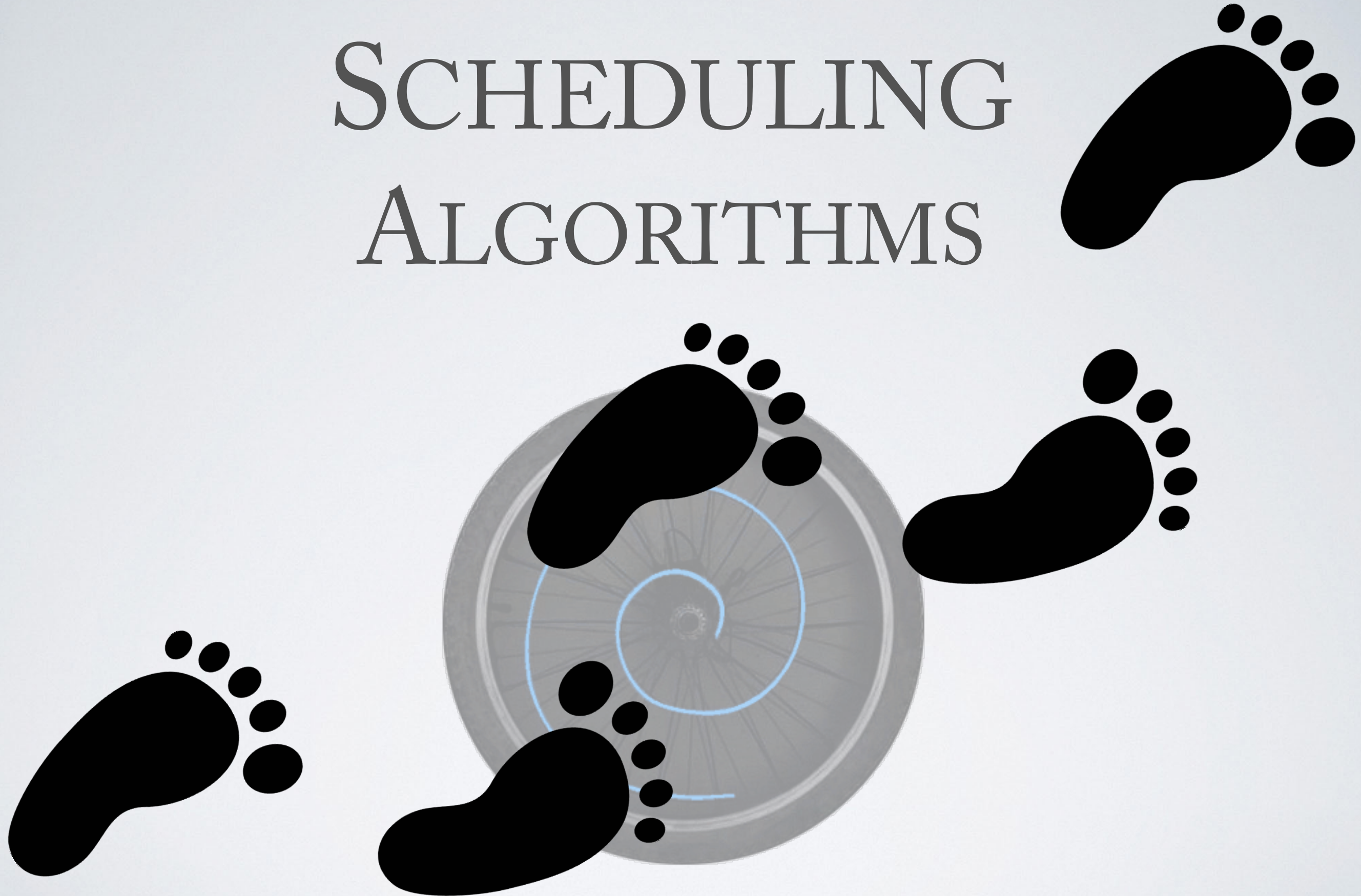
SCHEDULING ALGORITHMS



