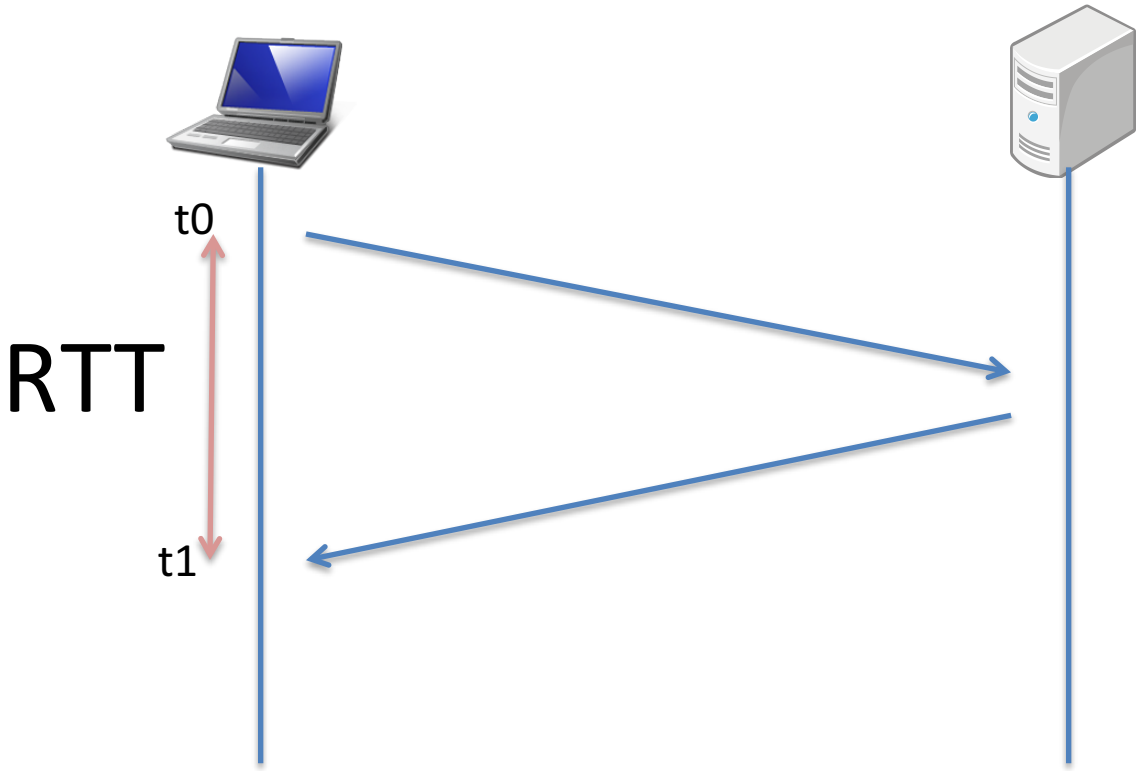
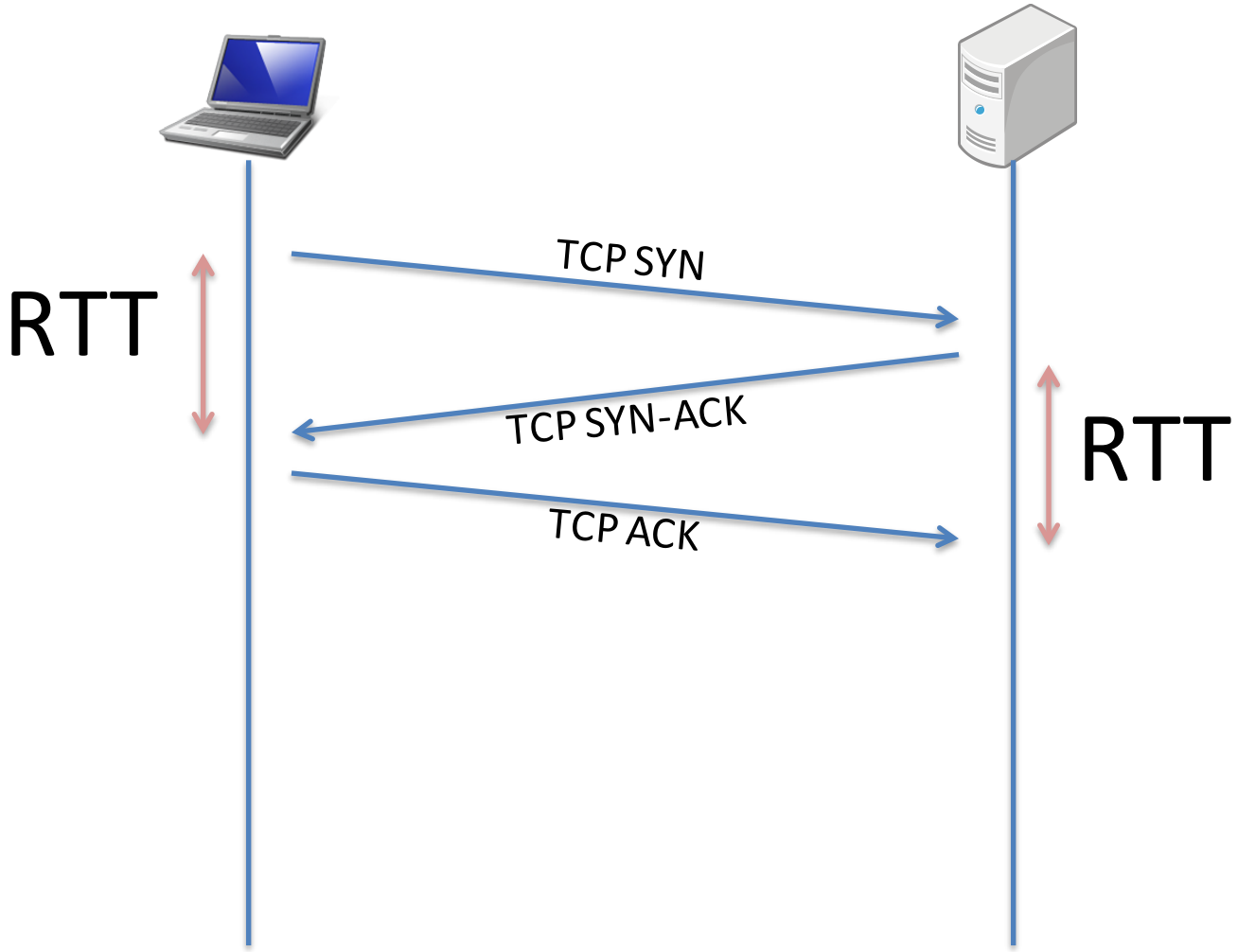
RTT matters

