

IoT Communications

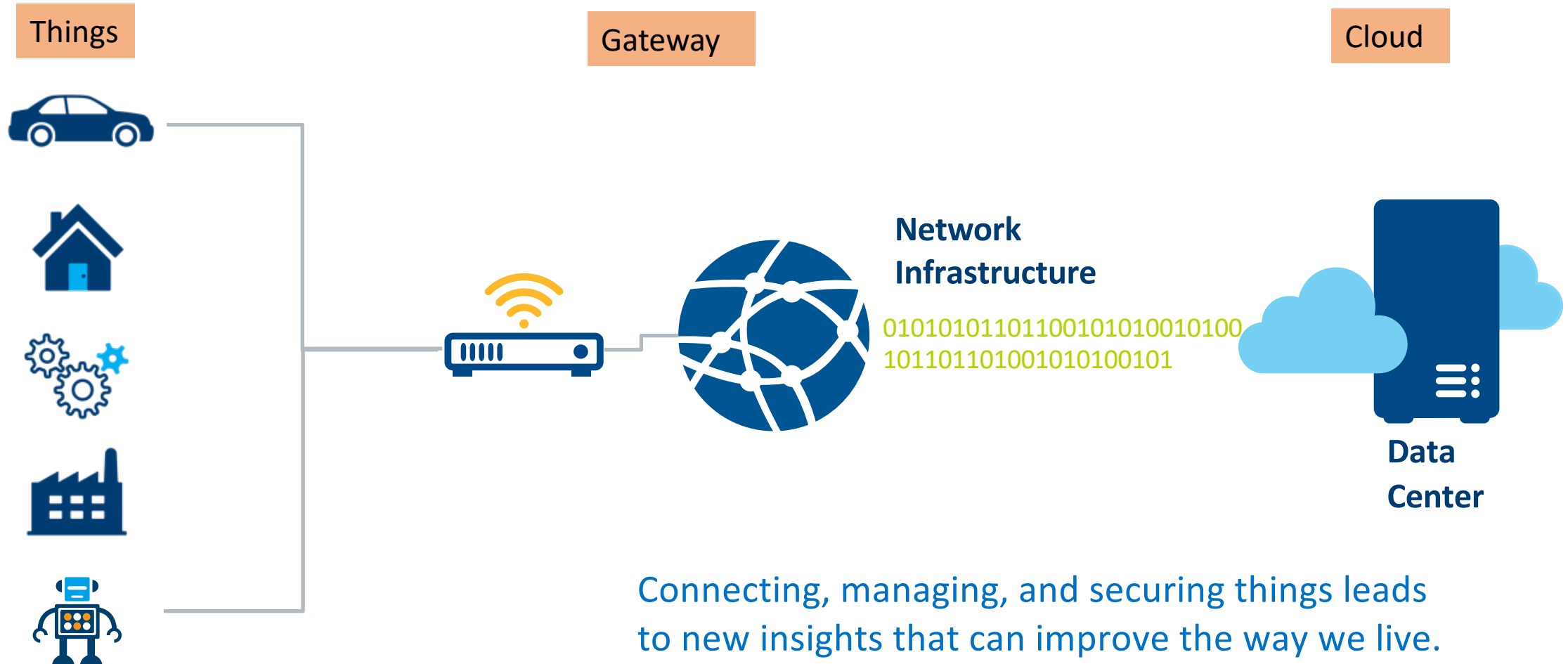
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CS698T, Lecture 4

