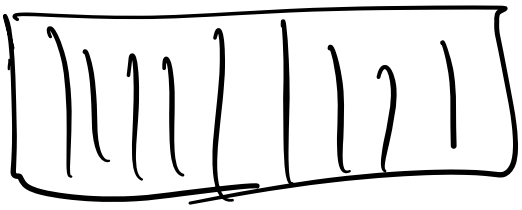
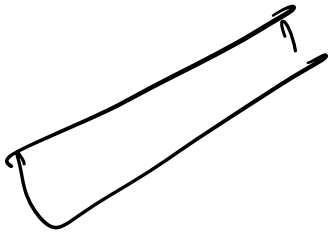
Today

- RFIDs and backscatter
  - Medium Access.
  - Physical Layer.
- Ambient backscatter techniques
- Wi Tag

RFIDs

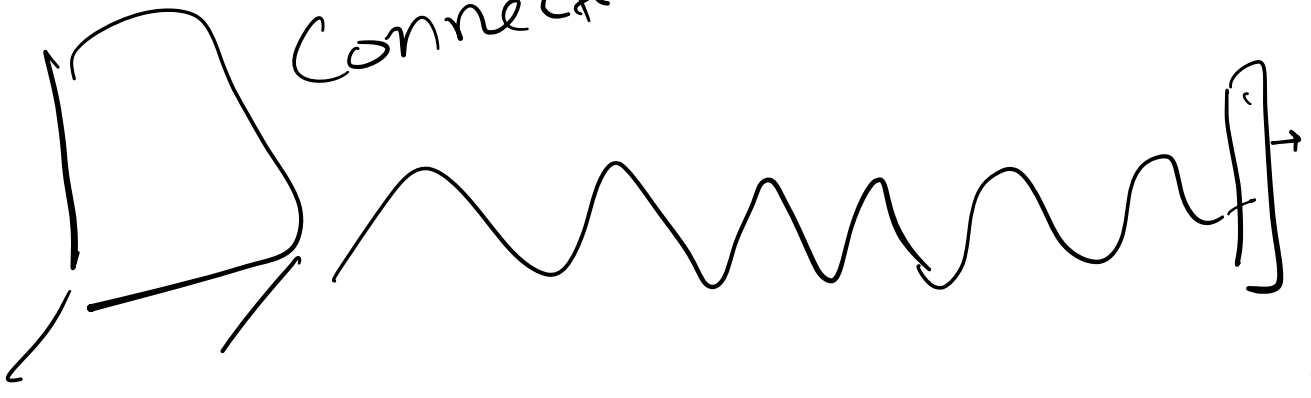




backscatter.

high power

connect



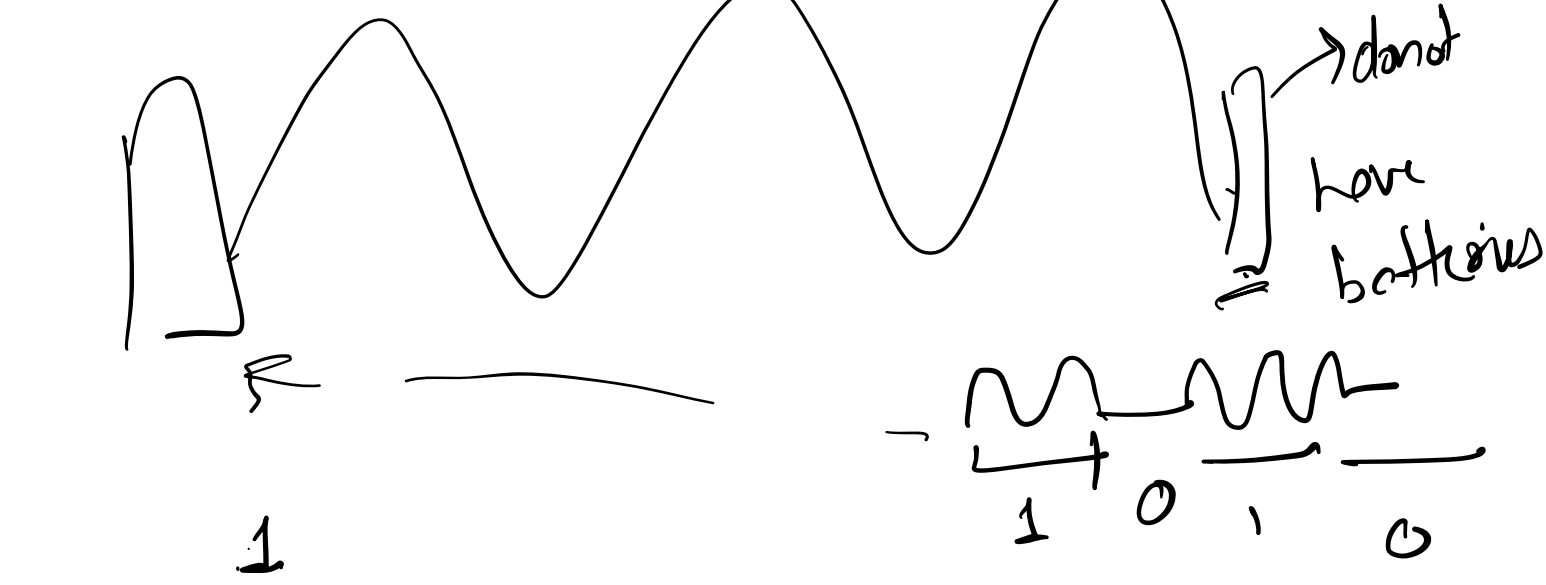
chip

antenna.