Matsuzaki ‘maz’ Yoshinobu
<maz@iij.ad.jp>

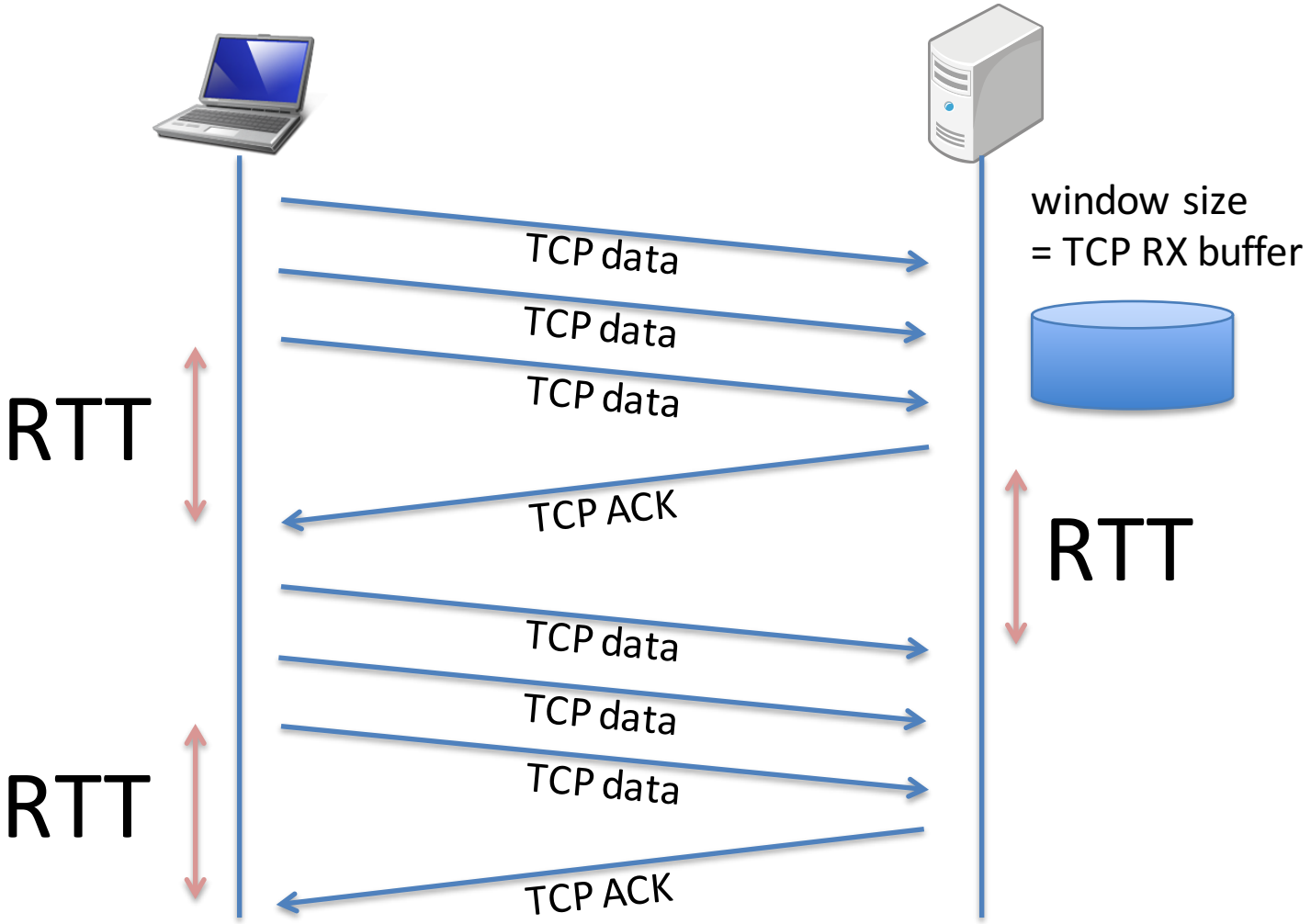
Round Trip Time (RTT)