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IoT Overview

83B devices will be connected to the Internet by **2024**¹

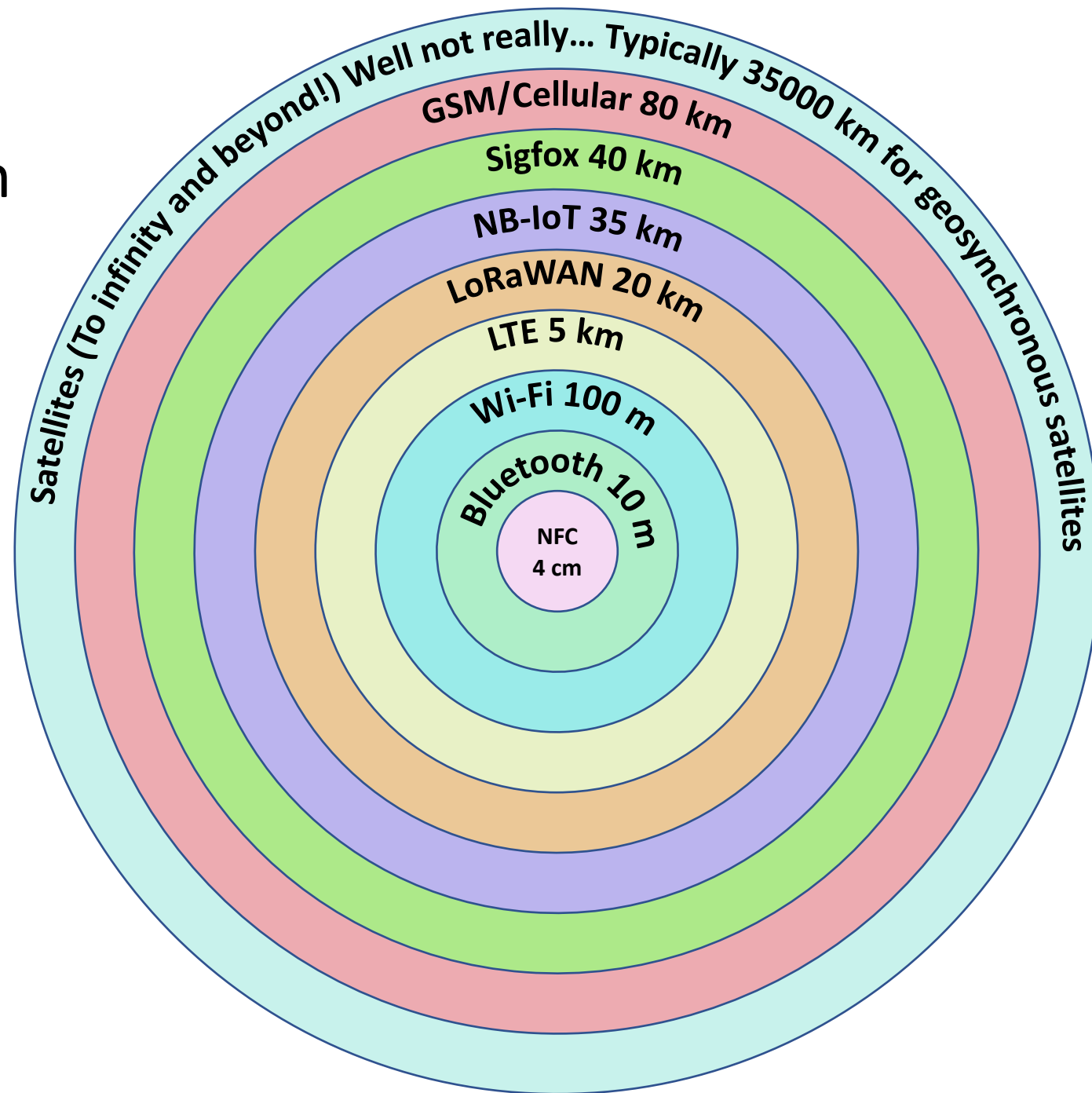


1. <https://www.saftbatteries.com/energizing-iot/how-iot-world-shaping-2021-and-what-trends-will-influence-future-iot-infographic>

Challenges in IoT communications

- Resource constrained devices require low power communication
- Identification – unique address for the connected devices
- Routing protocols with low memory requirements
- High speed and nonlossy communication
- Mobility of IoT devices

IoT communication Protocols





Phone to Phone



NFC (Near Field Communication)

