Using Visible Light Communication in the Smart City context

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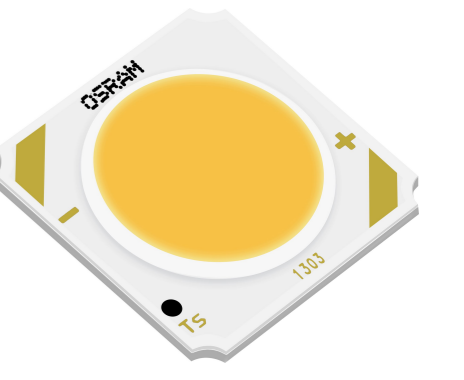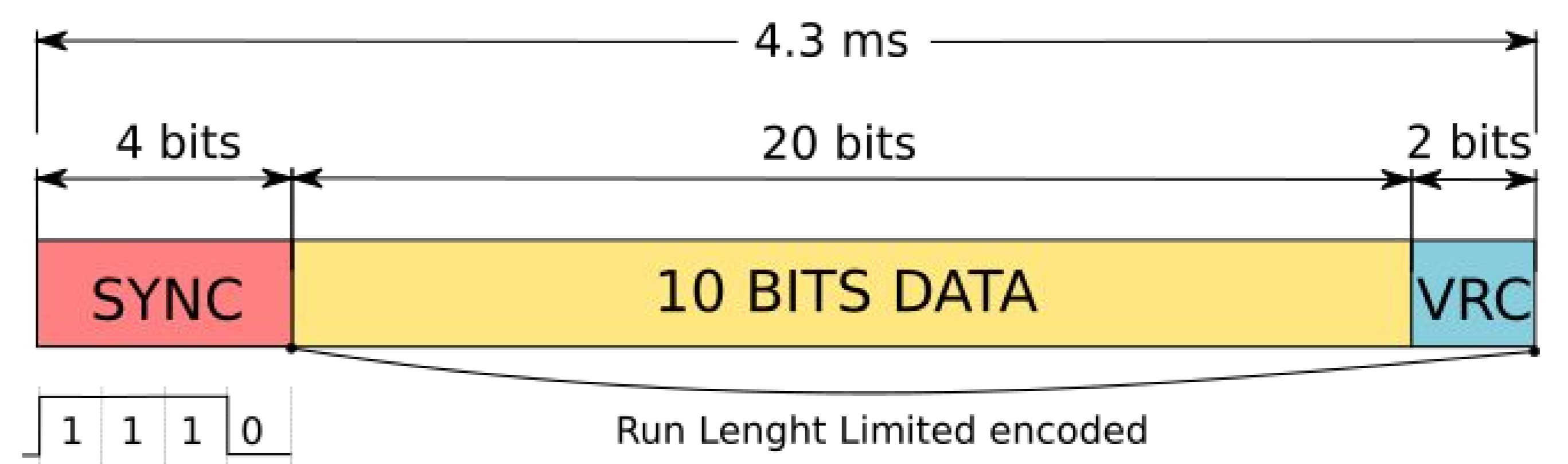PhD day 2016

Context and goals

➜ **Evaluate** the performance of **VLC** in different **smart city** applicative **use cases** such as **smart objects**