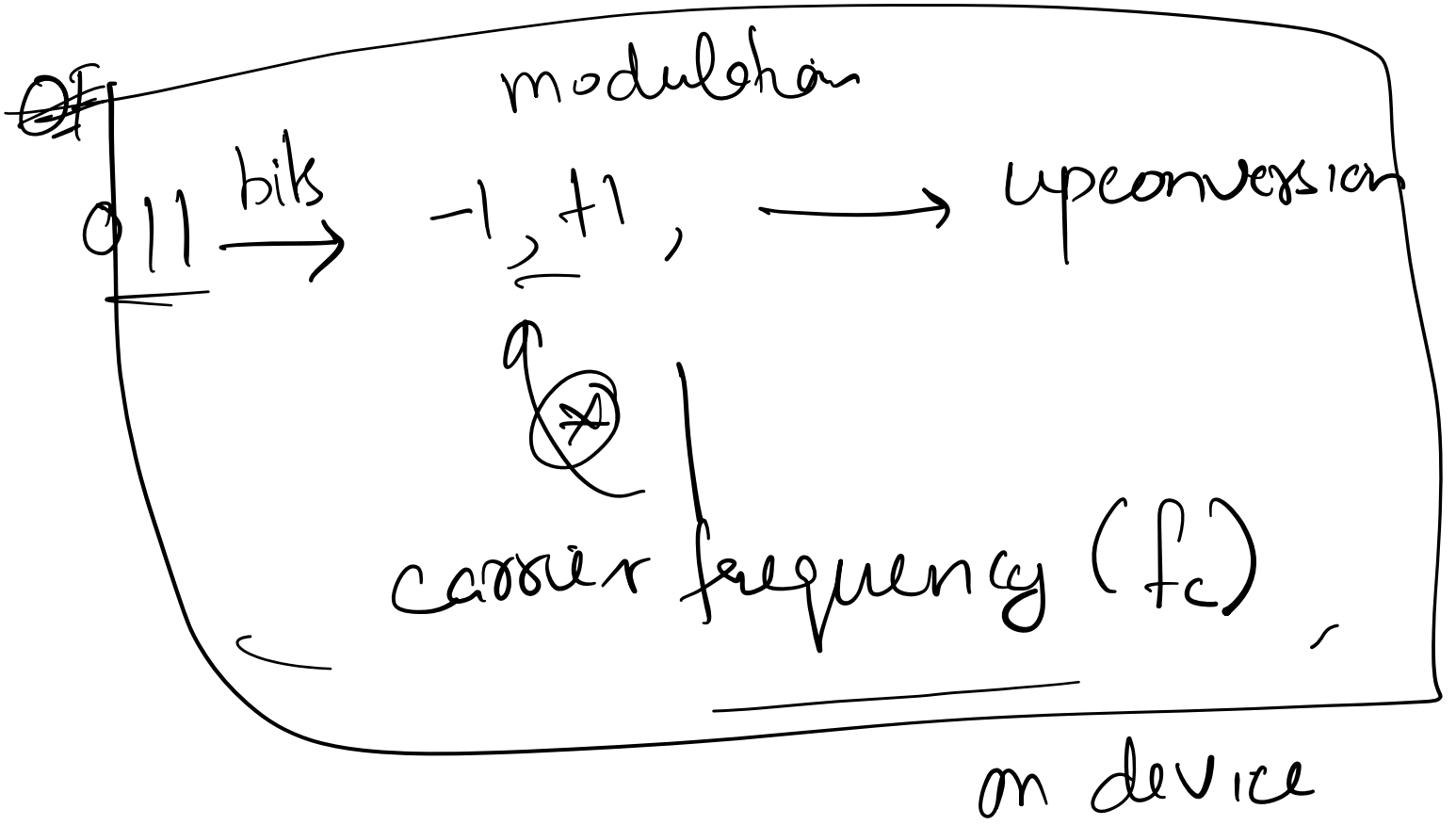
→ energy harvesting

→ reflect

→ not reflect.



backscatter → reflections to communicate

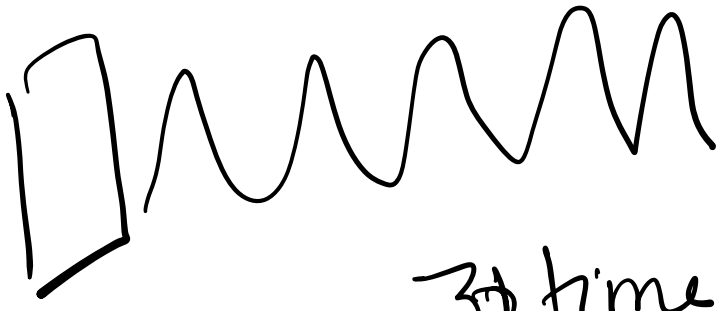


RFIDs → the reader transmits

the carrier frequency.

MEDIUM ACCESS

EPC Gen 2 → RFIDs



16 or 32 time slots,

- → pick a slot at random
- → transmit in that slot.

reader experiences collision

- → increase slots

otherwise

- → keep or decrease slots.