- Short distance communication using **electromagnetic field**, up to **4cm**
- Operates over a frequency band of 13.56 MHz **same as RFID**
- Data rate: 100-420kbps
- **Allows two-way communication – needs at least one NFC-enabled transmitter and one NFC-enabled receiver**
- **Active devices – e.g. smartphones**
 - **Have power their own power supply**
 - Can be used as transmitter and receiver
- **Passive devices - e.g. tags**
 - **Does not have dedicated power supply.**
 - Uses load modulation – Amplitude shift keying to transfer data
- Types of communication

Phone to Reader



Phone to device

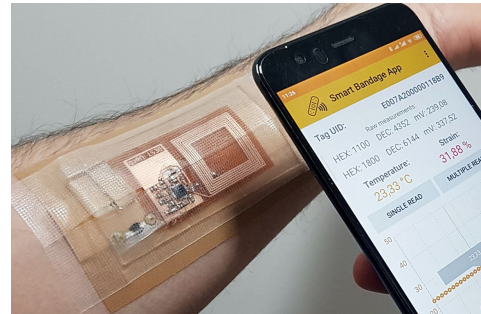


Phone to Tag

NFC Applications



Cashless payments/transactions with NFC chip on credit cards



NFC-enabled smart bandage¹



Access Control

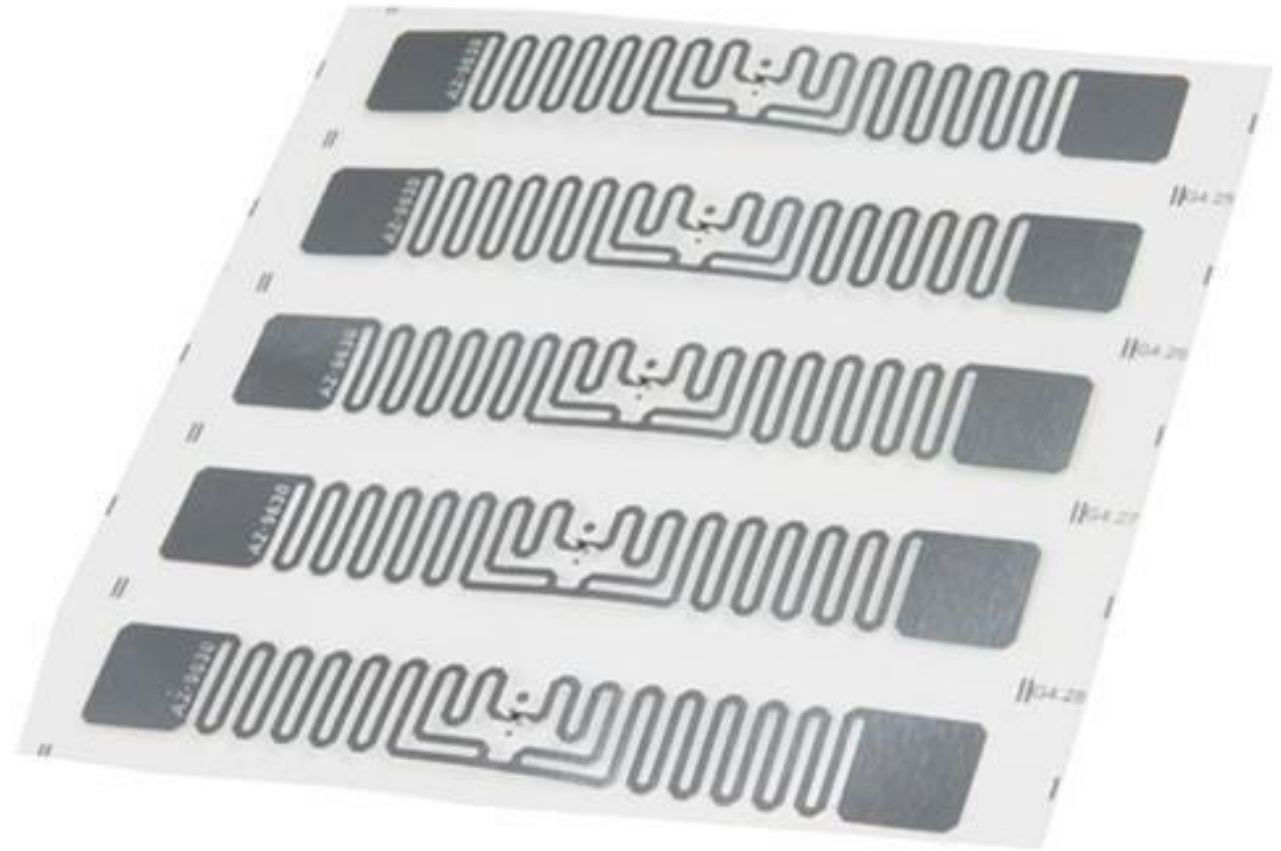


Smart poster

1. <https://www.nfcw.com/2021/04/06/371565/nfc-enabled-smart-bandage-aids-healing-could-detect-covid-19-symptoms-researchers-say/>

RFID (Radio Frequency Identification)

- RFID Tag (with the chip) + RFID reader
- Does not require line of sight communication unlike barcodes
- Range: up to 100 m
- One way communication – only tag contains the data
- RFID tag types¹
 - Active tags – have power source
 - Passive tags – draws power from the electromagnetic waves from the reader
- RFID technology types
 - Near – based on the magnetic field generated in the coils of RFID reader and tags
 - Far – both reader and tags have dipole antennas. The reader propagates EM waves which leads to potential difference at the tag.