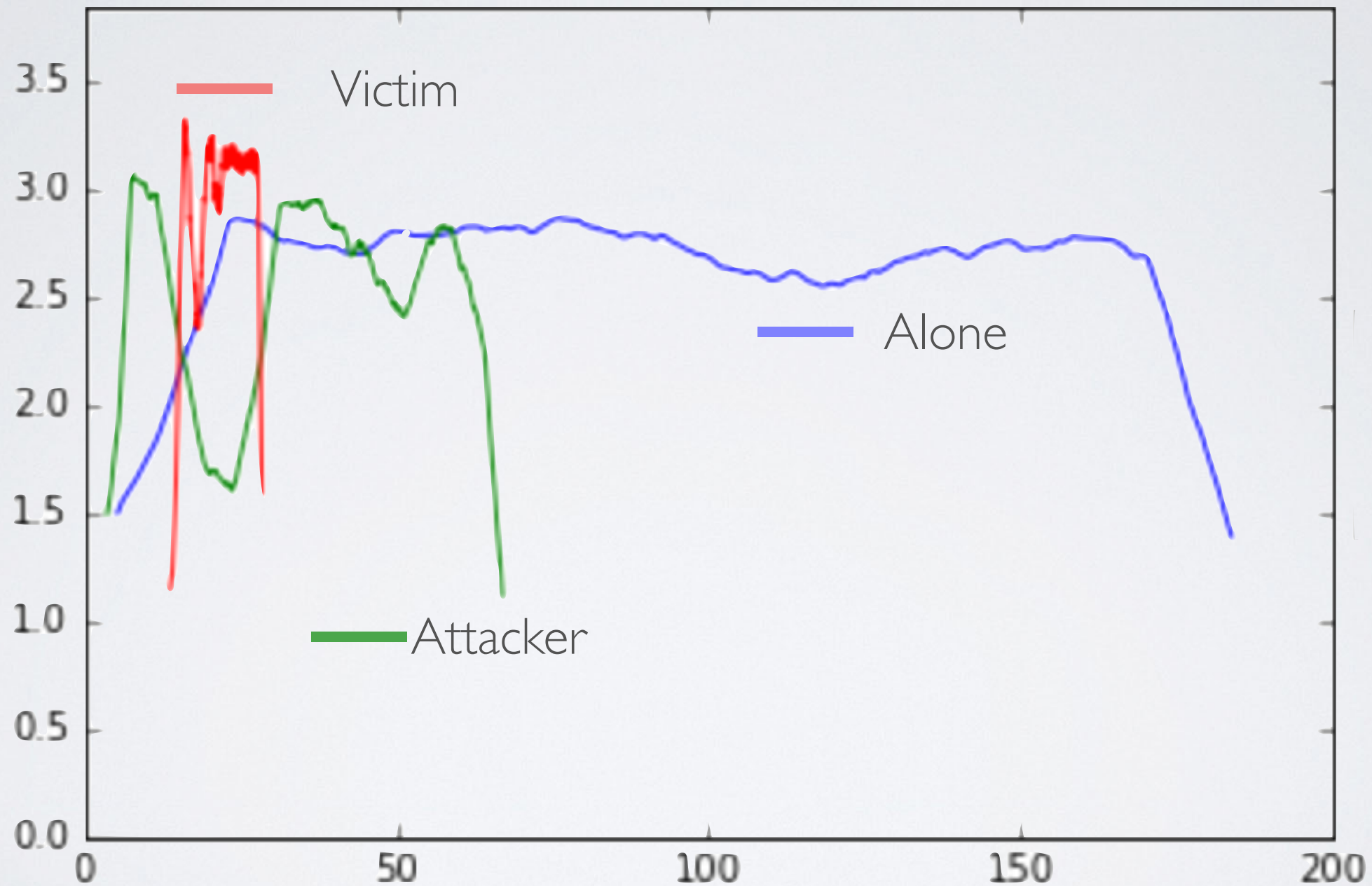
SCHEDULING ALGORITHMS



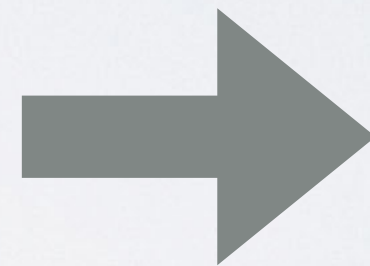