Physical Layer

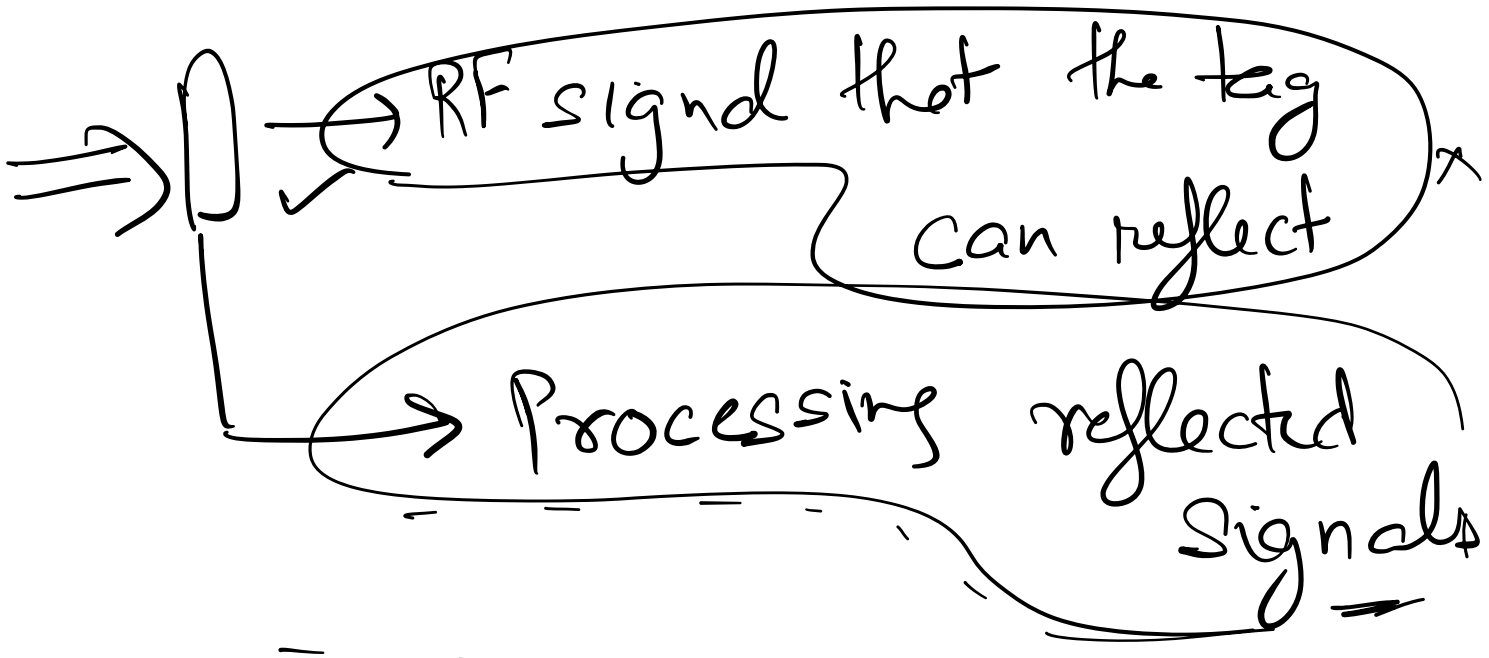
Pros

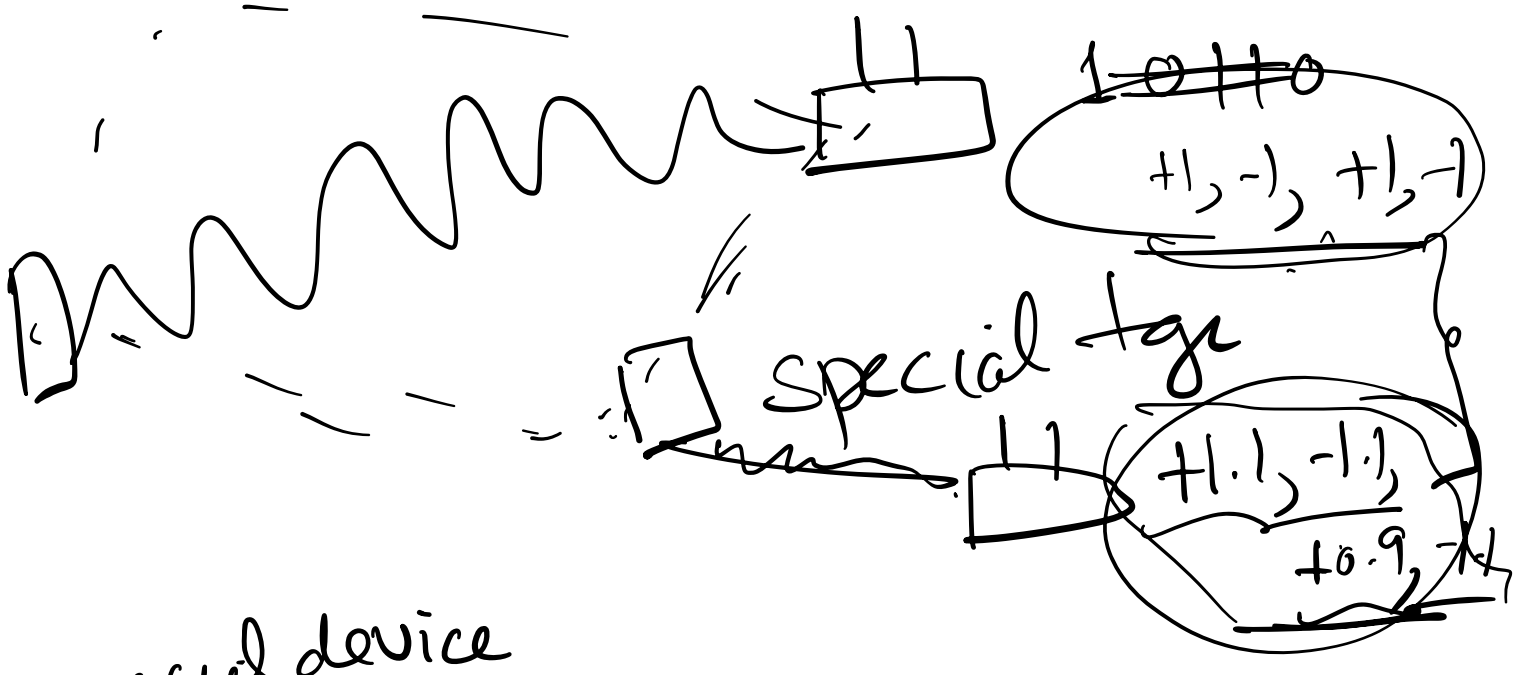
- Low power (battery-free)
- cheap (IoT)

