

IoT Tracking Of Trolleys At Hong Kong Airport

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Outline



Smart City applications



LoRa properties



LoRa versus GPS

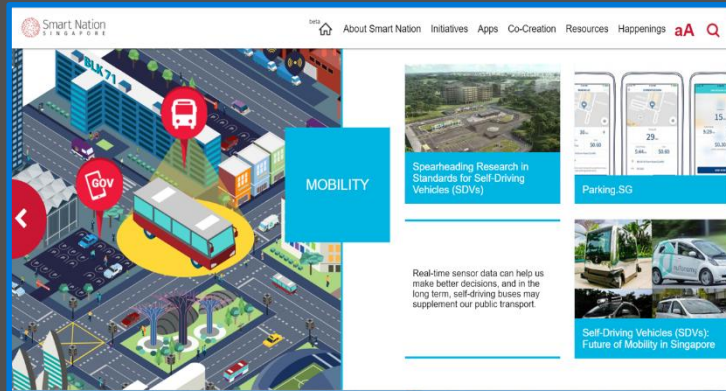


LoRa seamless localization for HK airport

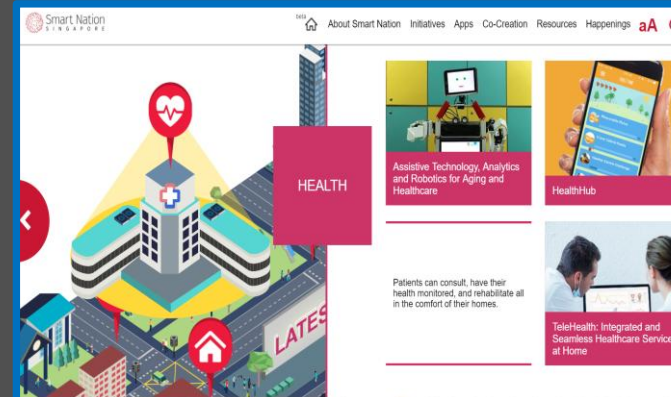


Way forward

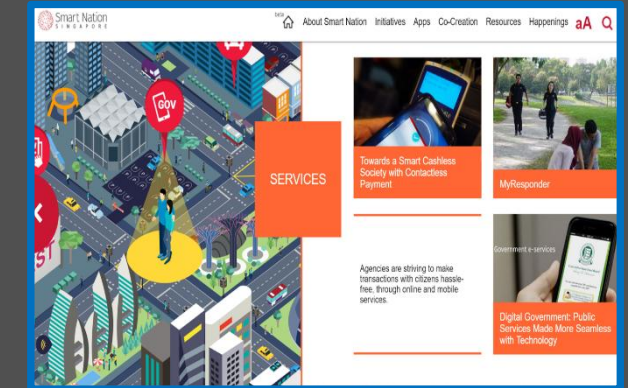
Smart city applications



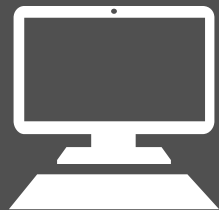
Transportation



Healthcare



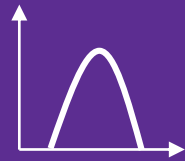
Government



Tracking plays an important roles in smart city applications!

Physical Property of LoRa

- LPWAN is a Low Power Wide Area Network intended for wireless battery operated things in a regional, national or global network.



Frequency band:
915MHz (US)
920-925MHz(HK)



Receiver Sensitivity:
-136dBm optimal



Security:
AES-128 Encryption



Channels: 64+8+8(US)
BW uplink: 125/500KHz (US)
BW downlink: 500KHz (US)



Channel Access:
ALOHA-type



Data rate:
980bps-21.9kbps(US)



Link Budget:
Up: 154dB(US)
Dn: 157dB(US)