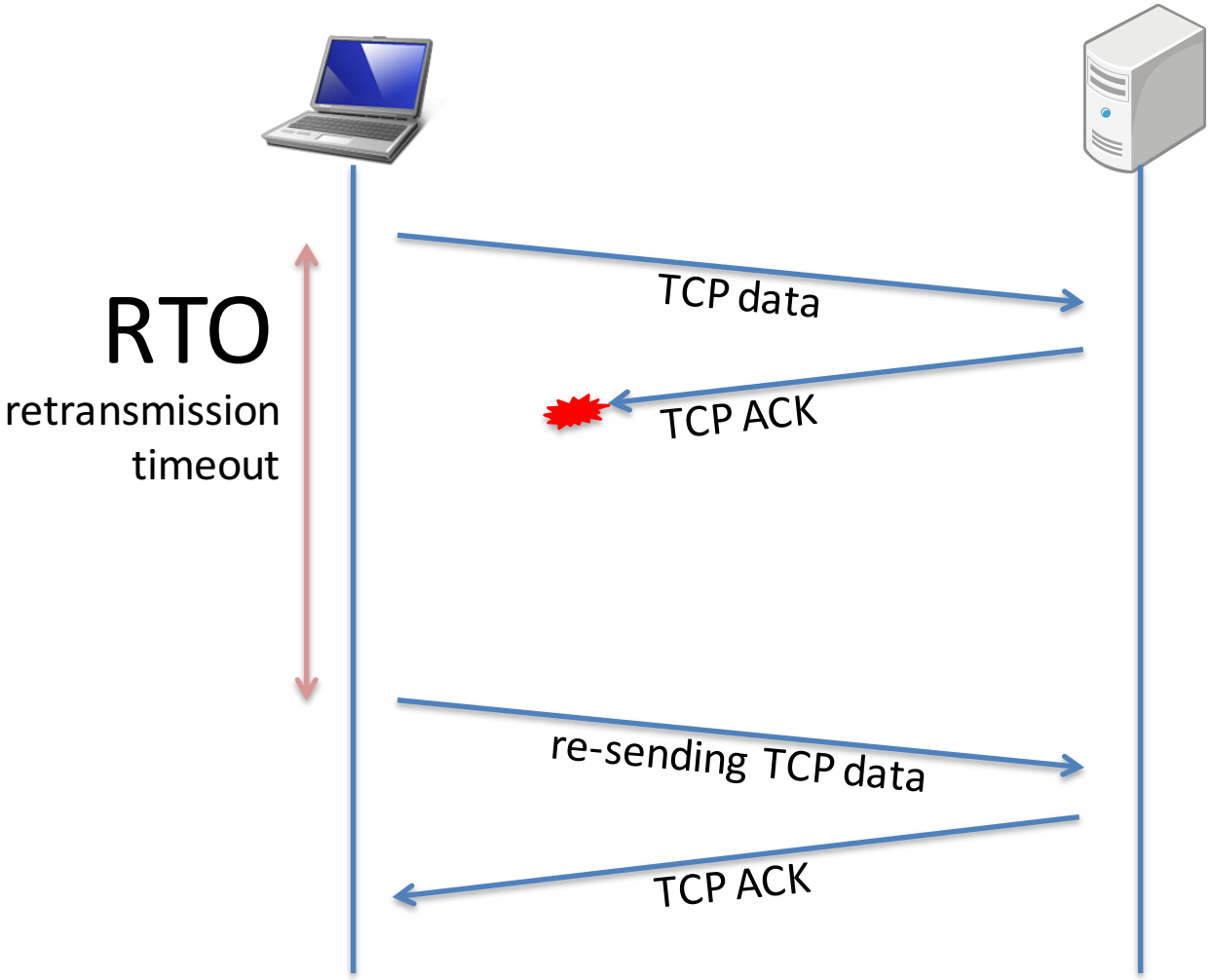
TCP 3 way handshake and RTT



TCP and RTT


window size
= TCP RX buffer
TCP data
TCP data
TCP data
TCP ACK
TCP data
TCP data
TCP data
TCP ACK
RTT
RTT
RTT

packet loss and RTT



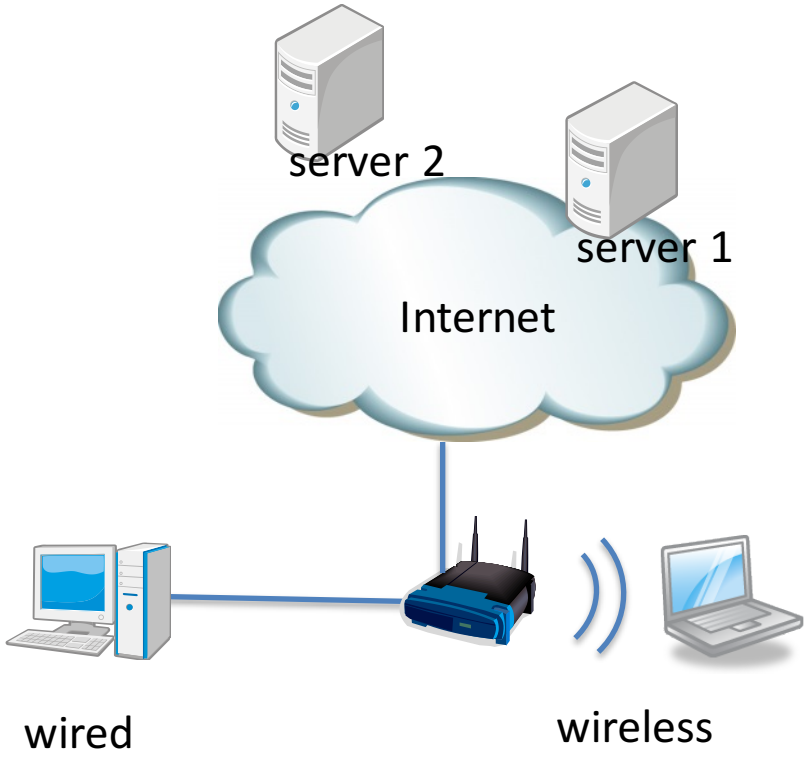
RTO is computed based on RTT -- see rfc6298