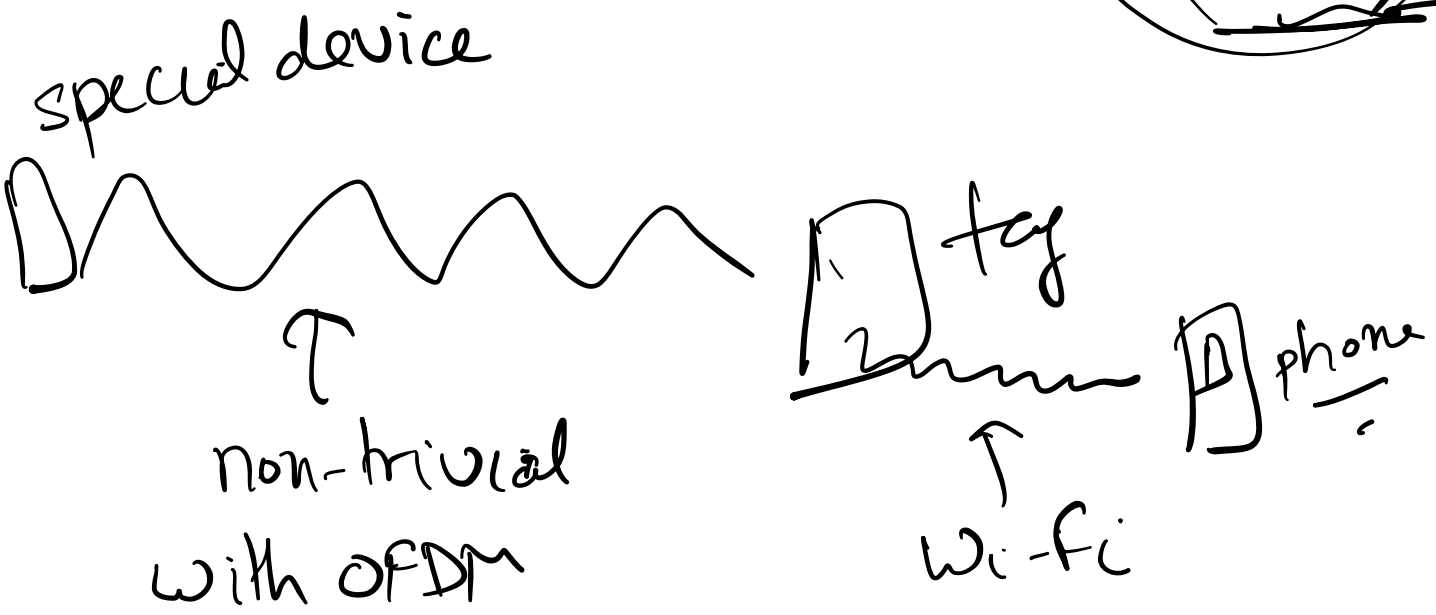
Cons

- special readers.
- expensive
  - good IoT

Ambient Backscatter





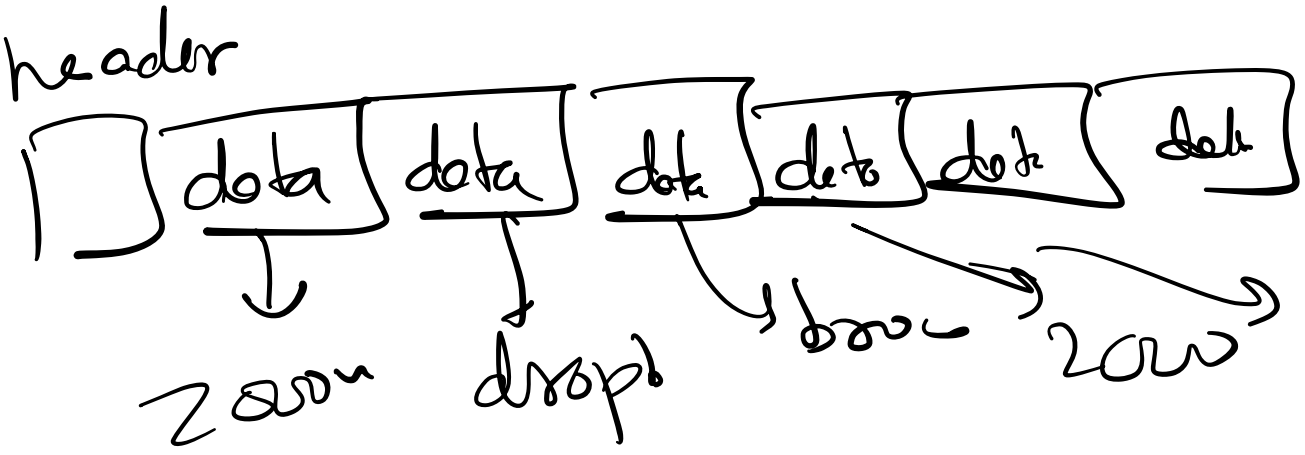


possibility.

WiTag: Goals

- no specialized device (both transmitter & receiver are off the shelf)
- even with encryption
- any software or protocol modifications

