# Perceptual evaluation of Web browsing

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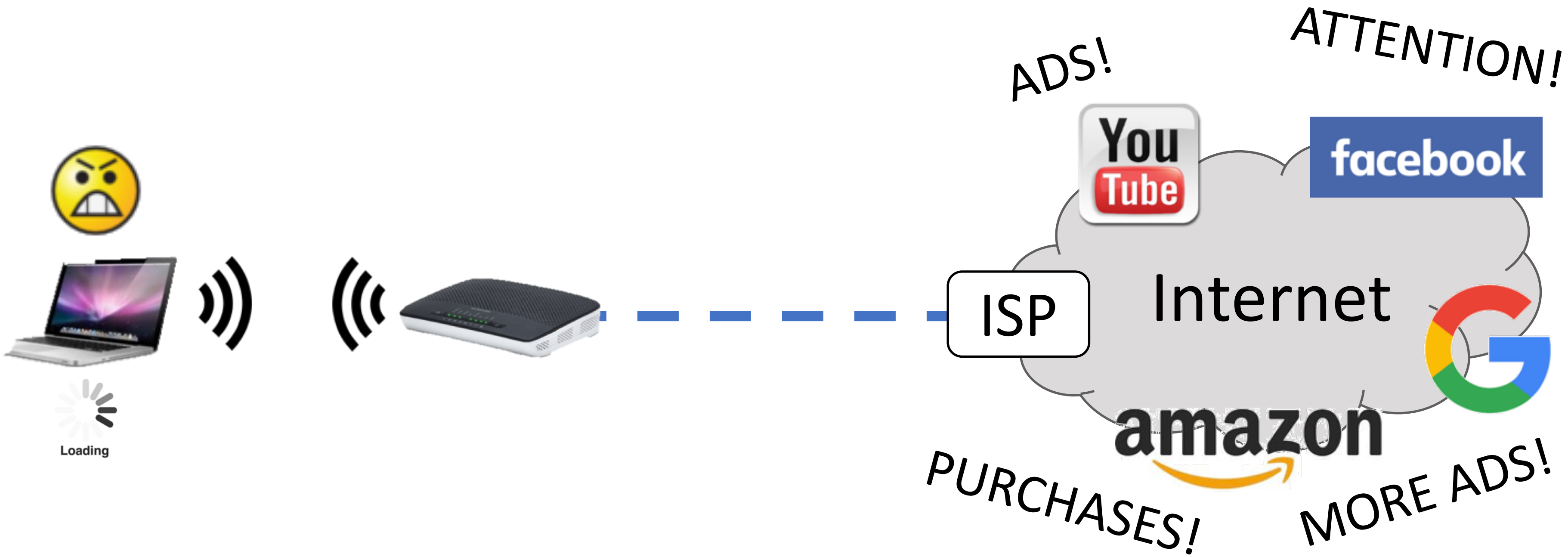
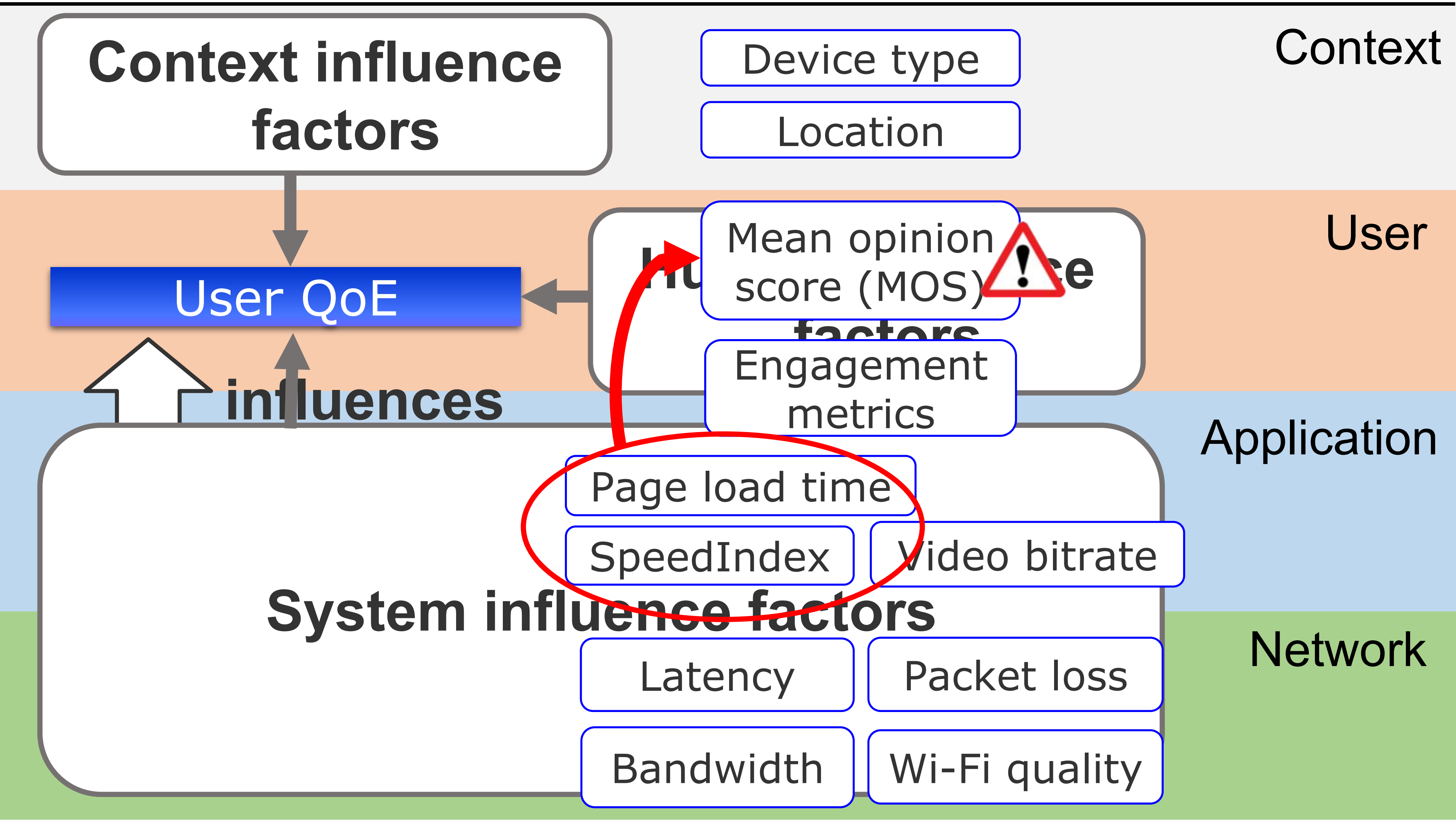
# Quality-of-Experience matters!