RTT

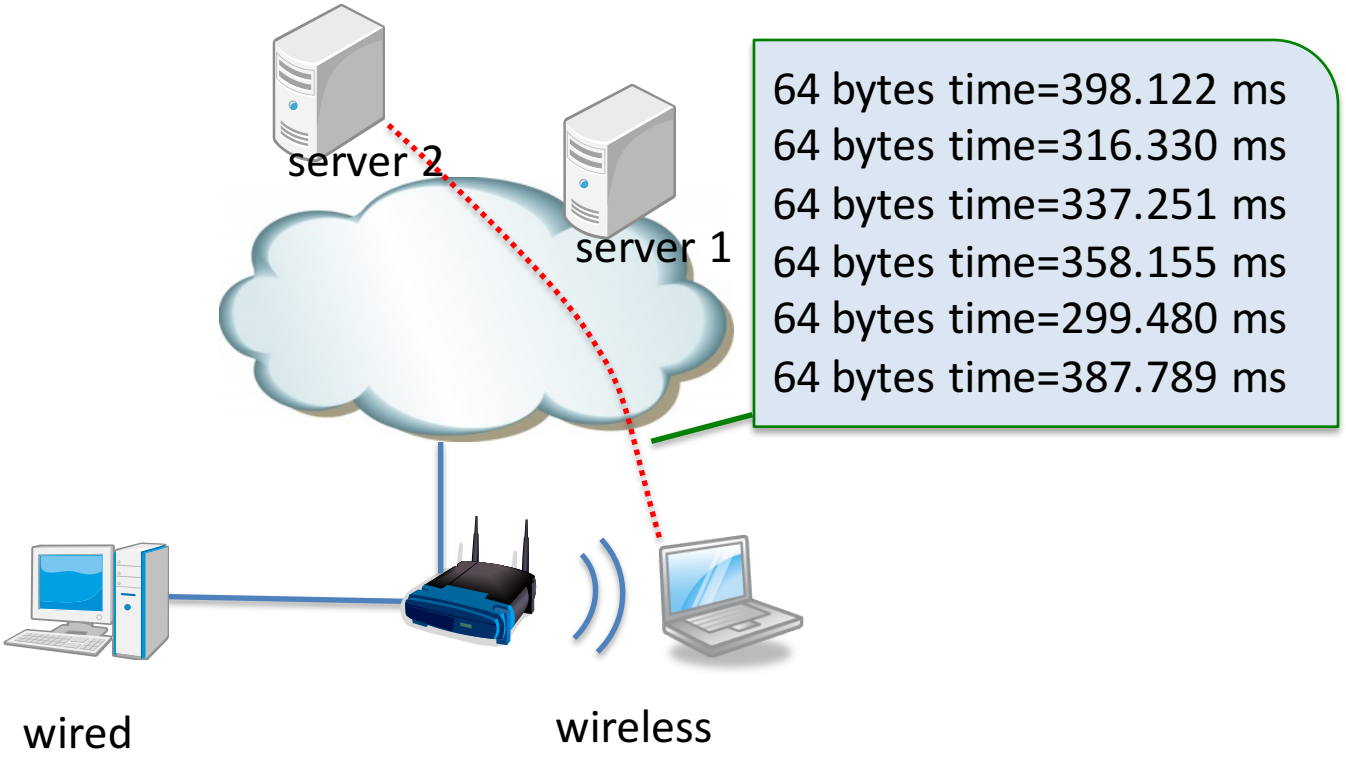
- the lower, the better
  - faster TCP handshake
  - better TCP throughput
  - faster TCP recovery from a packet loss

- There are various efforts to improve TCP performance even in a high latency situation