➜ Propose a series of **smart city services** based on **VLC**

➜ Propose **an efficient** communication **protocol** at **the MAC layer** to take into account the **integration of VLC objects**
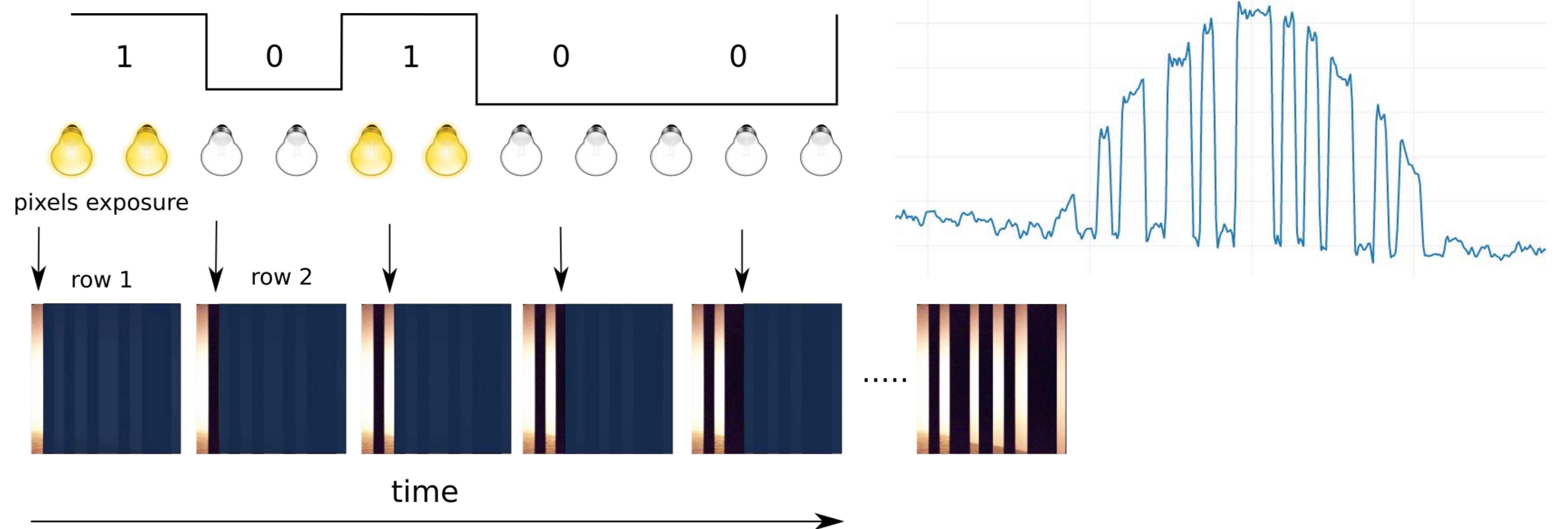