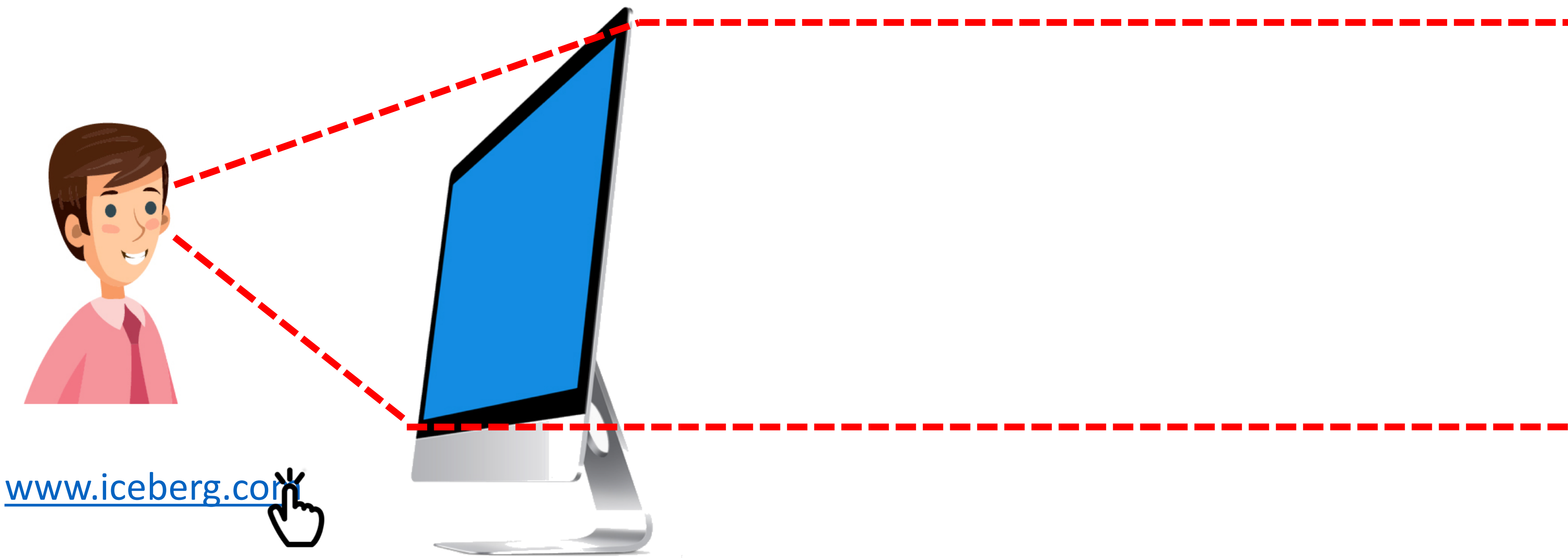



Detecting user QoE is necessary, but how do we measure it?

# Quality at different layers



# Web QoS: instant metrics

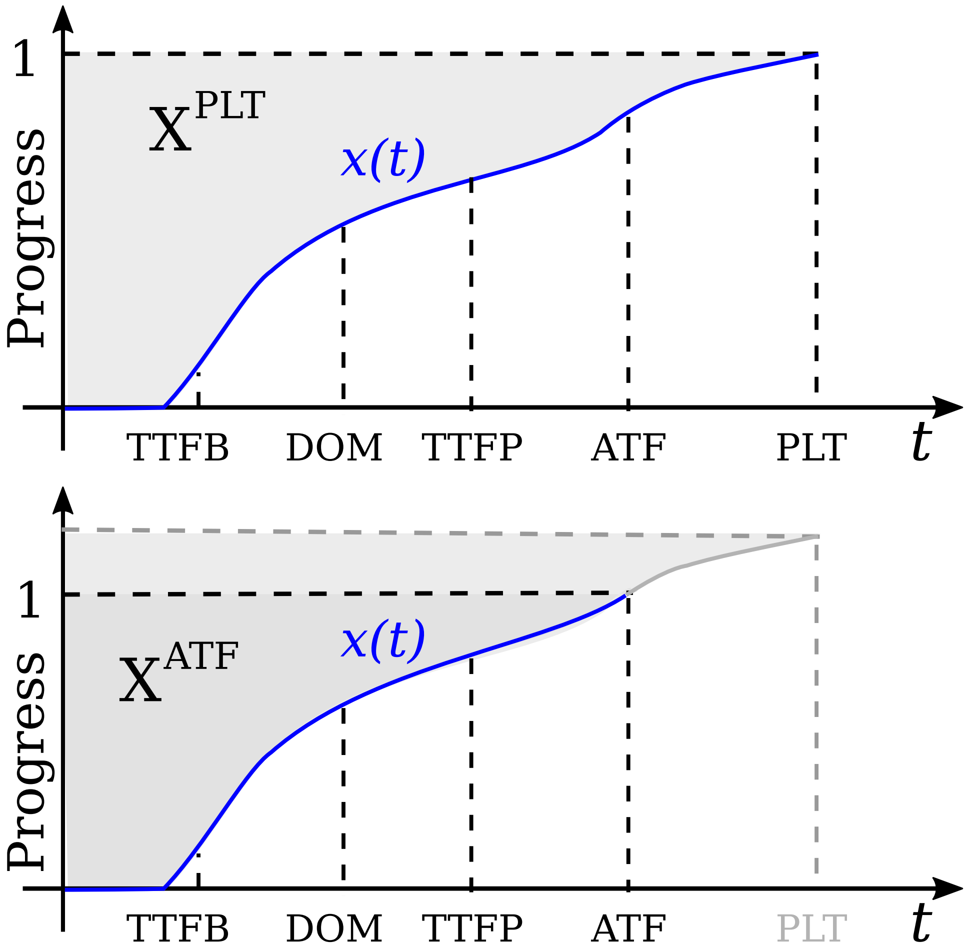



DOM ✓ ATF ✓ PLT ✓

* Images by vvstudio, vectorpocket, Ydlabs / Freepik

# Web QoS: integral metrics

- SpeedIndex
  - Visual metric
  - Processing intensive
- ObjectIndex, ByteIndex, and ImageIndex
  - Lightweight
  - Possible from network
  - Possibly far from user
- Cutoff: PLT or ATF