Wi-Fi is getting popular

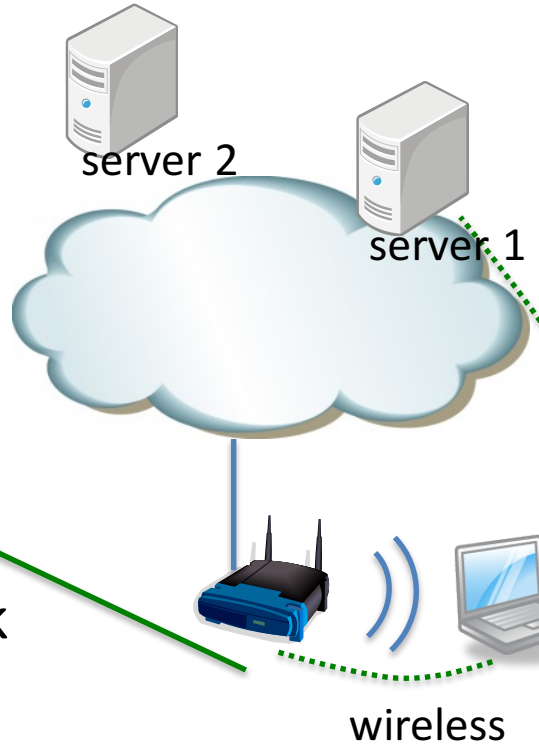


I faced a trouble



- RTT was not stable from a wireless client to the server 2. ☹

let's try to isolate the problem



64 bytes time=3.757 ms
64 bytes time=3.789 ms
64 bytes time=3.768 ms
64 bytes time=3.718 ms
64 bytes time=3.644 ms
64 bytes time=3.762 ms

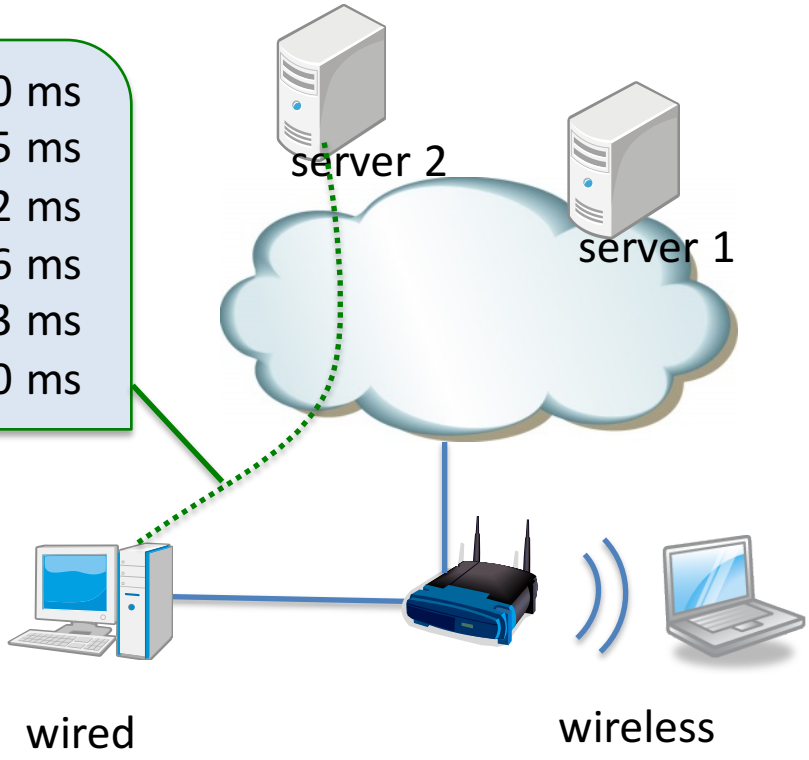
1) the local wifi network looks pretty stable

64 bytes time=169.588 ms
64 bytes time=170.666 ms
64 bytes time=169.793 ms
64 bytes time=168.185 ms
64 bytes time=169.783 ms
64 bytes time=169.957 ms

2) RTT to server 1 looks also stable

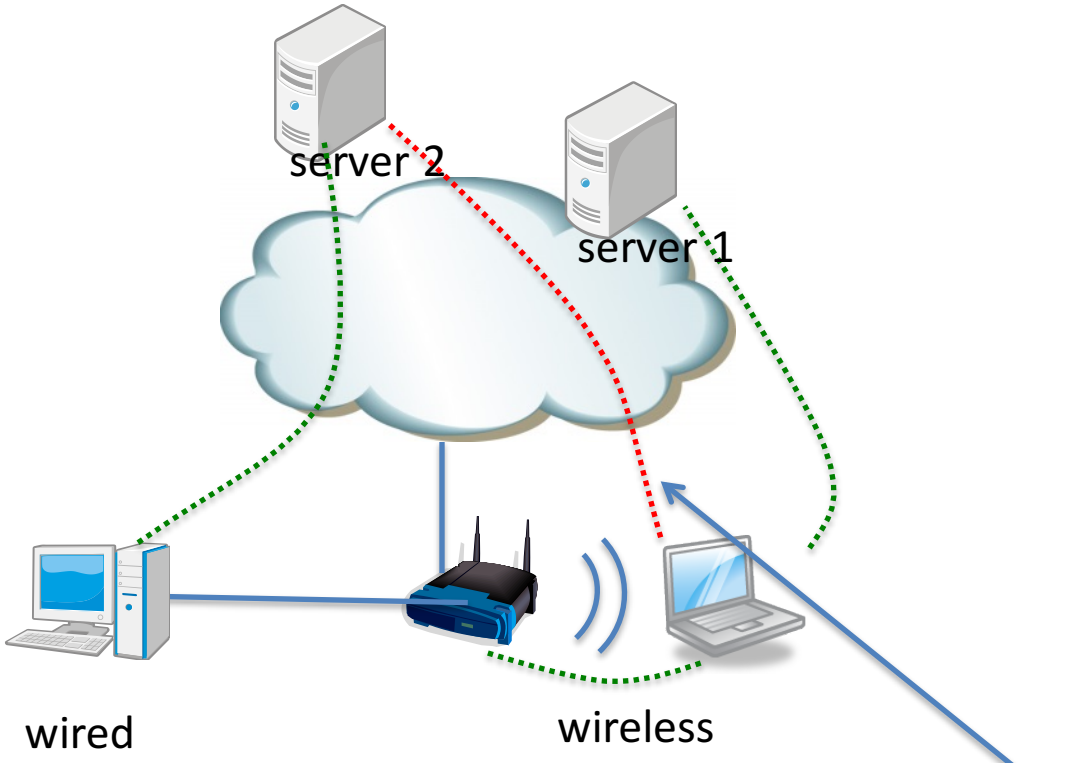
hmmm...