Coverage:~10km
open area

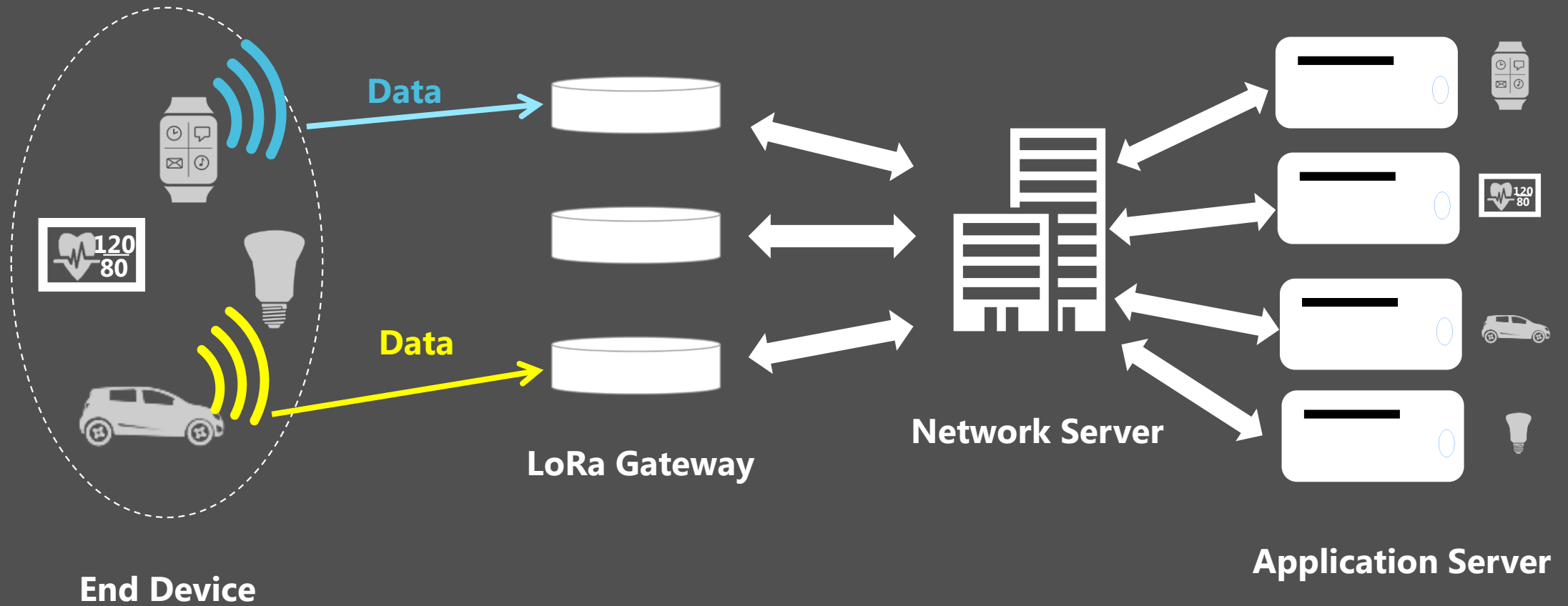


Battery lifetime:
105 month

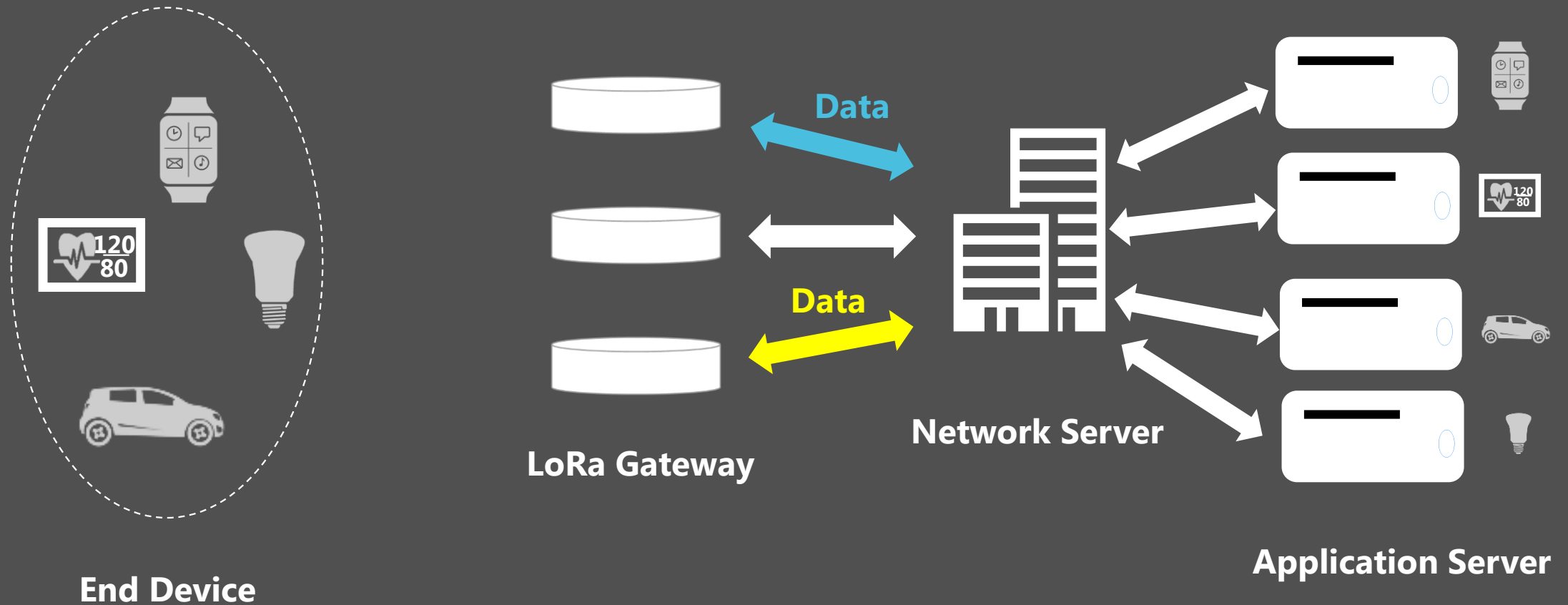


Device Cost:
1-5 US dollar

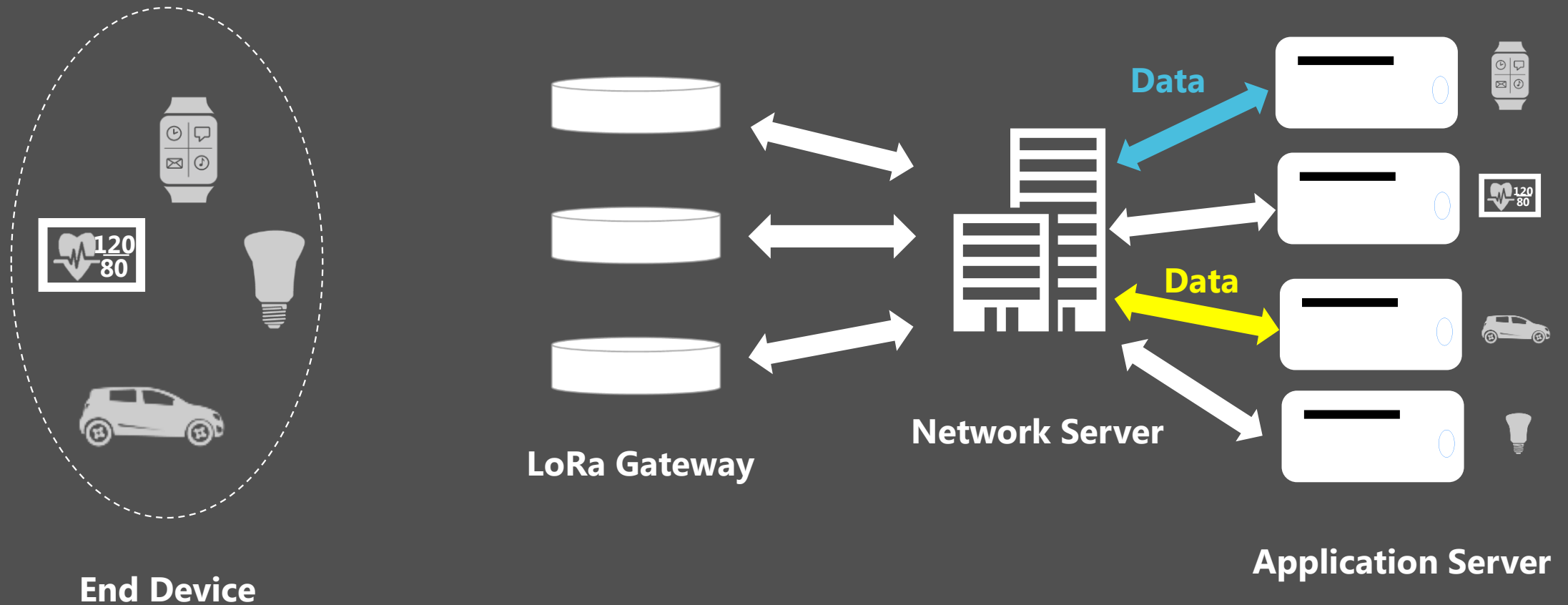
Data Message



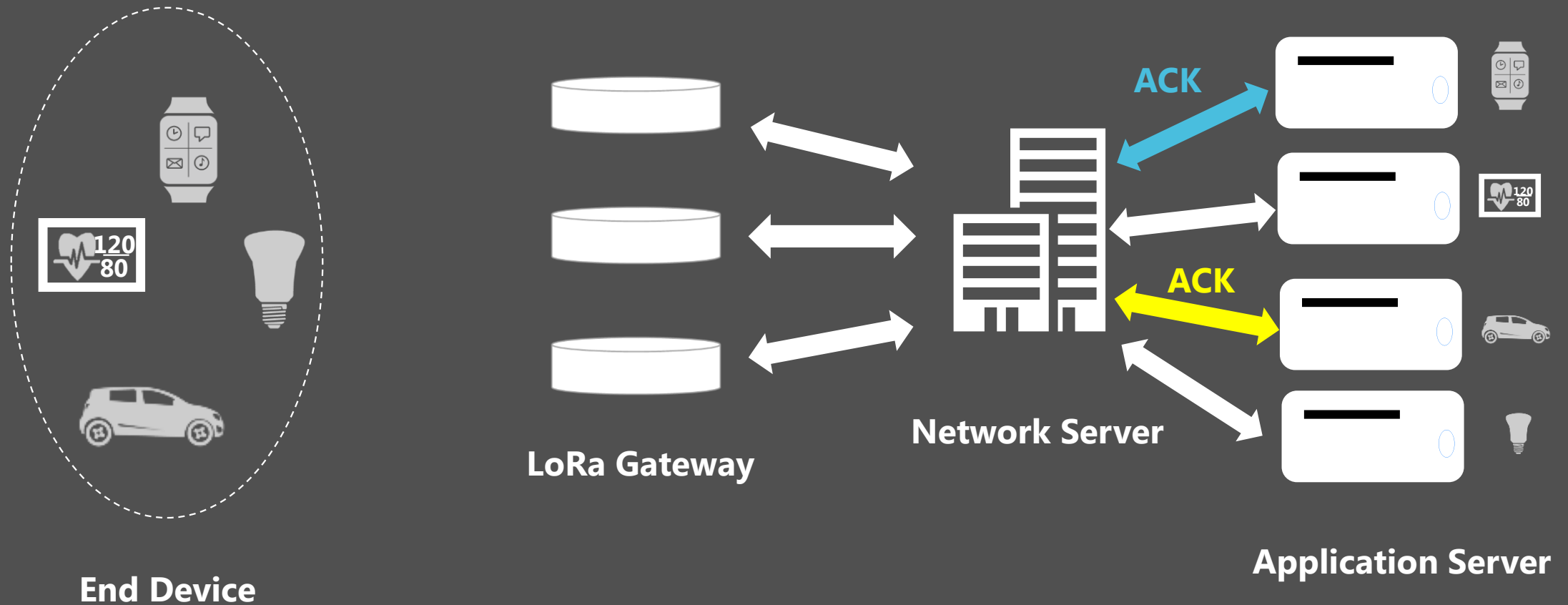
Confirmed-Data Message