Frame aggregation



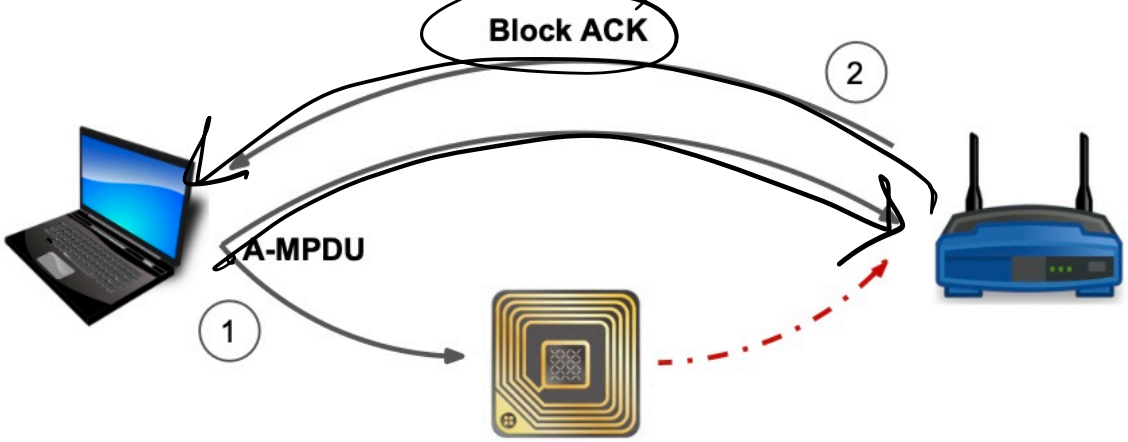
WiTag: Idea

Figure 1: 802.11n/ac A-MPDU structure

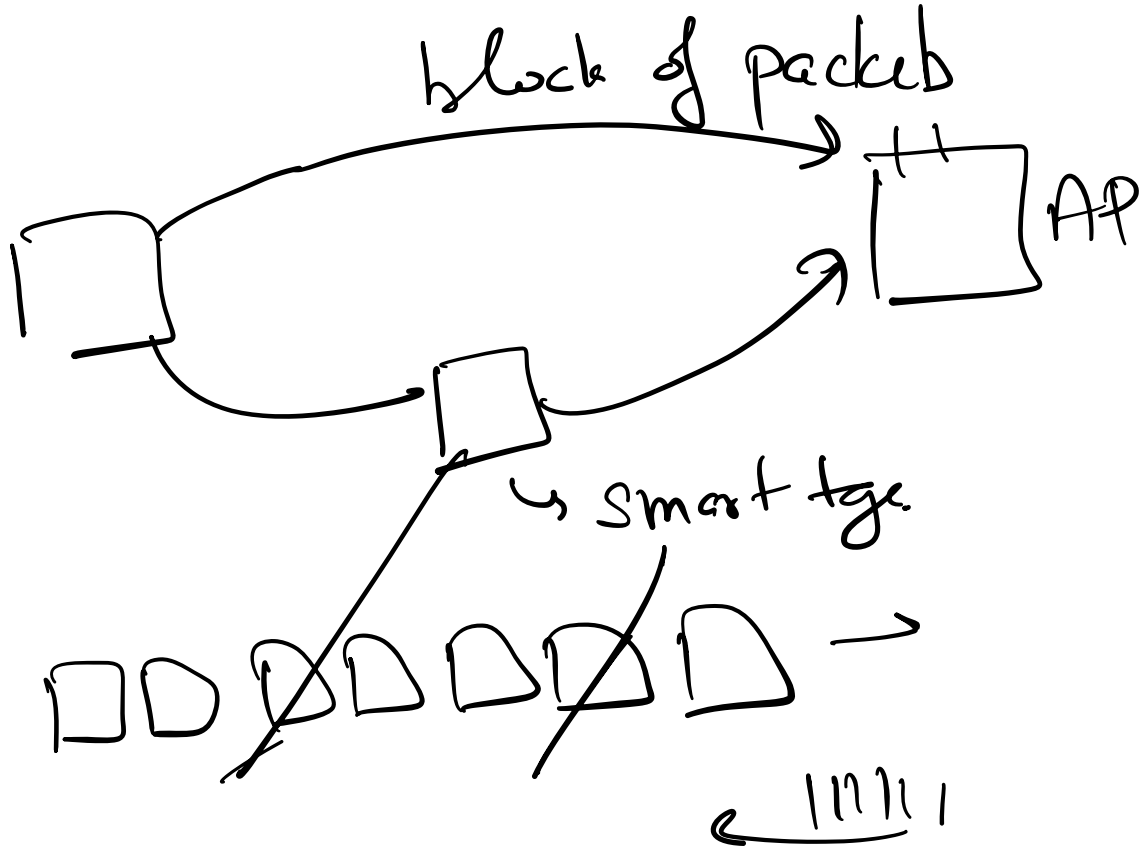
Aggregate

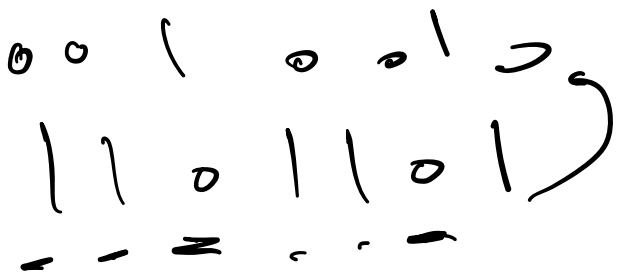
MAC Protocol data unit

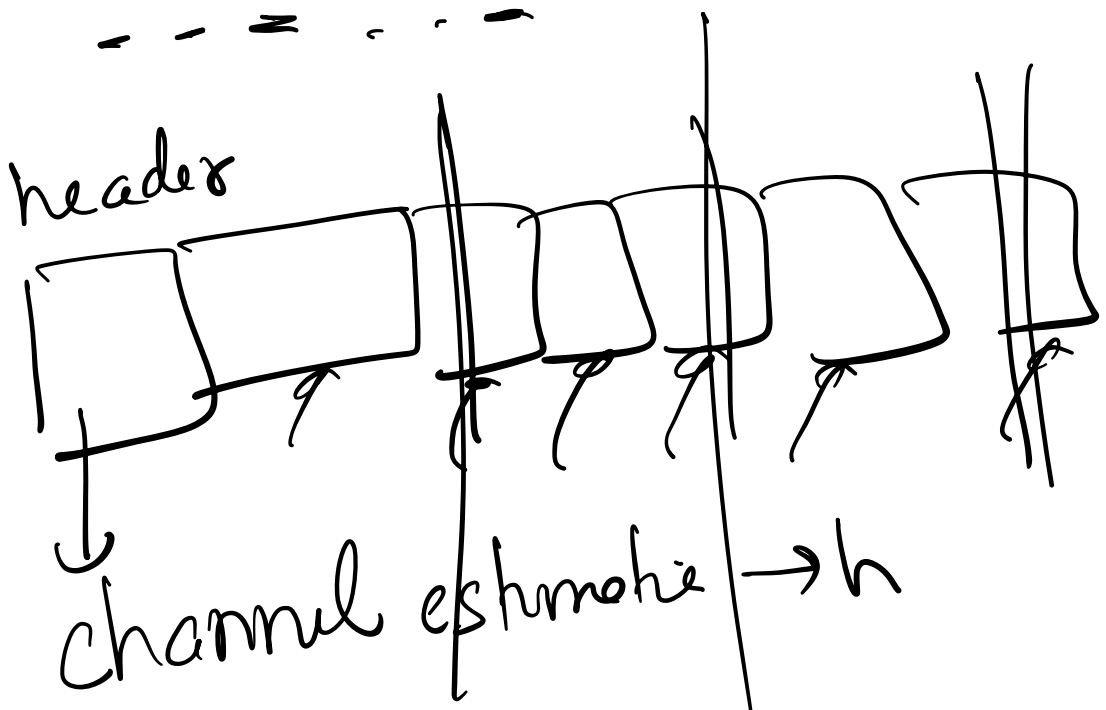
1 0 1 1 1 0 1 1 1 1 0 0 1 1 1



Corrupting Packets



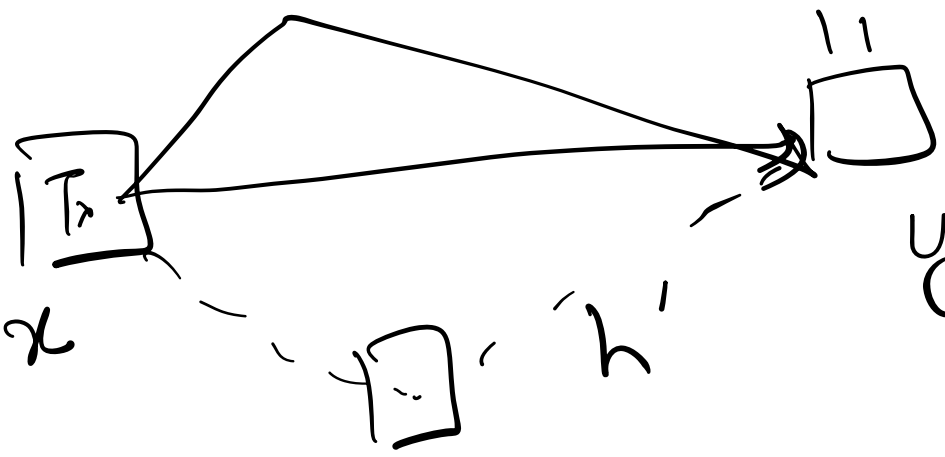