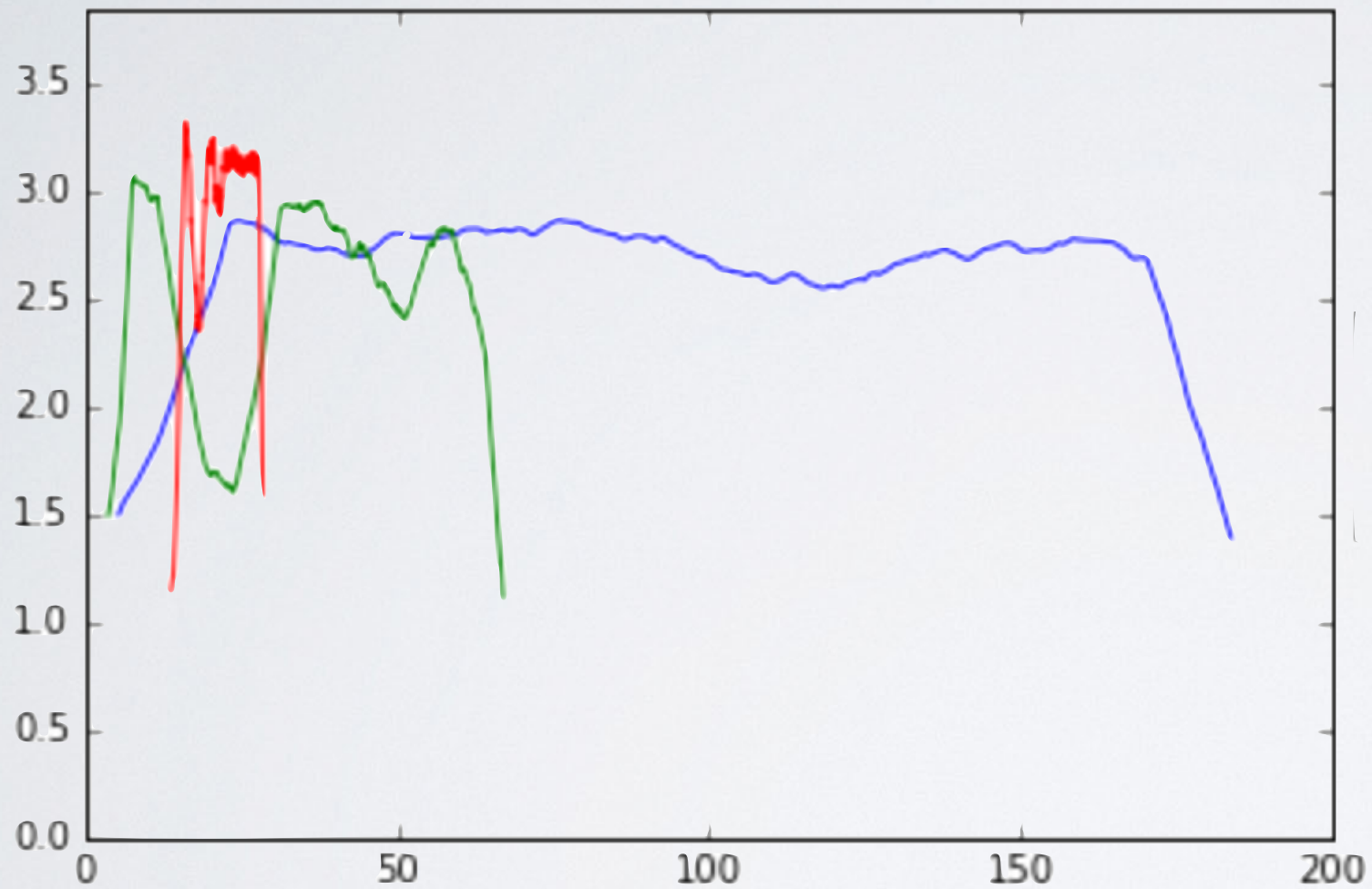
SCHEDULING ALGORITHMS