RFID applications



Supply chain
management
– inventory
management



Tracking in
healthcare



Bag tracking
at the airport



Access control



Bluetooth

- Short range communication technology using **radio waves in personal area networks (PAN)**
- Works in 2.4GHz ISM band
- Up to **8 devices can connect** and communicate with each other at any given point
- Bluetooth Applications

5x2

Bluetooth versions

Bluetooth
1.0
(1999)
0.7Mbps

Bluetooth 1.2
(2003)
0.7Mbps
- Avoided
interference
with wifi
- Better pairing
speed

Bluetooth 2.0
(2004)
3 Mbps
- Better
interference
handling
- Less power

Bluetooth 2.1
(2007)
3 Mbps
- More secure
- Less power

Bluetooth 3.0
(2009)
24 Mbps
- Pairing through
bluetooth and
data transmission
over wifi

Bluetooth 4.0
(2009)
3 Mbps
- Bluetooth Low
Energy (Bluetooth
Smart)

Bluetooth 4.2
(2014)
3 Mbps
- Supports IPv6
(6LoWPAN)
- Large number of
devices connectivity
with unique
addresses for each

Bluetooth 5
(2016)
-improved range up to
200 m
- Low power
- Better for IoT
devices due to
extended battery life

BLE – Bluetooth Low Energy

- Range up to 10 m
- Types of devices in BLE: master and slave
 - E.g. smartphone as master device and smart watch as slave.
 - Slave devices are energy efficient. They wake up periodically to receive data from master

	Bluetooth	BLE
Data transfer	streaming	packets
Connection activity	Always on	Sleeps when not communicating
Data channels supported	79	40
Channel bandwidth	1 MHz	2MHz
Data rate	1 million symbols/s	1 million symbols/s