LEDs as Emitter

➜ **IM/DD Modulations**
  - On-Off Keying
  - Frequency Shift Keying

➜ Driven by cheap **MCU**

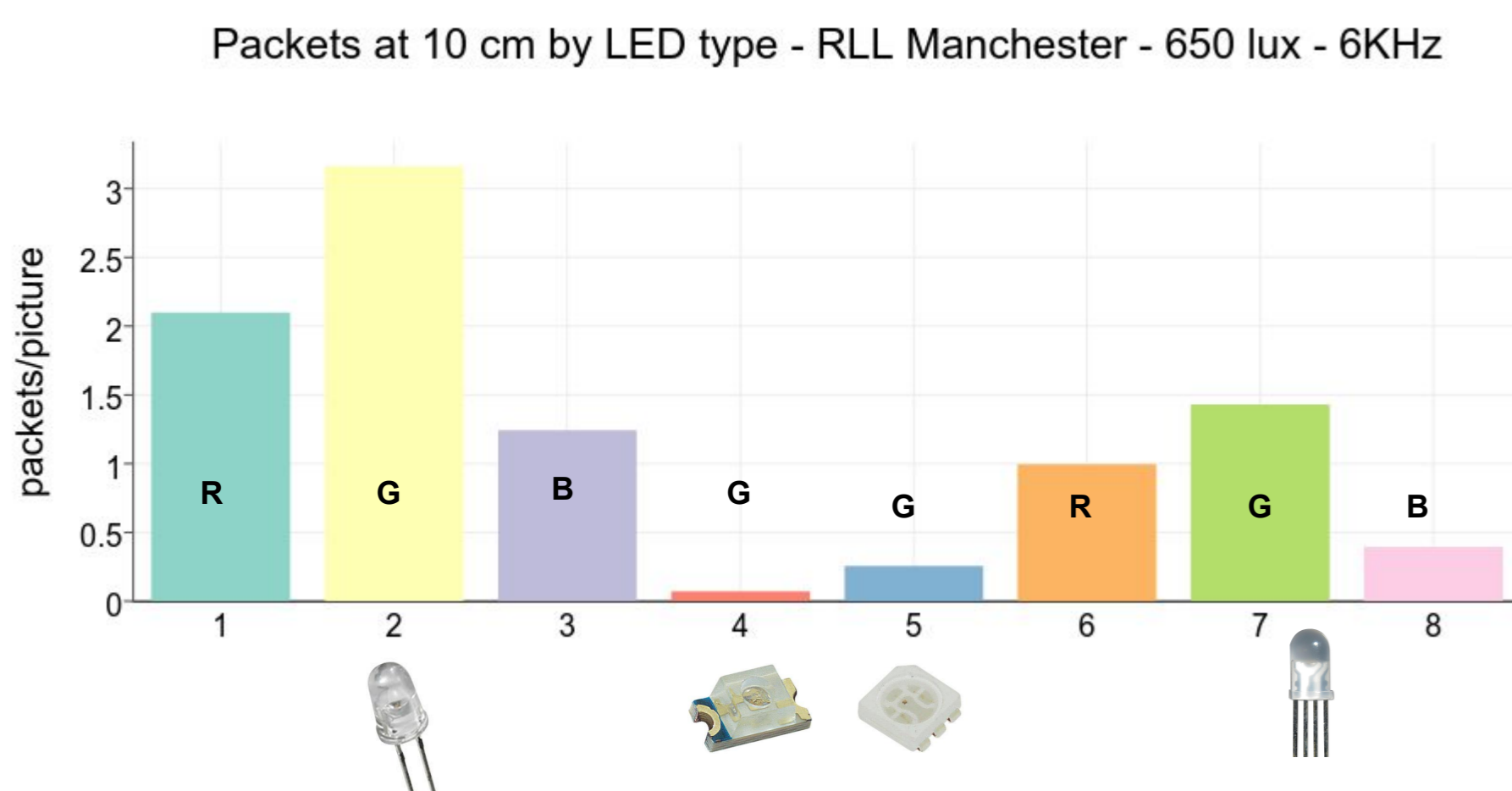➜ **PHY Layer**
  - 6KHz OOK
  - Manchester
  - 500-4000 bit/s