STEPS FORWARD

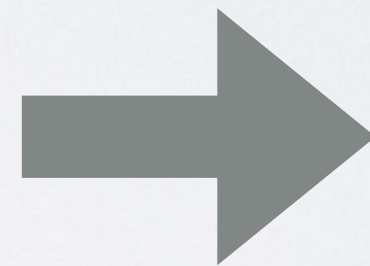
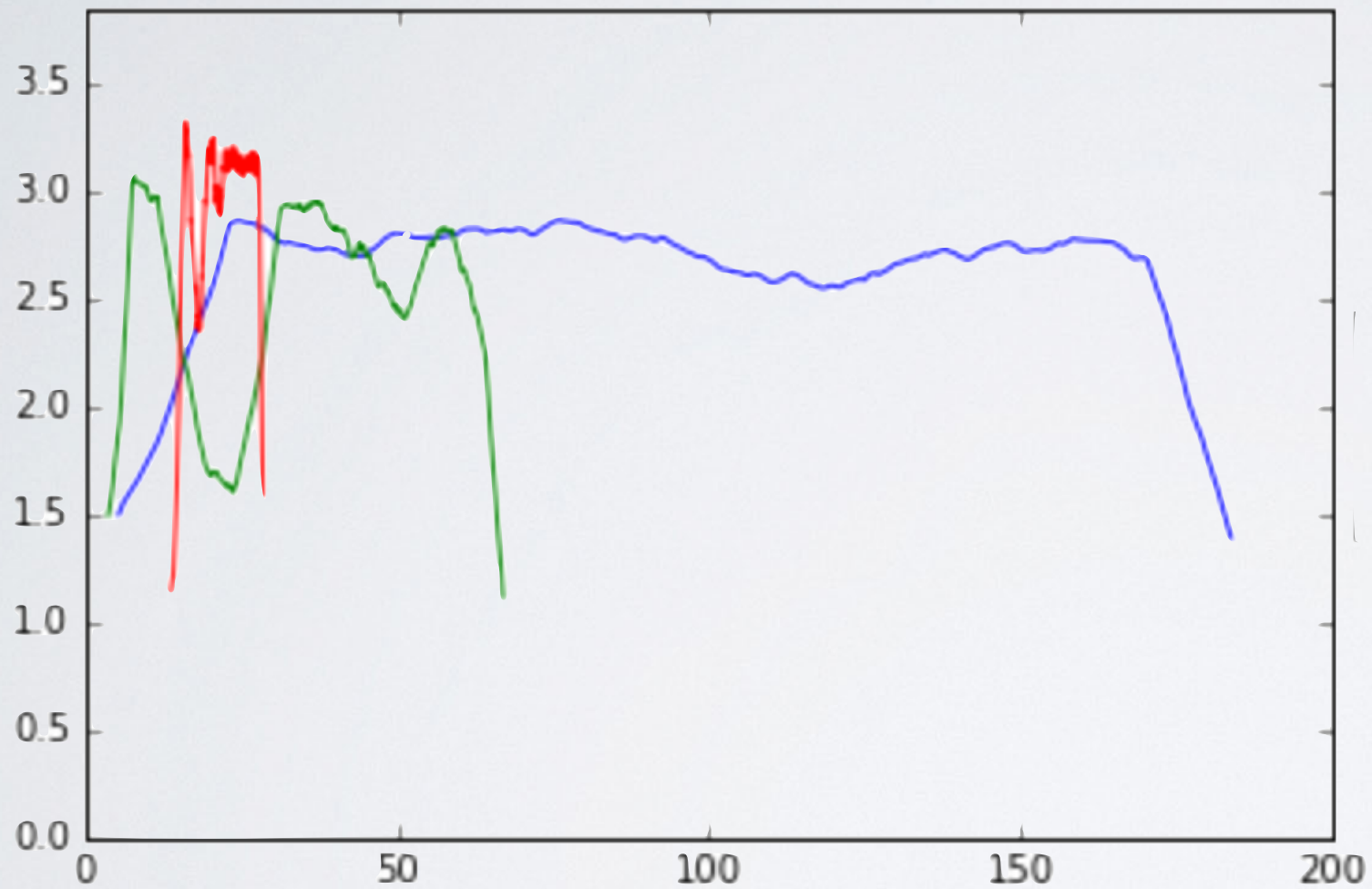