64 bytes time=296.040 ms
64 bytes time=296.105 ms
64 bytes time=296.442 ms
64 bytes time=296.186 ms
64 bytes time=296.103 ms
64 bytes time=296.070 ms



3) from the wired host in the same network, RTT to the server 2 looks stable

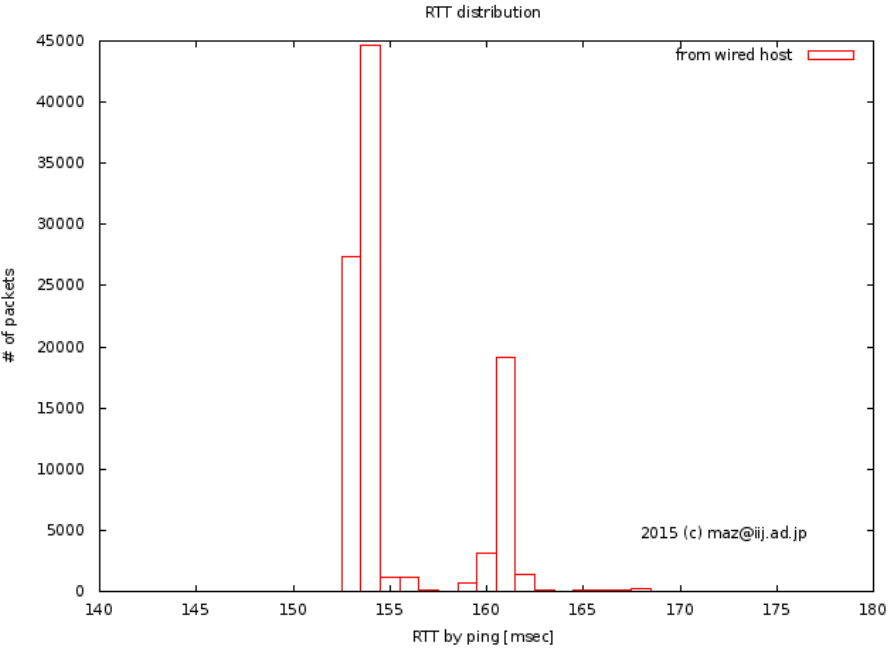
so...