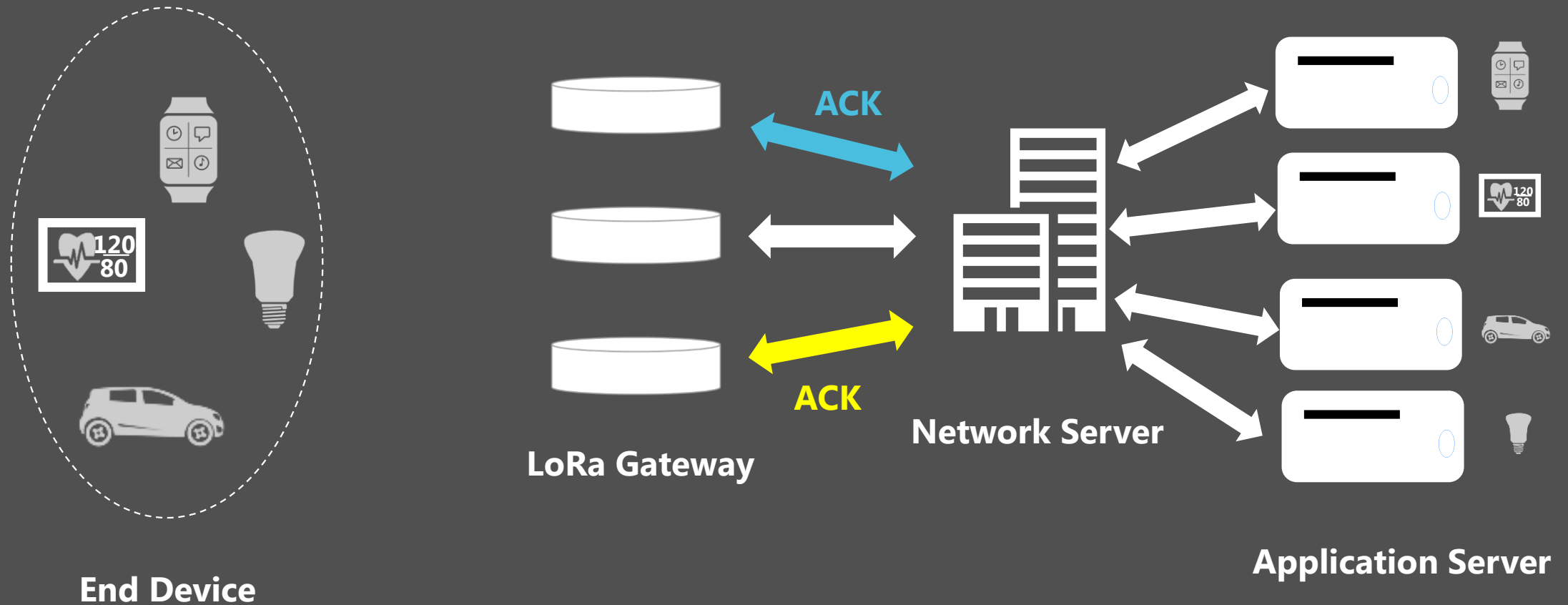
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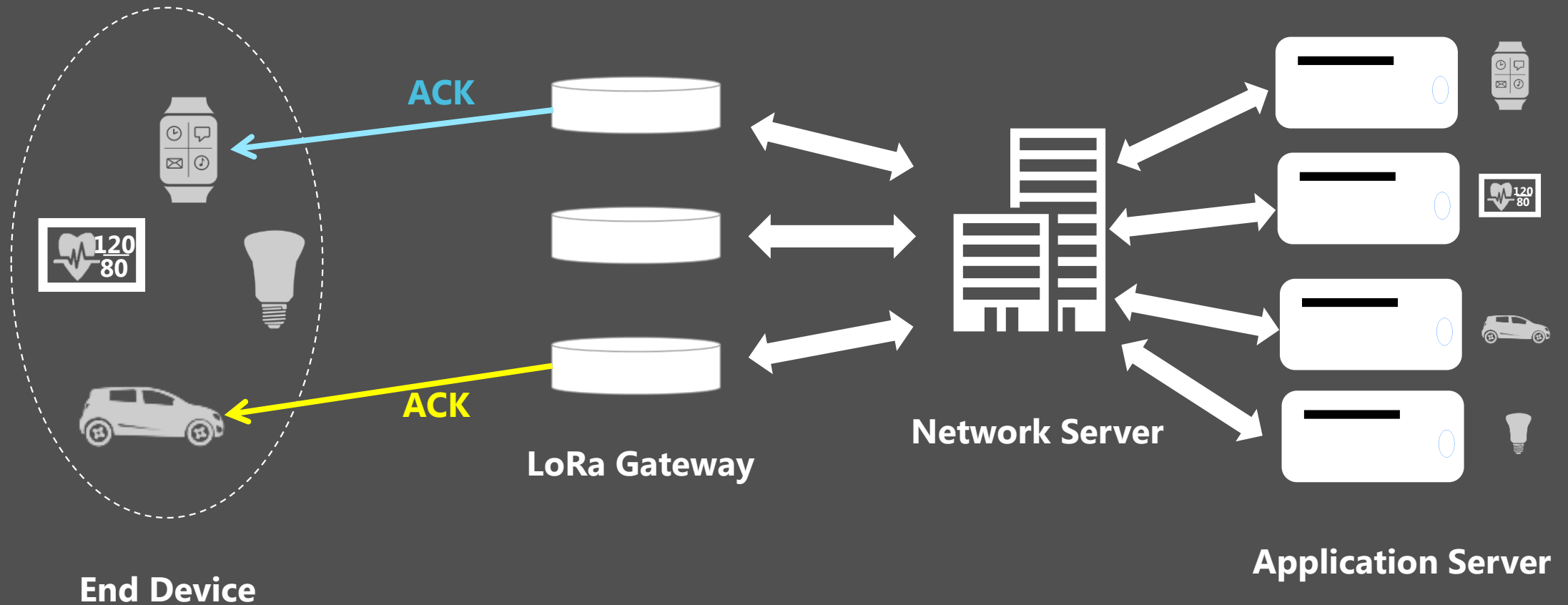
Confirmed-Data Message