# Approximating the ATF time

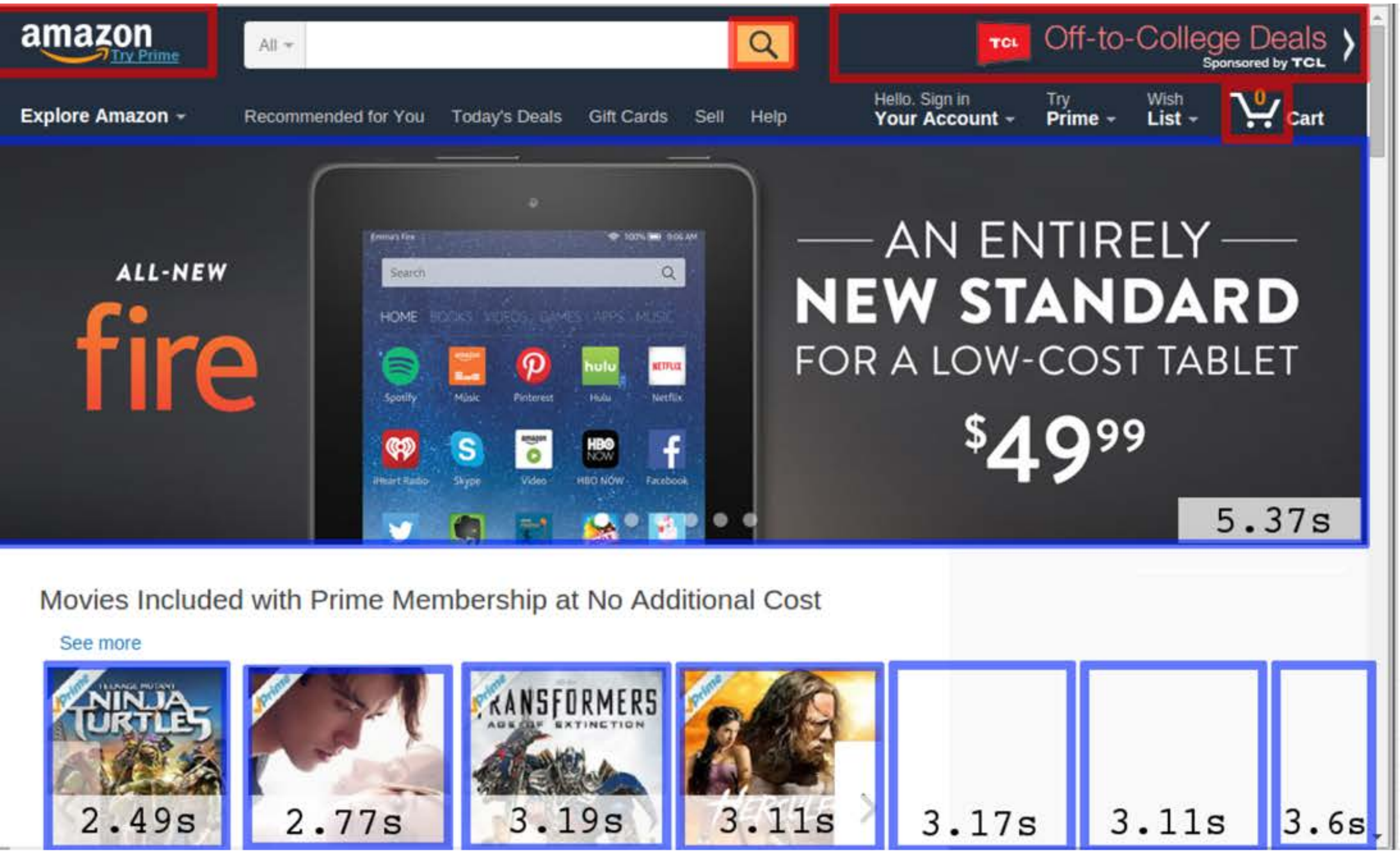



Image objects: 154
Images ATF: 8

| | |
|---|---|
| DOM: | 2.62s |
| $II^{AATF}$: | 1.91s |
| $II^{PLT}$: | 1.99s |
| $OI^{AATF}$: | 3.83s |
| $BI^{AATF}$: | 3.85s |
| $OI^{PLT}$: | 4.31s |
| $BI^{PLT}$: | 4.49s |
| AATF: | 5.37s |
| onload: | 16.11s |

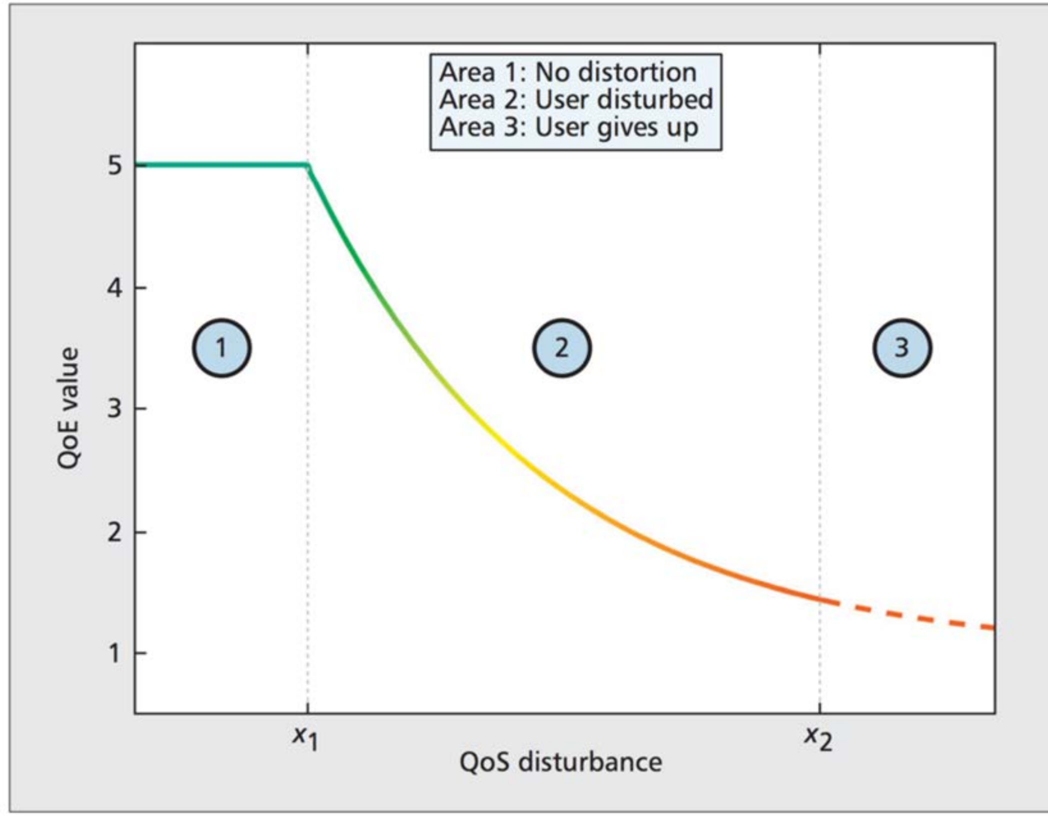
$$AATF = \max_{o}\{T_o | o \in \mathcal{J} \cup \mathcal{C} \cup \mathcal{I}_{ATF}\}$$

Open-source Chrome extension

# Modelling Web browsing QoE

**QoE( x ) = f( x )**

- $x \rightarrow$ App. QoS
- QoE → MOS
- Mapping function
  - **Expert models**
  - Machine learning




Example: QoS effect on QoE – proposed by Fiedler et al.