- this strange behavior happens only for this combination ☹

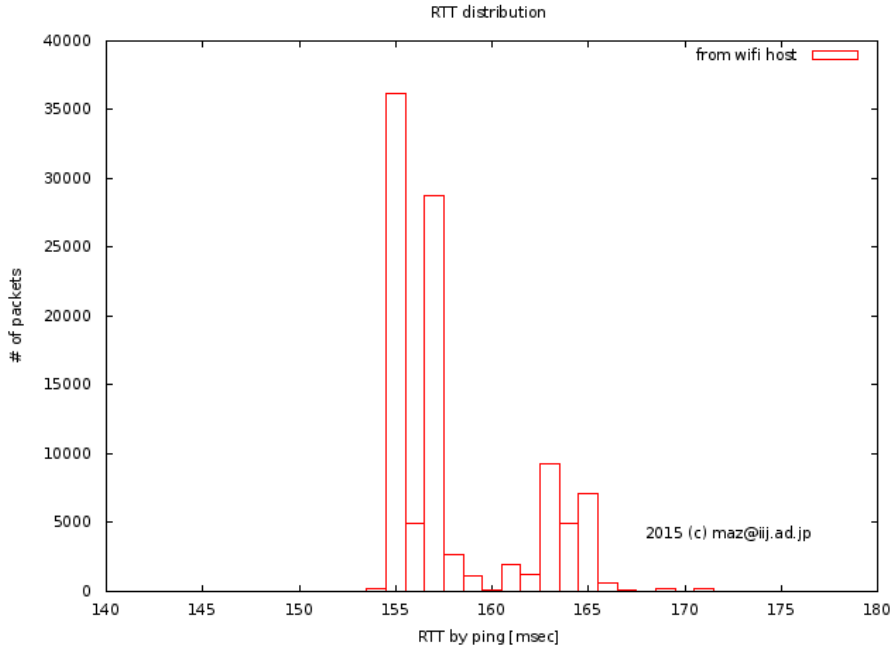
RTT distribution to server 1

wired



from wired host to server 1

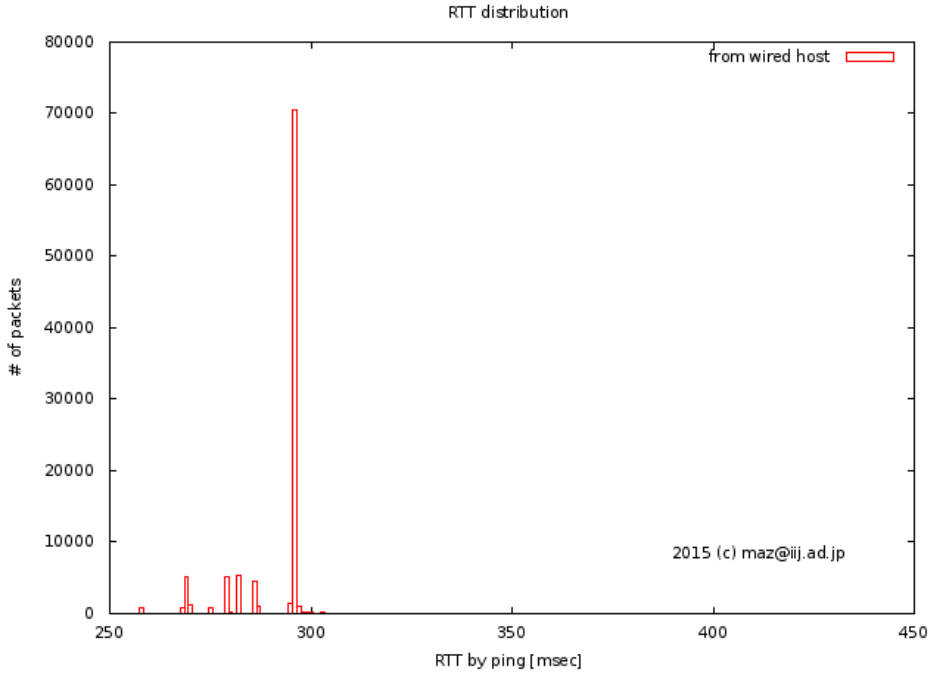
wifi



from wifi host to server 1

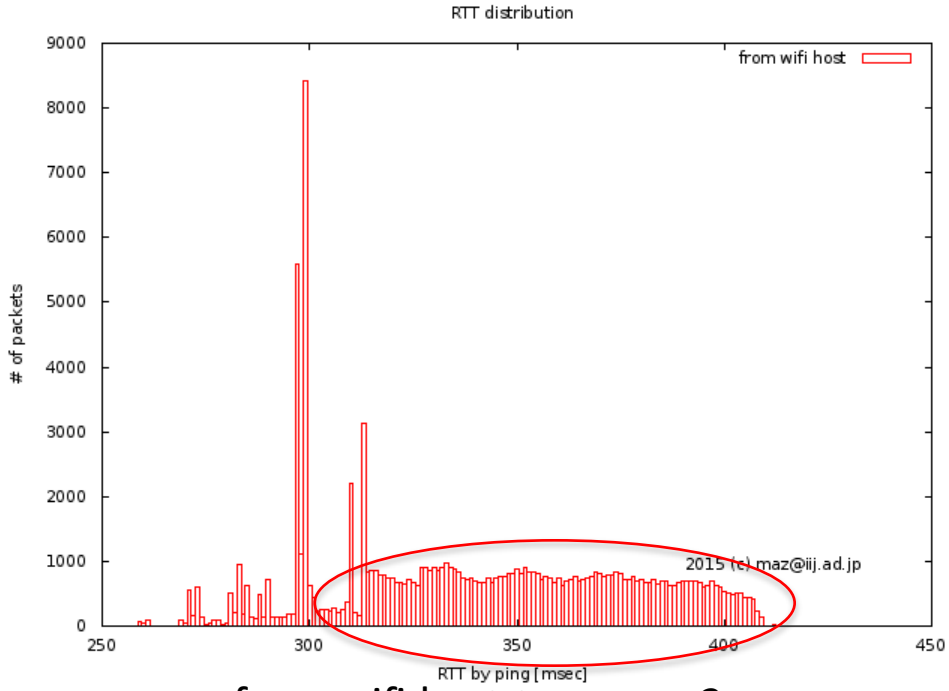
RTT distribution to server 2

wired



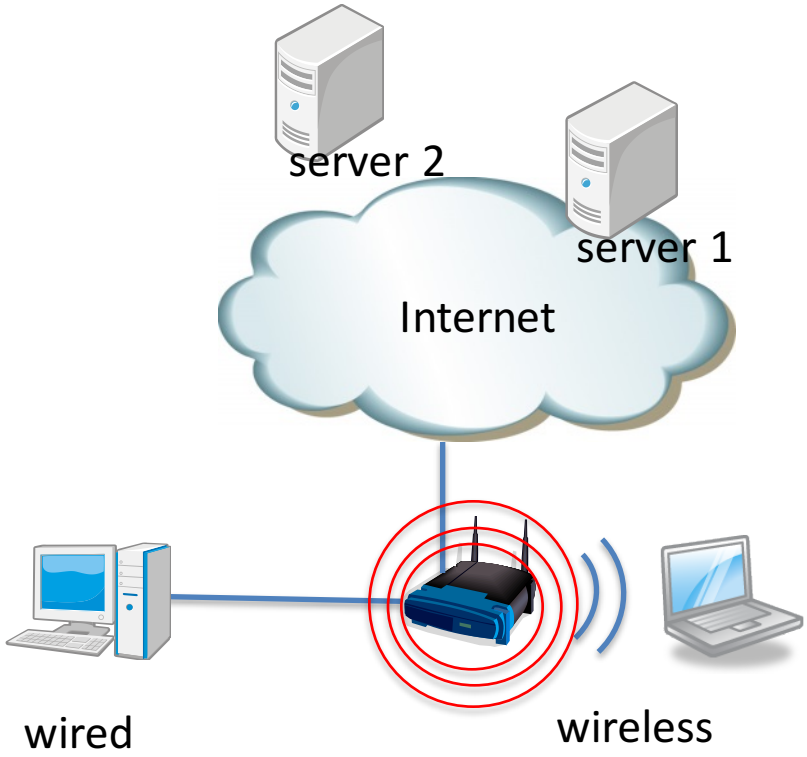
from wired host to server 2

wifi



from wifi host to server 2

the wifi AP was buffering packets



- and this caused the unstable RTT ☹

My wifi adapter does sleep

- to reduce battery usage
- before sleeping, the client send a notification to the wifi AP, and the AP keeps packets until the client wake up