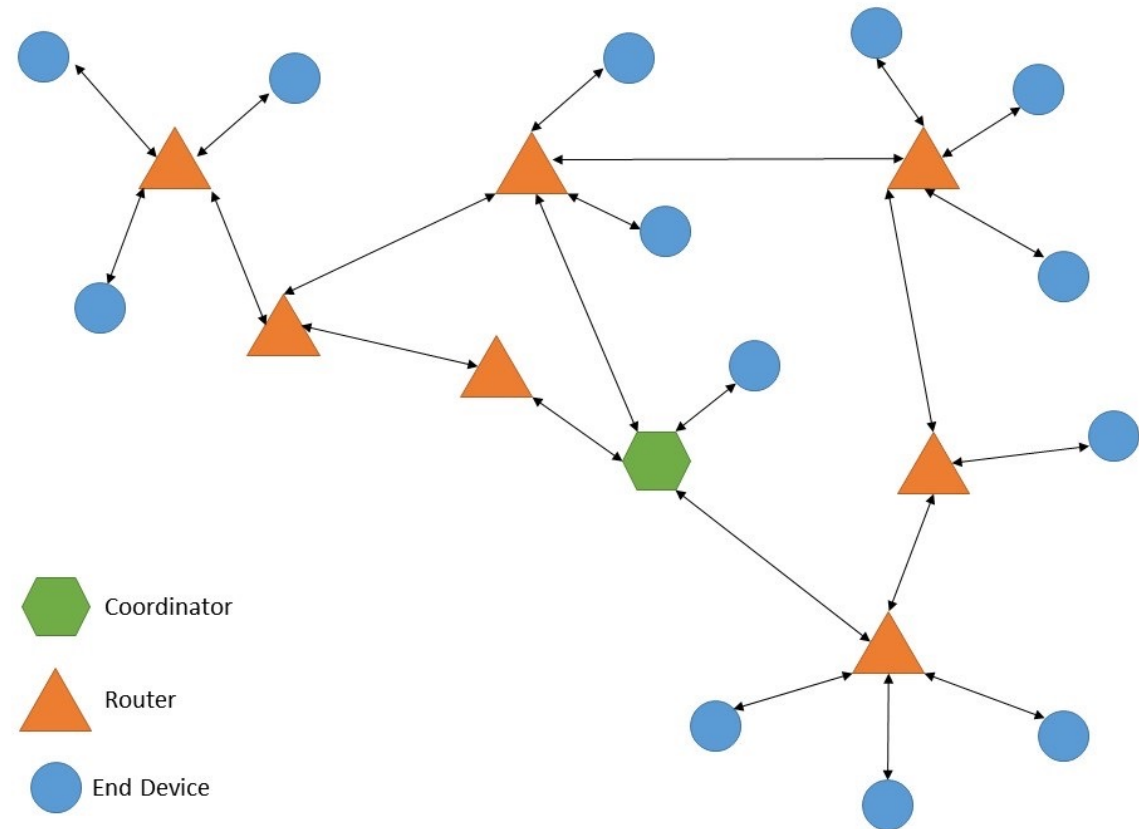
Zigbee



- Mainly used in Wireless sensor networks (WSN)
- Based on IEEE 802.15.4-2003 standard
- Works in 2.4 GHz ISM band
- Reliable, low cost, low power, scalable and low data rate (similar to Bluetooth)
- Supports multihop routing unlike Bluetooth
- Data rate: 250 kbps
- Range: 100+ (with line of sight), indoor 10-20
- Low power – harvests energy from the surrounding (e.g. light, piezoelectric)
- Applications
 - Smart home
 - Smart industrial manufacturing
 - Smart parking

Zigbee

- Connect up to 65,000 devices using mesh topology
- Zigbee architecture
 - Coordinator
 - Router
 - End device
- Operating modes
 - Beacon mode – wakes up only during data communication
 - Non-beacon mode – always monitoring in active state
- Disadvantages
 - low range
 - Not secure



Z-wave

- Mainly developed for home automation by Zensys
- More secure than Zigbee – extremely reliable
- Low power as compared to wifi
- Data range – 0.3 to 50 kbps
- Range – 30 m
- Can control only up to 300 devices



Wifi



- Bluetooth/Zigbee/Z-wave can not be used for high data rate in short distance communication, wifi is the solution for it
- Range 100 m from the access point
- Best fitted for LAN environment with fast data rate, 200 Mbps
- Processes large amount of data
- Uses IEEE 802.11n standard
- Power consumption – 0.1W
- Uses ISM bands with frequencies 2.4 GHz and 5 GHz
- Not ideal for battery operated devices