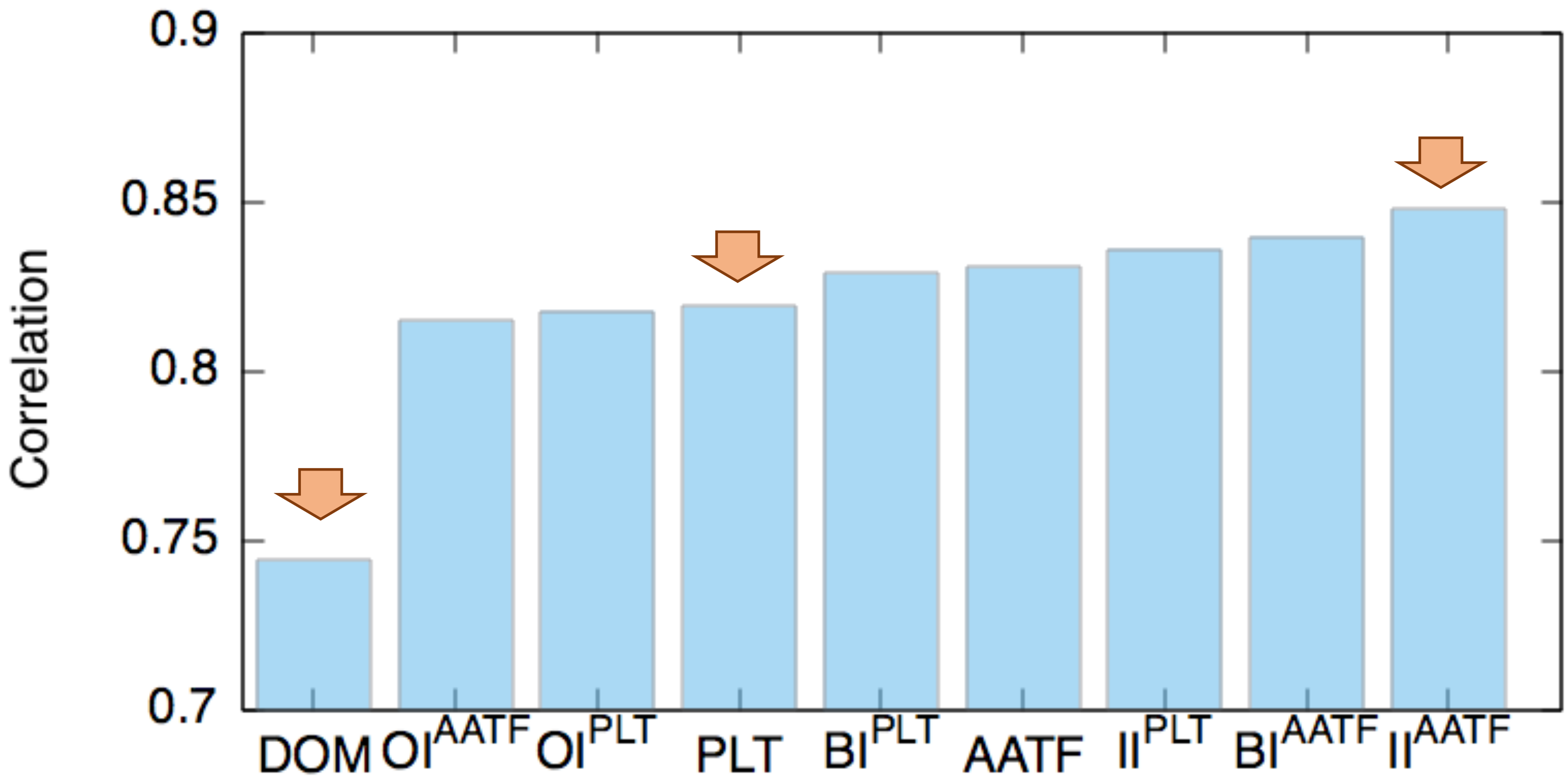
# Dataset: measuring user QoE

- Tests with 224 users on 12 pages
  - Pages served from testbed to similar computer
  - 3400 reviews total: each a number in [1-5]

- Datapoint definition:
  - Per page, group reviews by QoS percentile:
    [<20%, 20-40%, 40-60%, 60-80%, 80-90%, >90%]
  - **MOS**, application QoS