4.3 ms — 4 bits SYNC | 20 bits 10 BITS DATA | 2 bits VRC
1 1 1 0
Run Lenght Limited encoded

Smartphone as receiver

➜ Camera : **CMOS** Sensor

➜ Rolling Shutter Effect

1   0   1   0   0

pixels exposure
row 1   row 2
time

Evaluation

➜ **LED type & color** impact

Packets at 10 cm by LED type - RLL Manchester - 650 lux - 6KHz

➜ **Illumination** impact

Throughput with different illumination - RLL Manchester - 6KHz
210 lux / 650 lux / 3000 lux

➜ Achieved **throughput**

Throughput at differente distance - RLL Manchester - 650 lux
10Khz / 8kHz / 6kHz

➜ **Angle** impact

Throughput at 10 cm varying the angle - RLL Manchester - 650 lux - 6KHz

➜ Packet **Loss**

Packet loss 6KHz
Packet loss 8kHz
Packet loss 10KHz

➜ **PHY** Bitrate

Bitrate (30.0 fps) LED 2 Manchester 6 kHz
bit/frame
bits/s
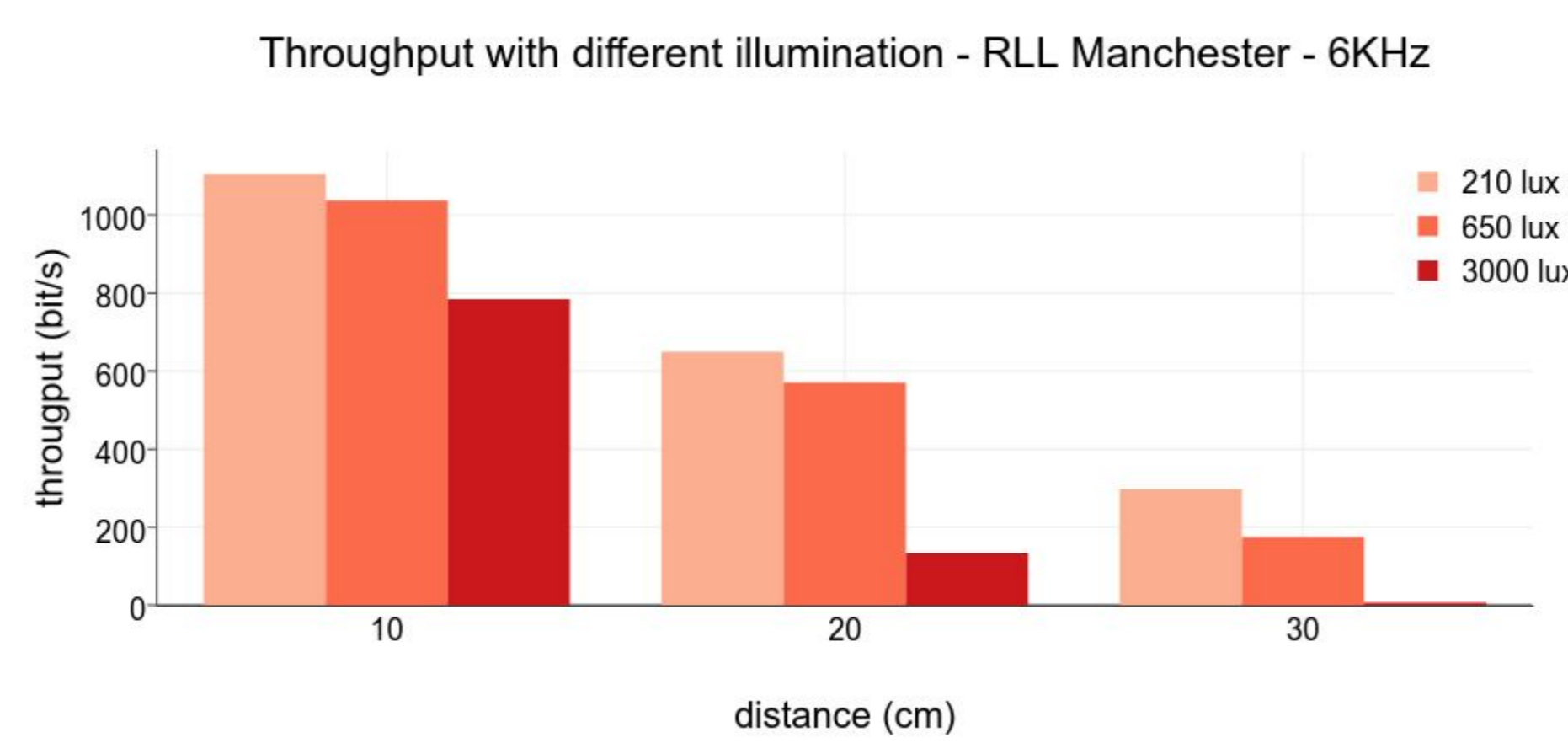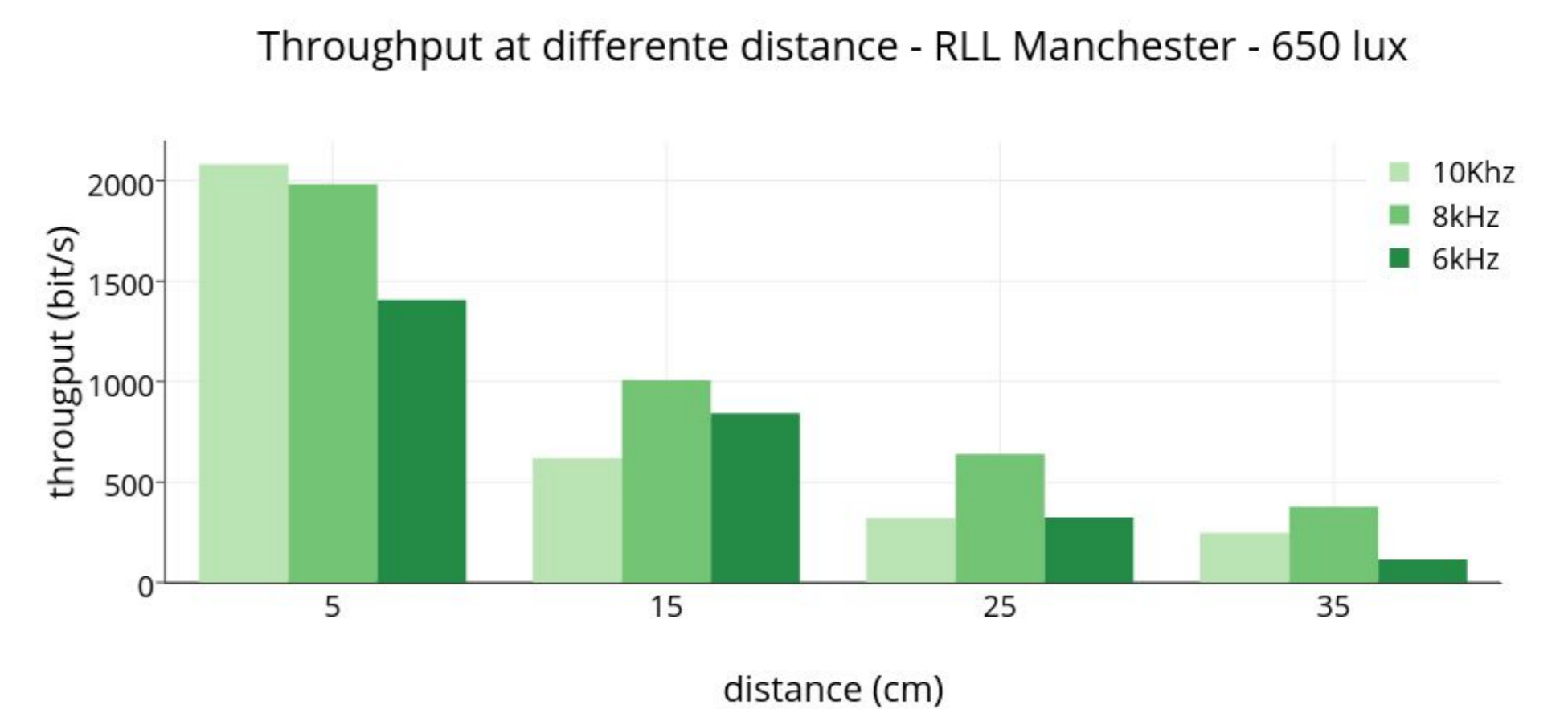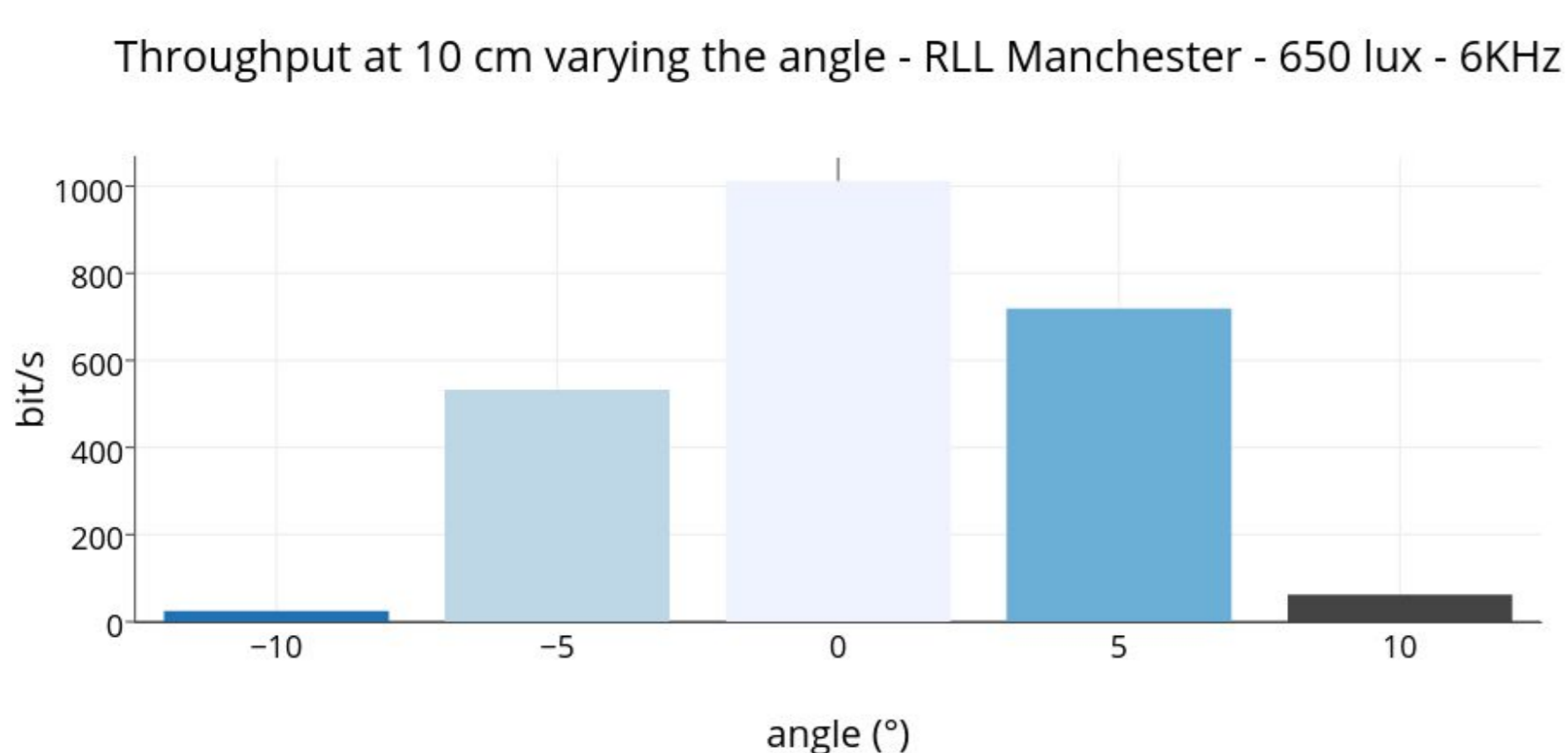