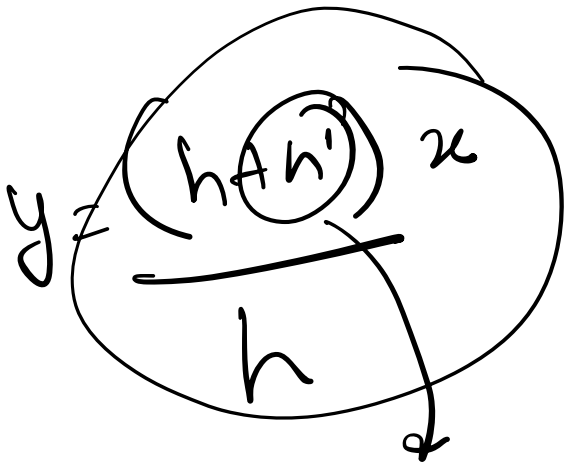
silent

no reflection

reflecting



$h + h'$



tag is silent $\Rightarrow h$

tag is reflecting $\Rightarrow h + h'$

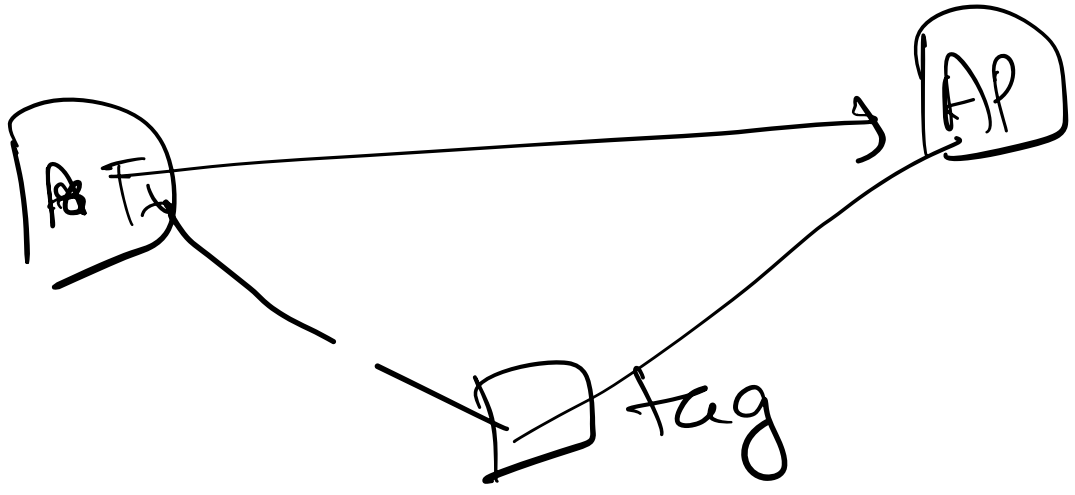
error is h', which can be small.

h $\qquad\qquad$ $h+h'$

$h-h' \Leftrightarrow h+h'$

$2h'$

by changing the phase