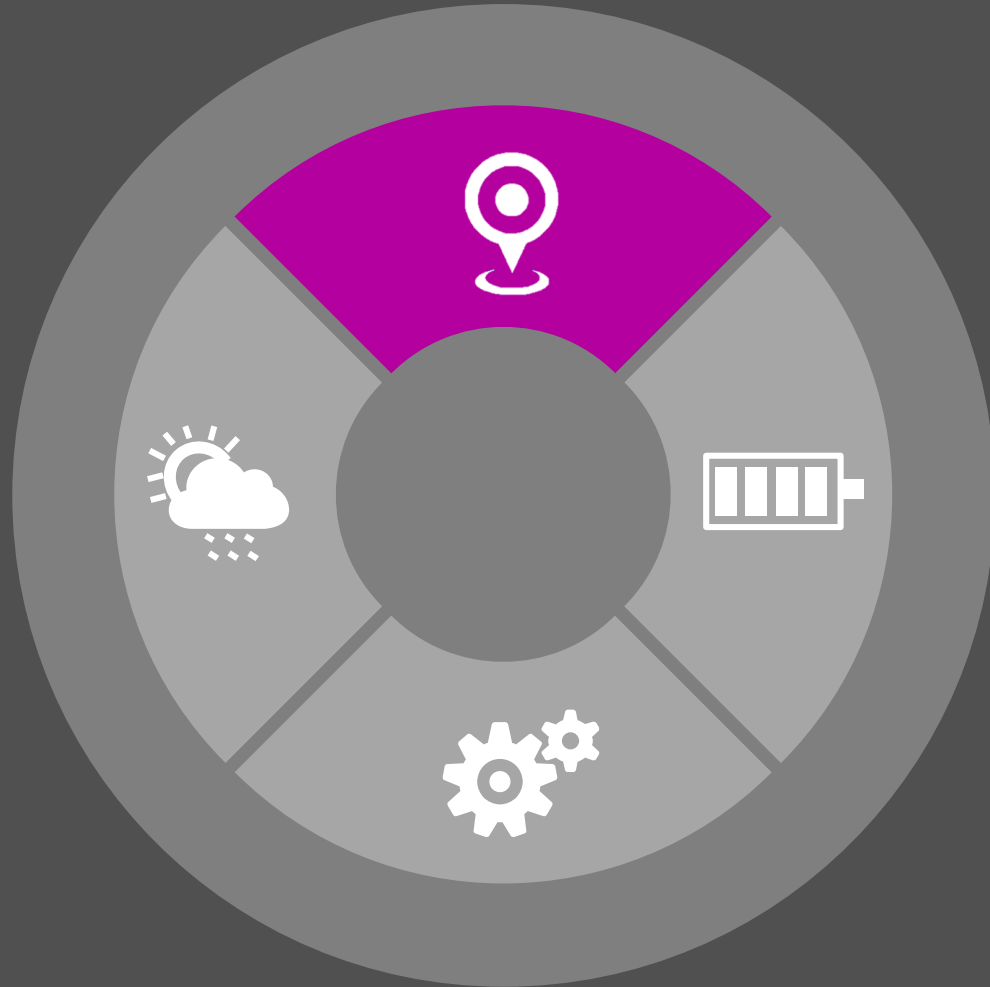
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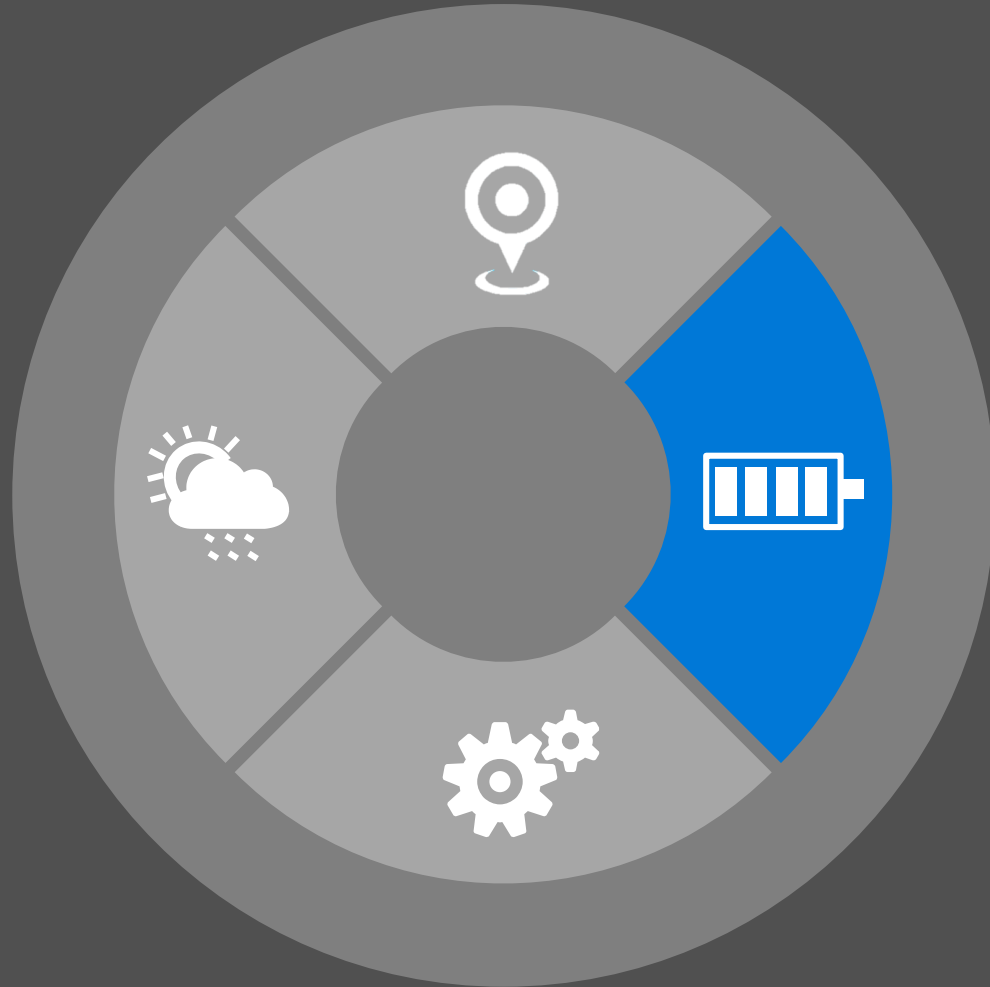
Why LoRa for tracking



■ LoRa Vs. GPS

- ▶ GPS: Outdoor
LoRa: Indoor and neighboring outdoor
- ▶ GPS: High Power
LoRa: Relative low Power
- ▶ GPS: not efficient at indoor
LoRa: Adaptive indoor location tracking
- ▶ GPS: Adversely affected by poor weather
LoRa: Better link budget in poor weather