- so, my PC was asking the buffering!

wifi AP sends beacon

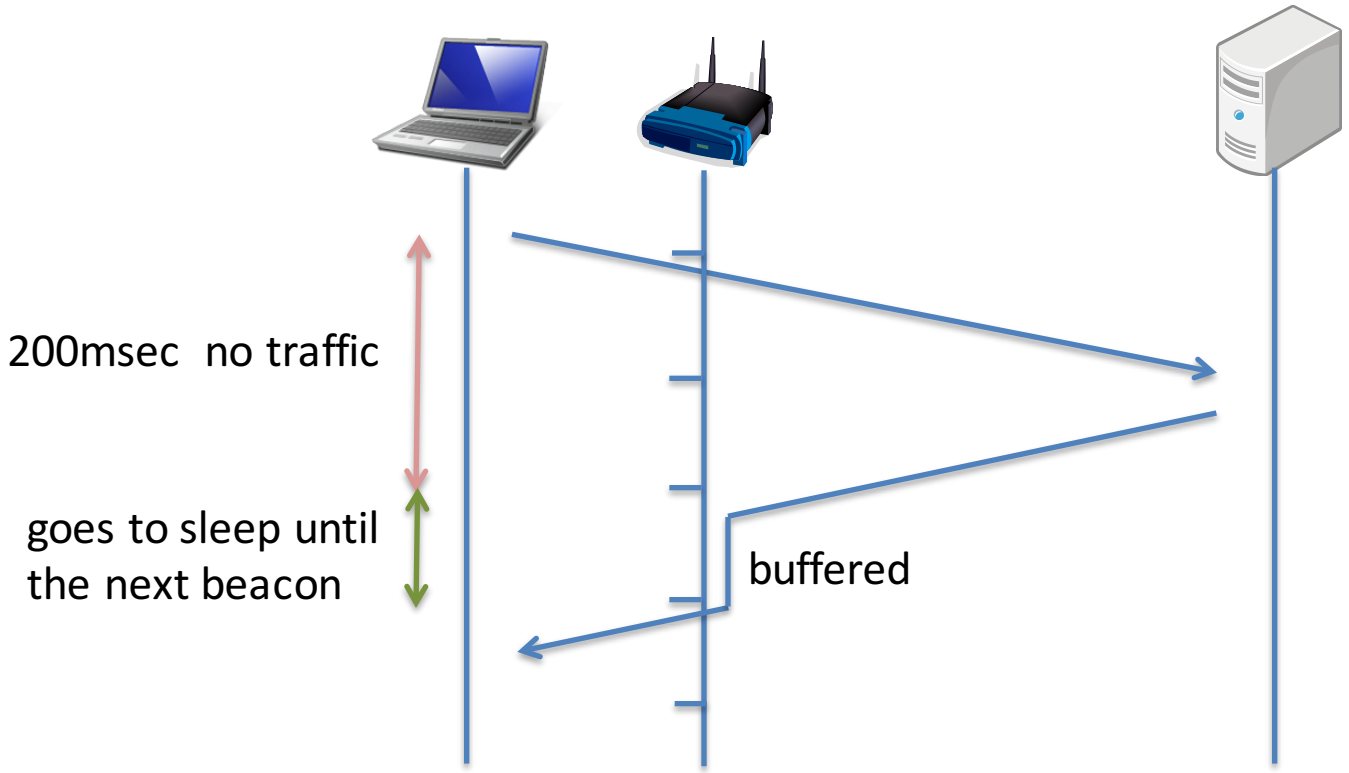
- beacon interval
  - time interval between beacon transmissions
  - usually 100msec, but it's configurable
- TIM (Traffic Indication Map)
  - to tell any sleeping clients if the AP has any buffered frames present for it

- wifi adapter can sleep between beacons, and wake up to check a beacon (TIM can indicate if the adapter need to receive data or not)

the scenario

- My wifi adapter went to sleep after 200msec of no traffic
  - that's why the unstable RTT happens only when I was communicating with server 2 (average RTT is 300msec)
- Based on the beacon interval information (which was 100msec in my case), it woke up and received a response
  - that's why most RTT distribution is within 100msec

sleeping and buffering



Summary

- Strange RTT behavior happens if your communication is between:
  - a host connected to a wifi network and
  - a far end host (RTT>200msec)
- Your wifi adapter goes to sleep
  - “200msec of no traffic” seems a common trigger
- The sleep duration is manageable by setting beacon interval of your wifi AP
  - 100msec would be reasonable
  - You might be able to reduce battery usage by setting it as 1000msec, but this could introduce more RTT penalty