QUANTIFICATION



0.23

QUANTIFICATION



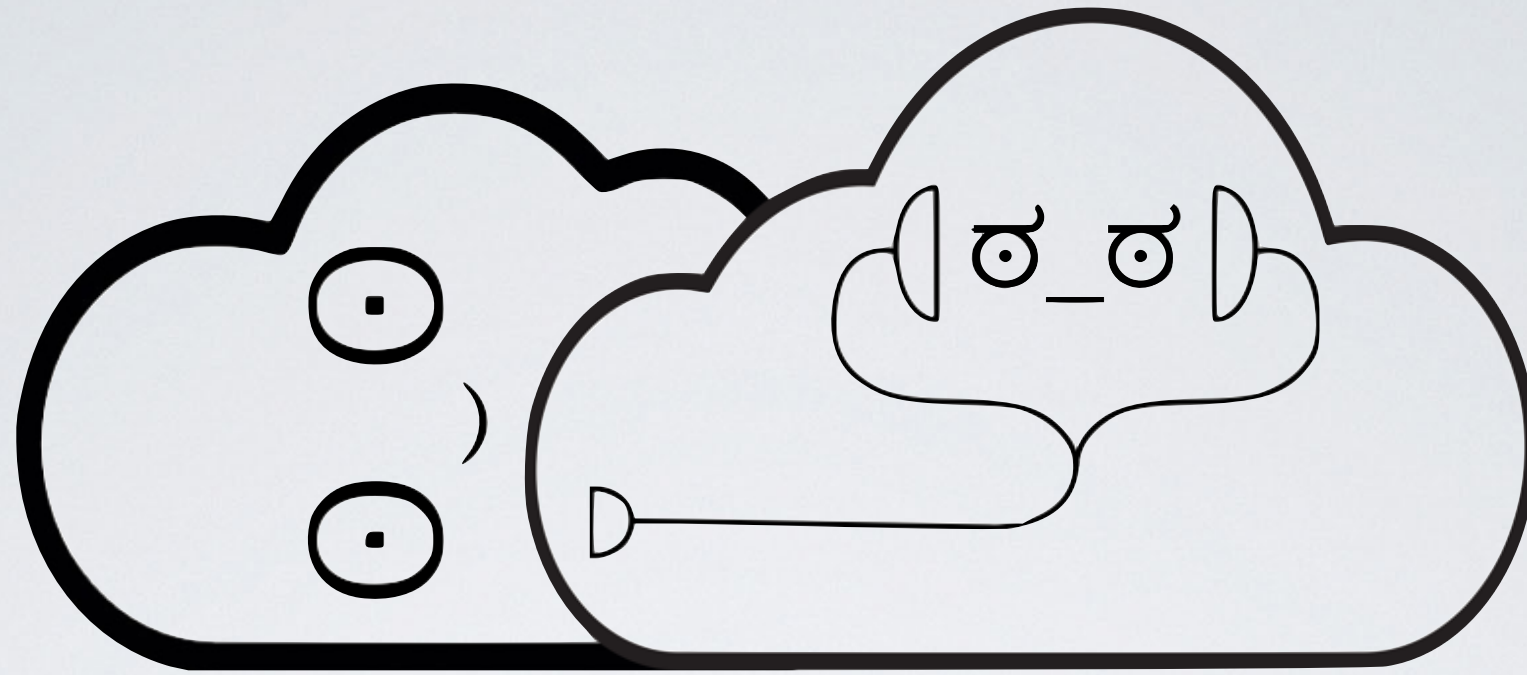
0.23

FINGERPRINTING

FINGERPRINTING

CALIBRATION

CALIBRATION



MOVING IN NEXT DOOR

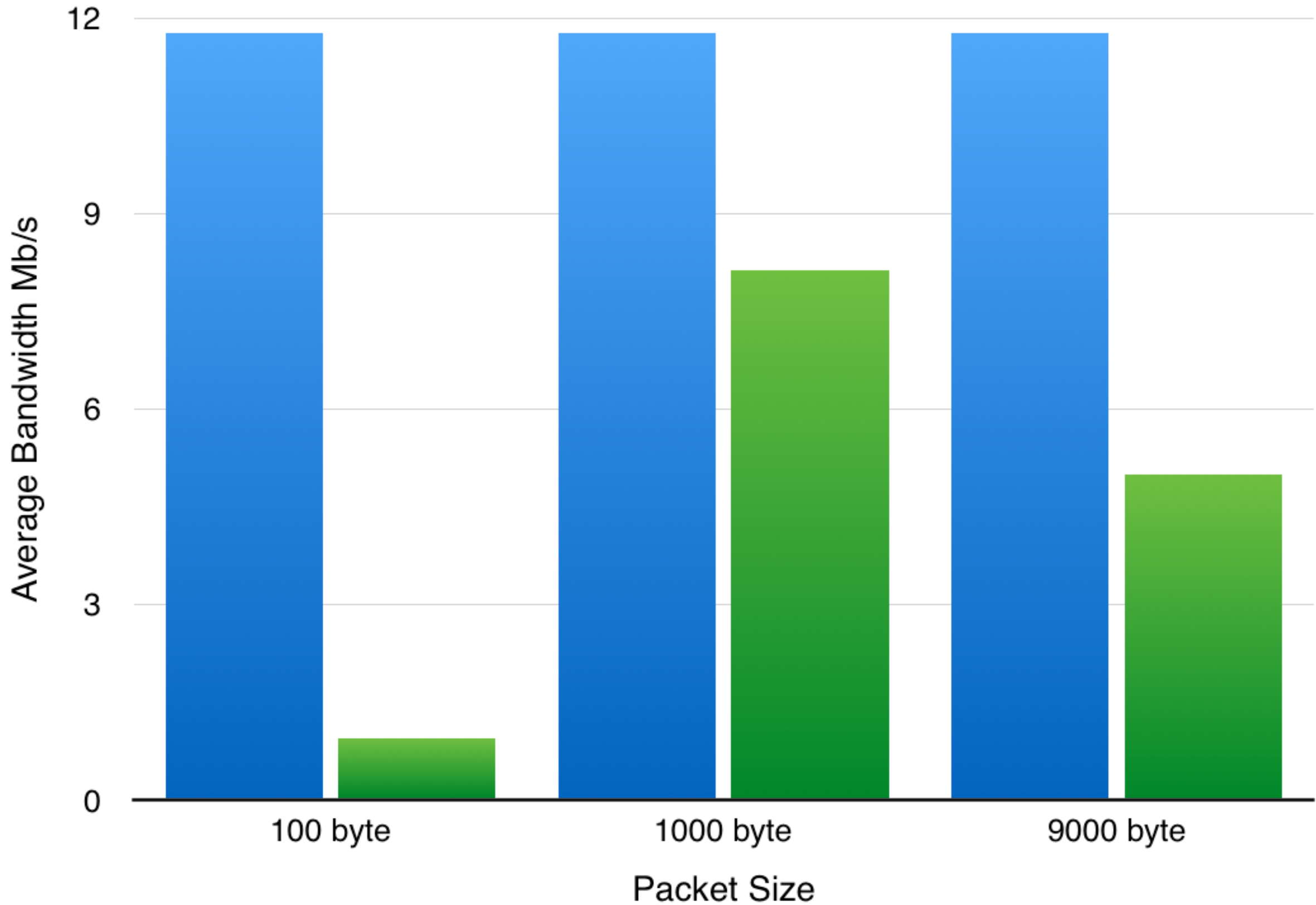
Network Flooding as a Side Channel in Cloud Environments

by Yatharth Agarwal and Vishnu Murale
mentored by Jason Hennessey, Kyle Hogan, and Mayank Varia

slido.com/primes

BONUS SLIDES

TCP vs UDP



NO SLEEP FOR UDP vs SLEEP (100 μ SEC)