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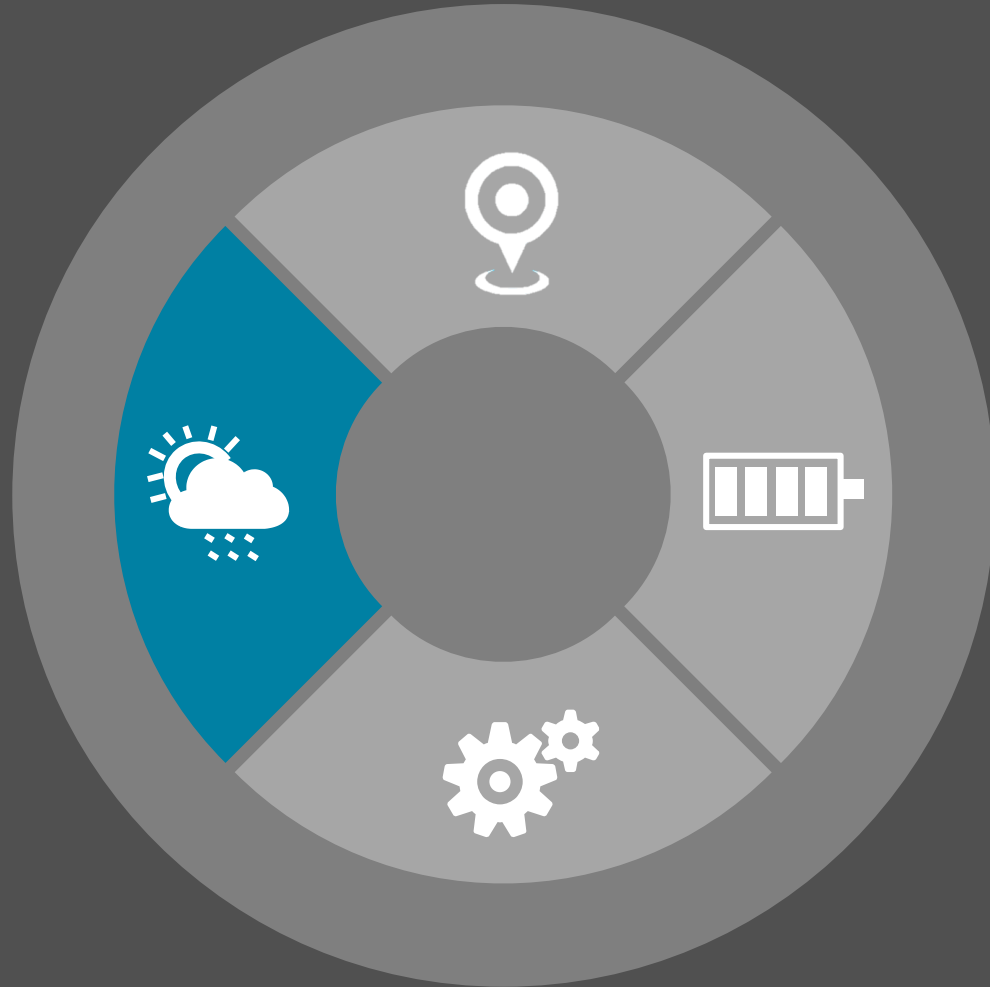
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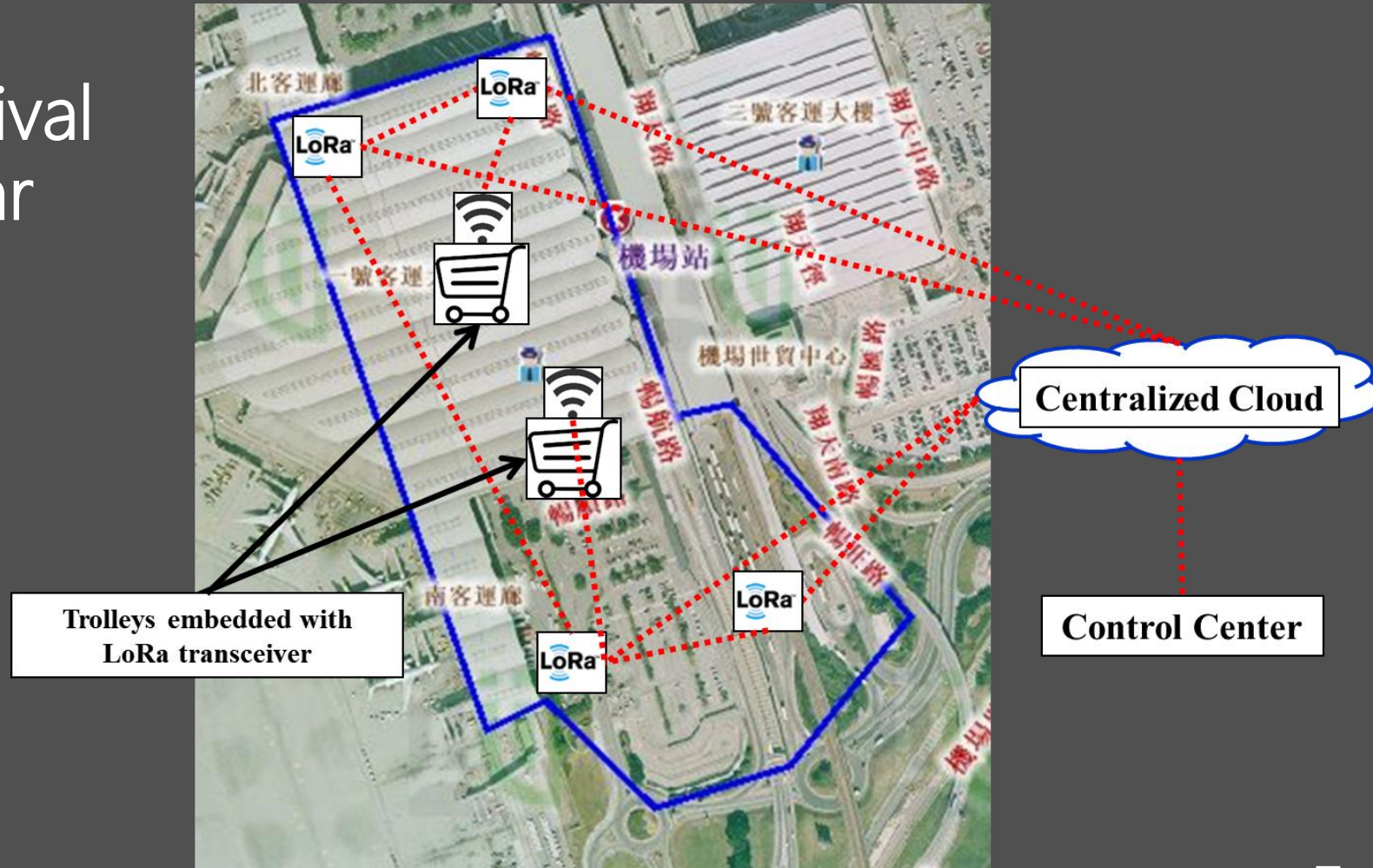