During channel estimation

↳ reflect in a "normal state"

$h+h'$

During corruption

↳ shift the phase of reflection by 180°.

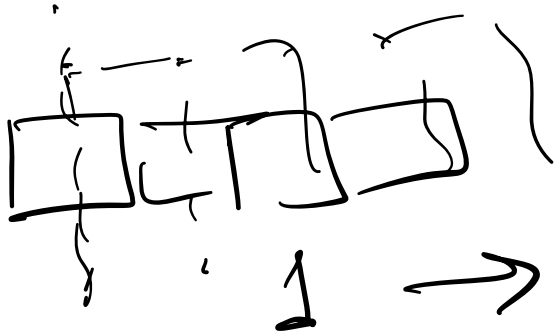
$h-h'$


2h'

Synchronization

→ to guess when a tag would turn on and need to transmit data.

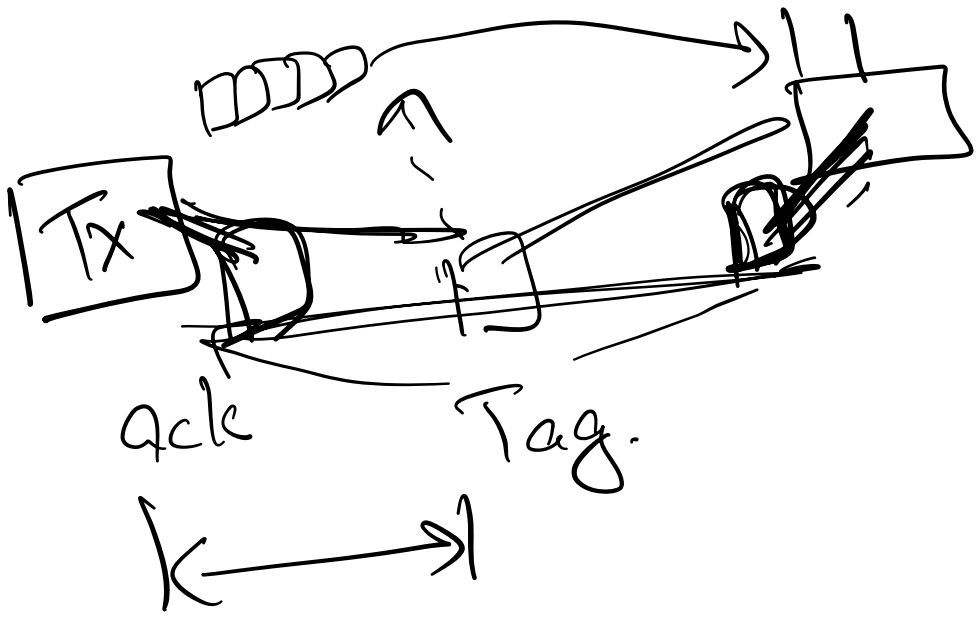
→ transmitting random frames before the tag comes on.