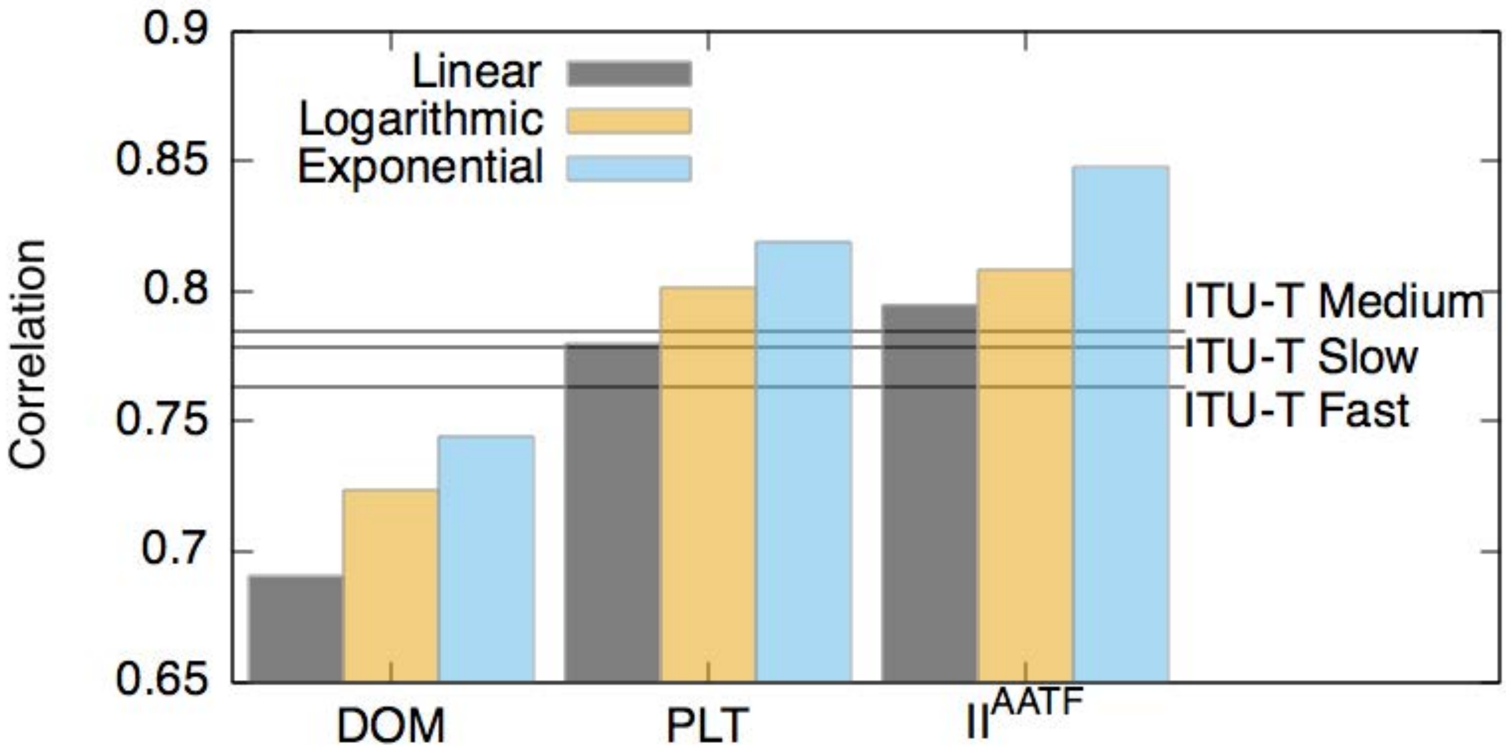
# Web QoE: application metric

- OI: Object Index
- BI: Byte Index
- II: Image Index
- Cut-off: PLT or AATF



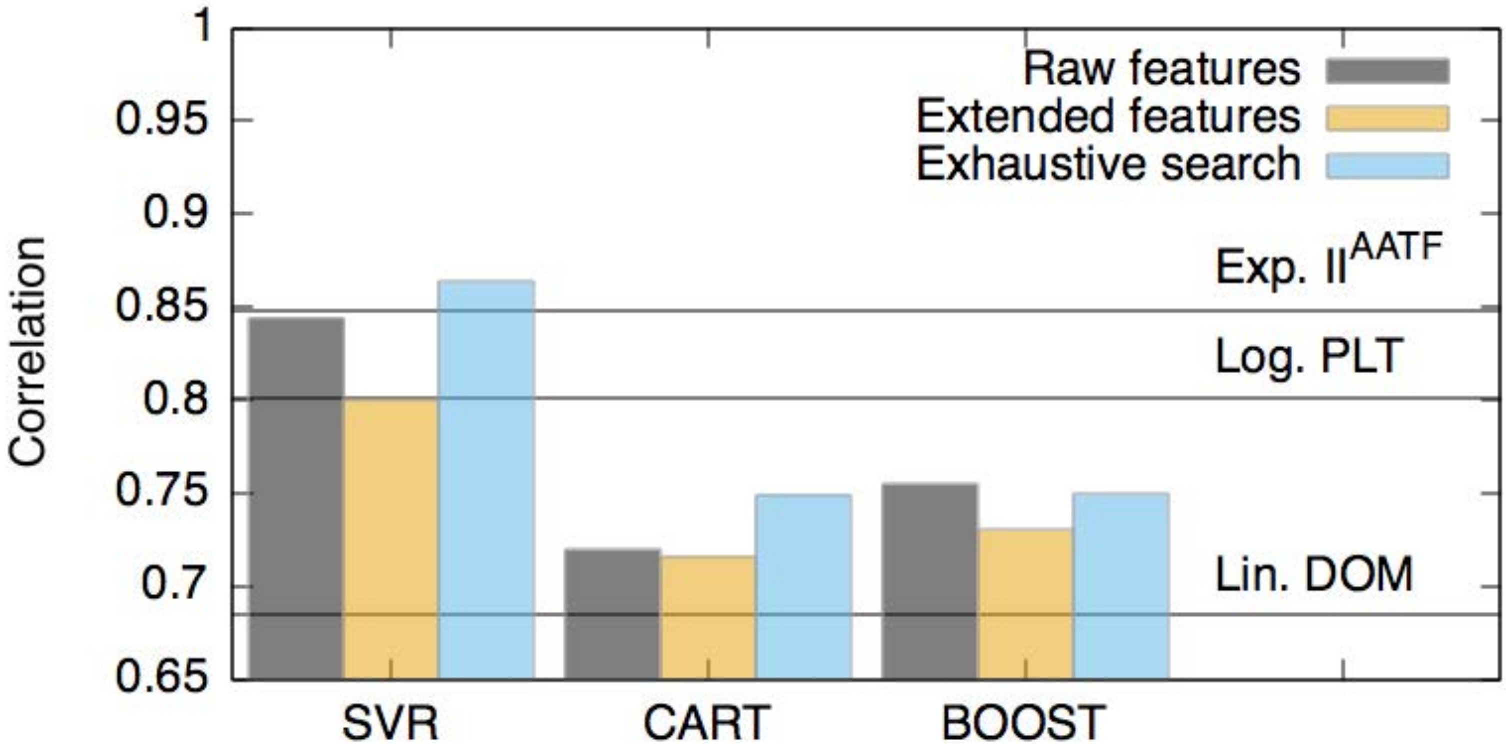
# Web QoE: Expert models

- Naïve (linear)
- Weber-Fetchner (log)
- IQX hypothesis (exp)
- ITU-T (most used)



# Web QoE: Machine Learning

- State-of-the-art methods
- Tests on 3 feature sets



# Summary

- User perspective is important !
- Application QoS correlates well with user QoE
  - Visual metrics → stronger correlation
- Machine learning is on par with expert models

# Next steps

- Comparison of AATF metric with user PLT
- Application on live pages
  - Partnership with ip-label
- Dataset and code available on our page:

  https://newnet.telecom-paristech.fr/index.php/webqoe/

D. Hora et. al, "Narrowing the gap between QoS metrics and Web QoE using Above-the-fold metrics." In *PAM*, 2018

# Thanks!

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https://newnet.telecom-paristech.fr/index.php/webqoe/