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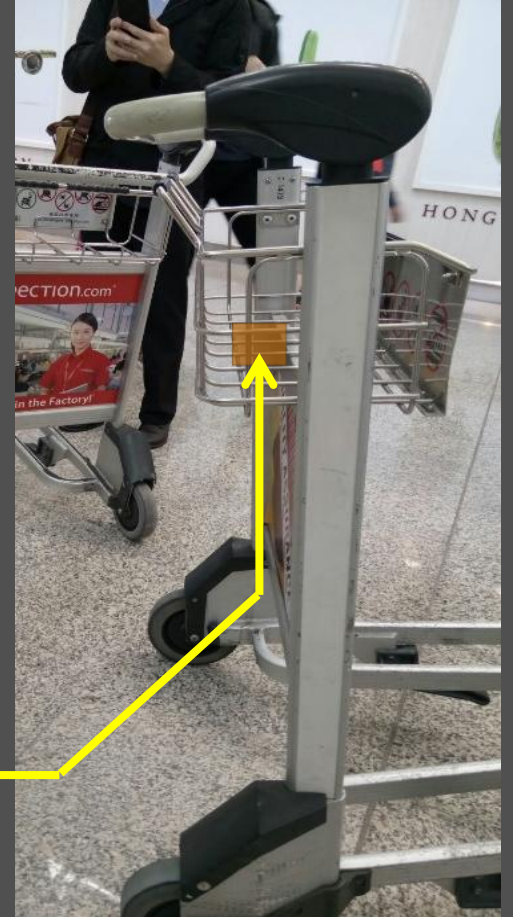
LoRa seamless localization for HK airport

- Testbed: Terminal 1 Arrival Hall, bus station and car park #1 at HK airport
- Tracking down trolleys
- Trial: ~770 trolleys



Preliminary Lora device Specification

- Battery Operated:
4.5~6V (4 pcs of AAA Battery)
- Frequency Band:
920-925MHz
- Size:
170x80x65mm (outer)
136x71x52mm (inner)
- Ingress Protection:
IP67
- Flammability Rating:
UL 746C 5" , with UV resistance



LoRa Device

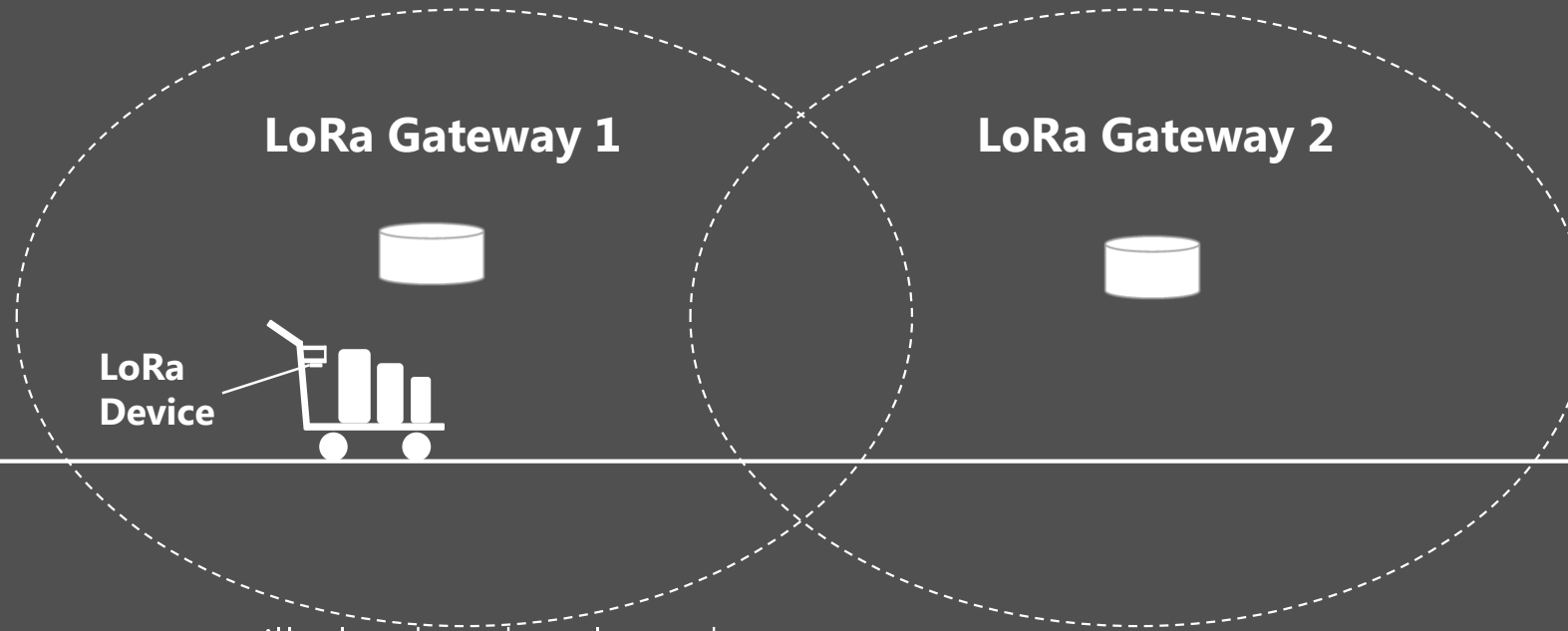
Link budget

- Link budget (PRX):