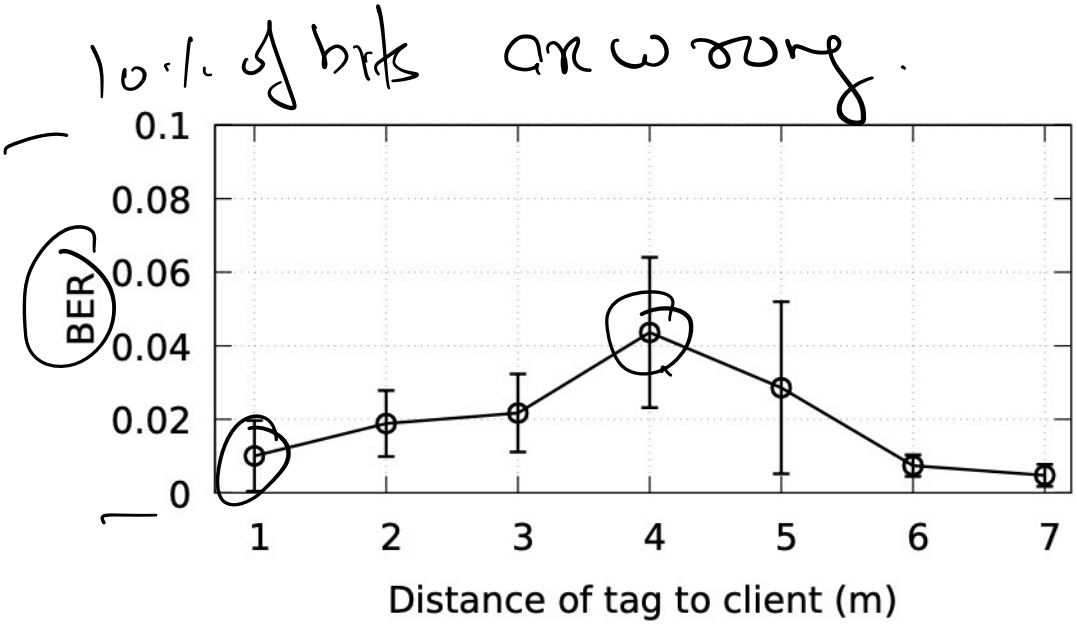
1 → k corrupt packets.

Still need batteries

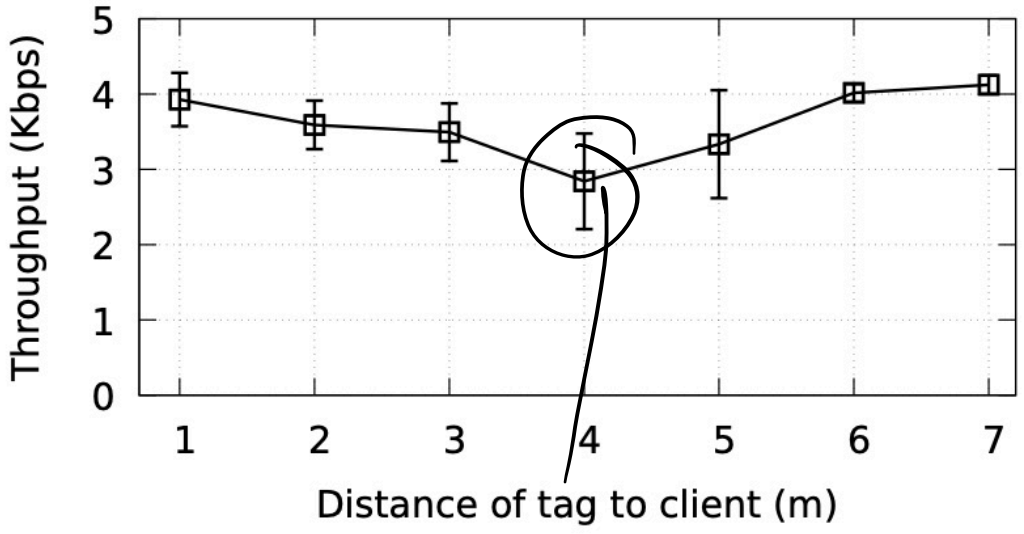
Setup



RESULTS



(a) Bit error rate



(b) Throughput

Figure 13: BER and throughput of WiTAG in the line-of-sight scenario. The client and AP are 8 meters apart.

Pros

→ works with off the shelf devices

→ despite encryption

Cons

→ Lack of robustness to location

→ low data rate

→ inefficient

BCE

LoRA

- gateways
  - ↓ In smart home devices

Chime.