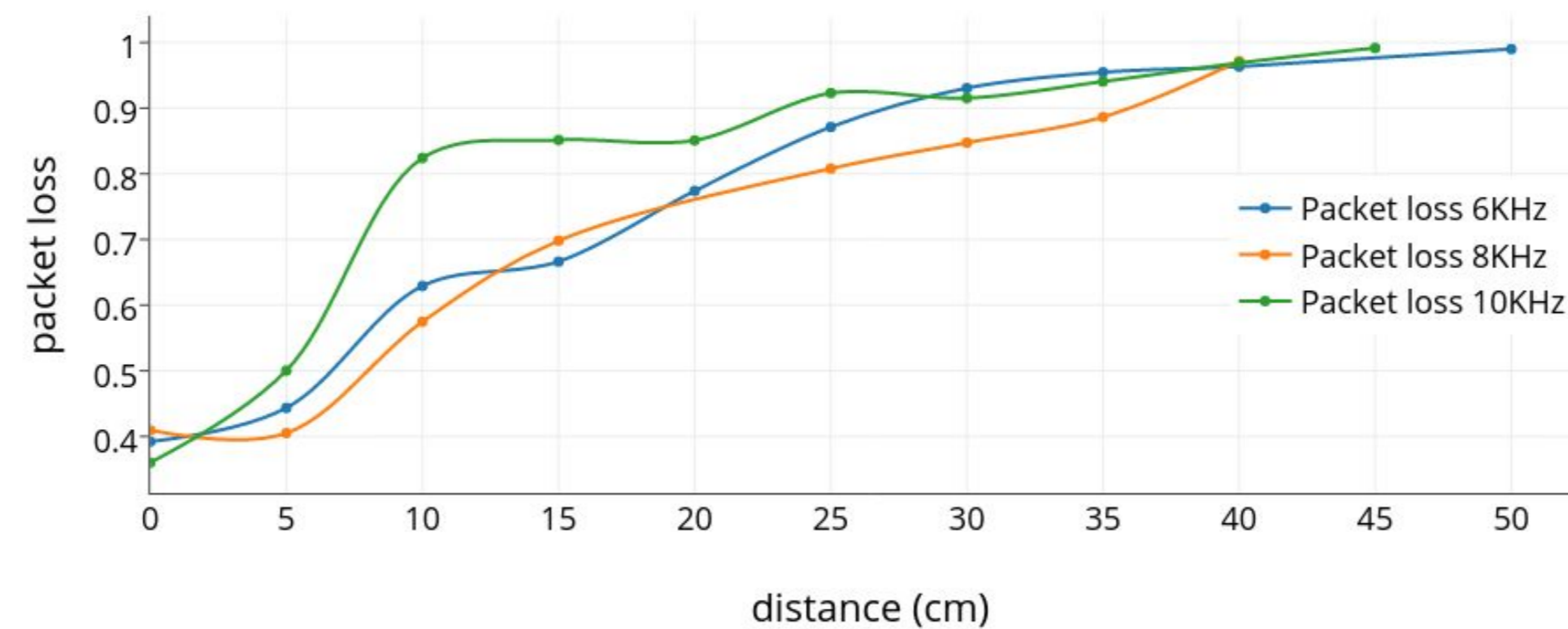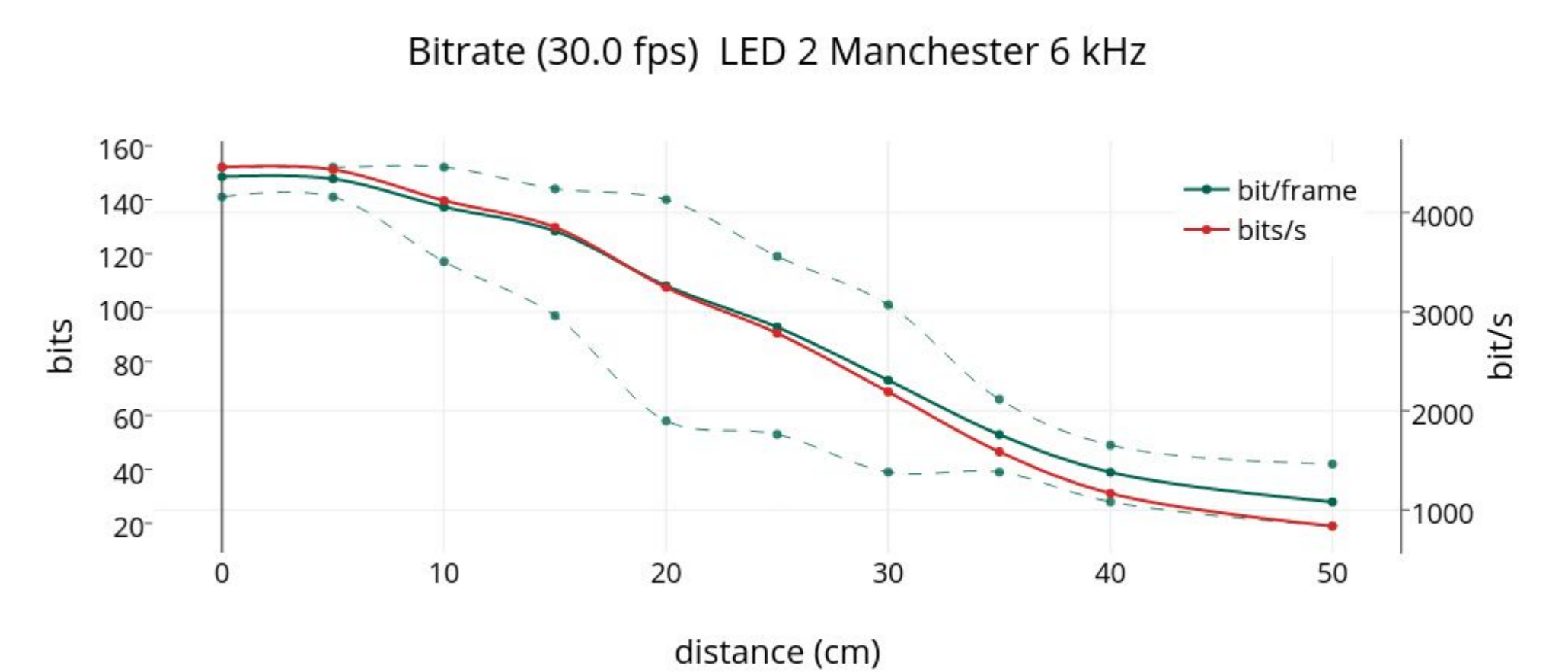
Use Cases

➜ **Low cost** wireless & smart device

➜ Secured **Near Field Communication**

➜ Accurate **Indoor Localization**

➜ **Contextual Information** broadcasting

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