$$P_{RX} = P_{TX} + G_{TX} + G_{RX} - L_{TX} - L_{RX} - L_P$$

Link budget analysis and handover strategy

- Handover Strategy



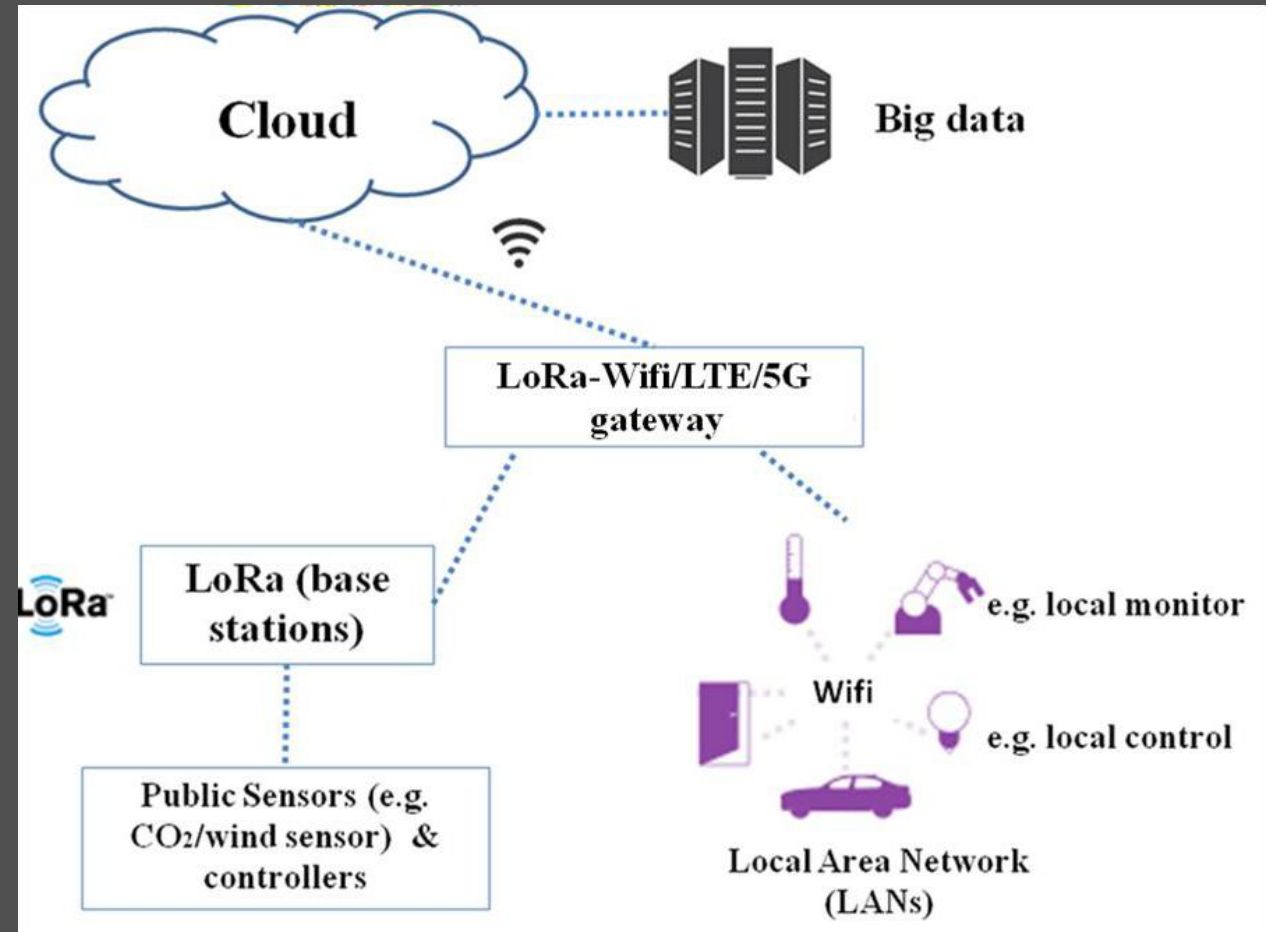
- Handover strategy will also be developed
 - To provide a wider coverage
 - The received signal strength (RSS, P_R)

$$P_R = P_0(d_0)_{dB} - 10\alpha \log_{10} \frac{d}{d_0} + v_\sigma$$

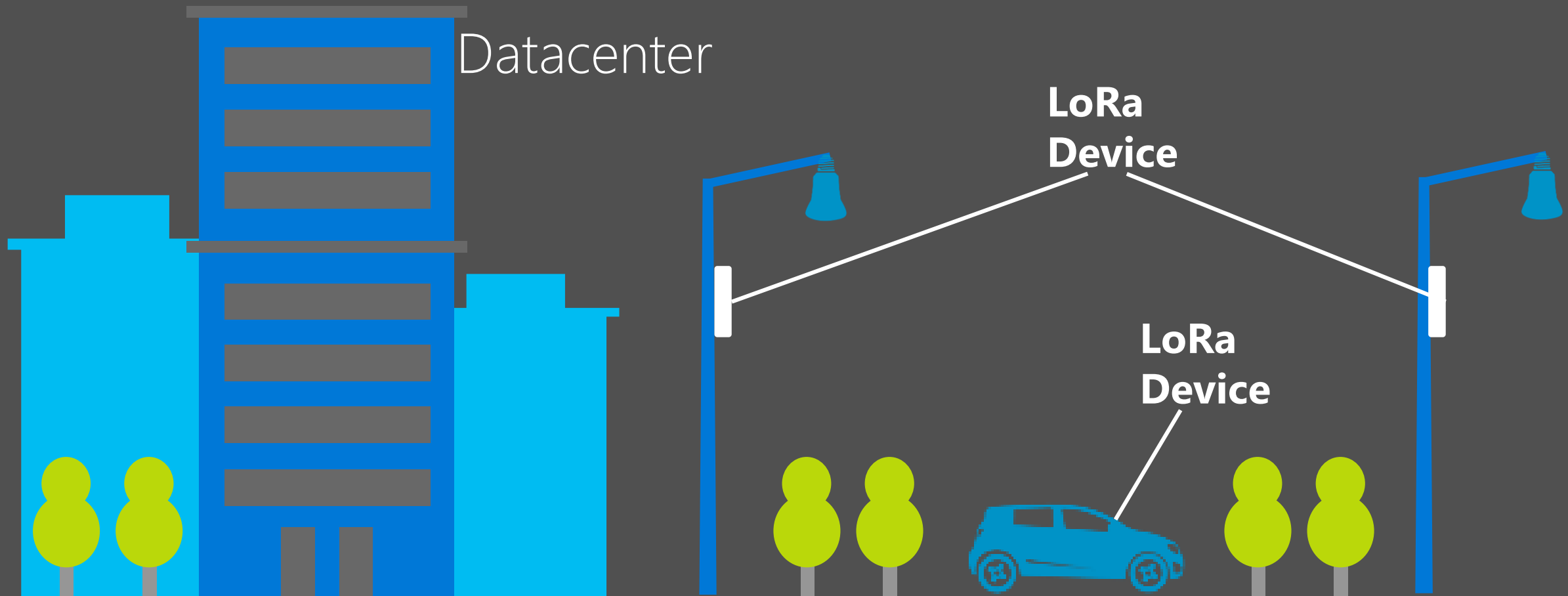
- α and the link budget-related parameters will be designed
 - \rightarrow communication environment $\uparrow \rightarrow$ seamless localization

Co-existence and Network Planning

- LoRa-based Cloud prototype for IoT
- Network Planning for indoor wireless networks
 - Signal penetration and propagation are much more difficult due to the general complex fading environment



Future development: Put LoRa Gateway On Street Light





Thanks!

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