Wifi applications

- Video Surveillance
- Home applications

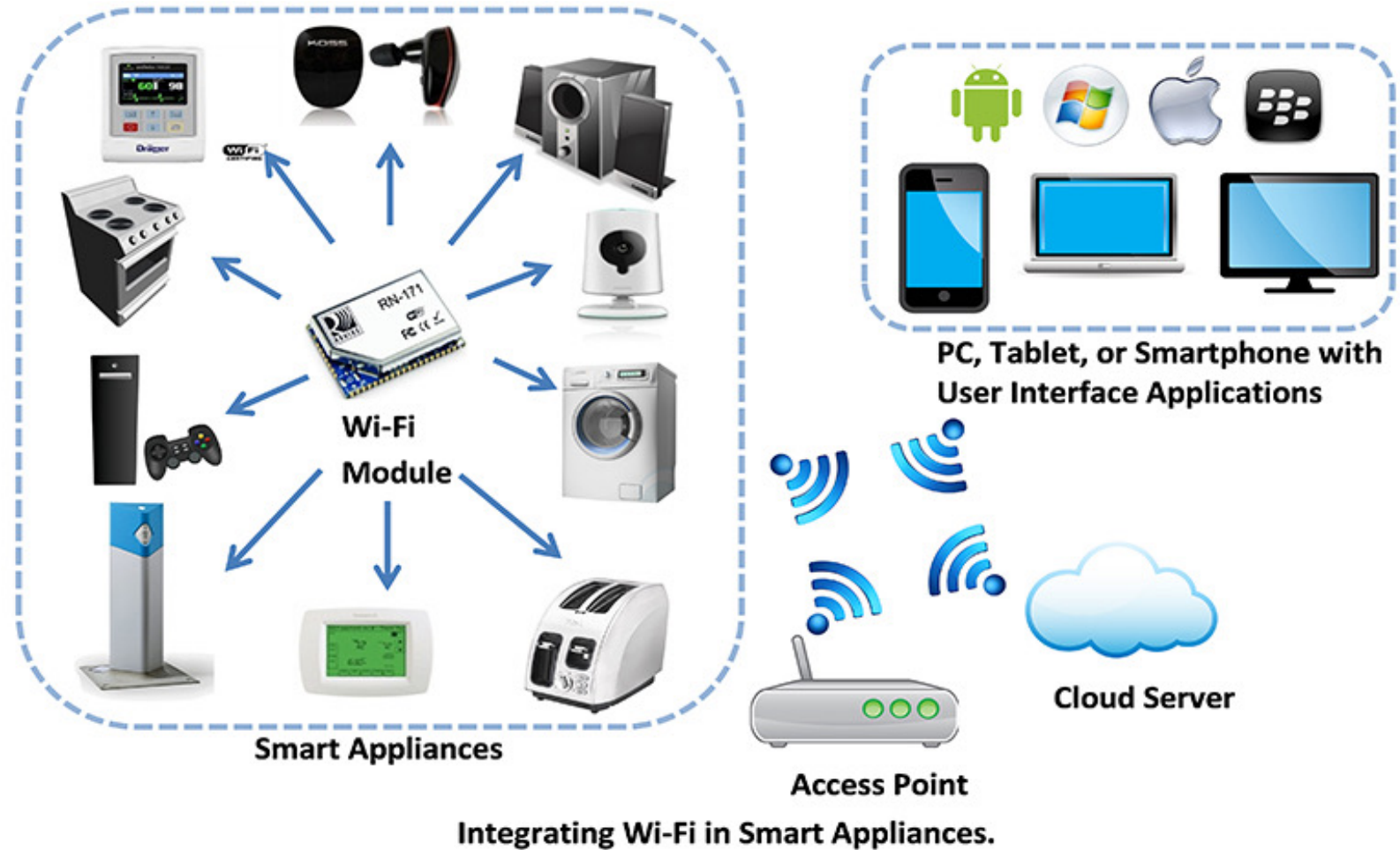


Image source: <https://av4india.wordpress.com/2014/10/29/why-standard-wifi-so-important-for-ict-applications/>

Questions?

