Fog Computing

- **Fog Technology Architecture**
- **Case Study**

Existing Cloud Computing

Cloud computing is a type of computing that relies on **sharing computing resources rather than having local servers or personal devices** to handle applications

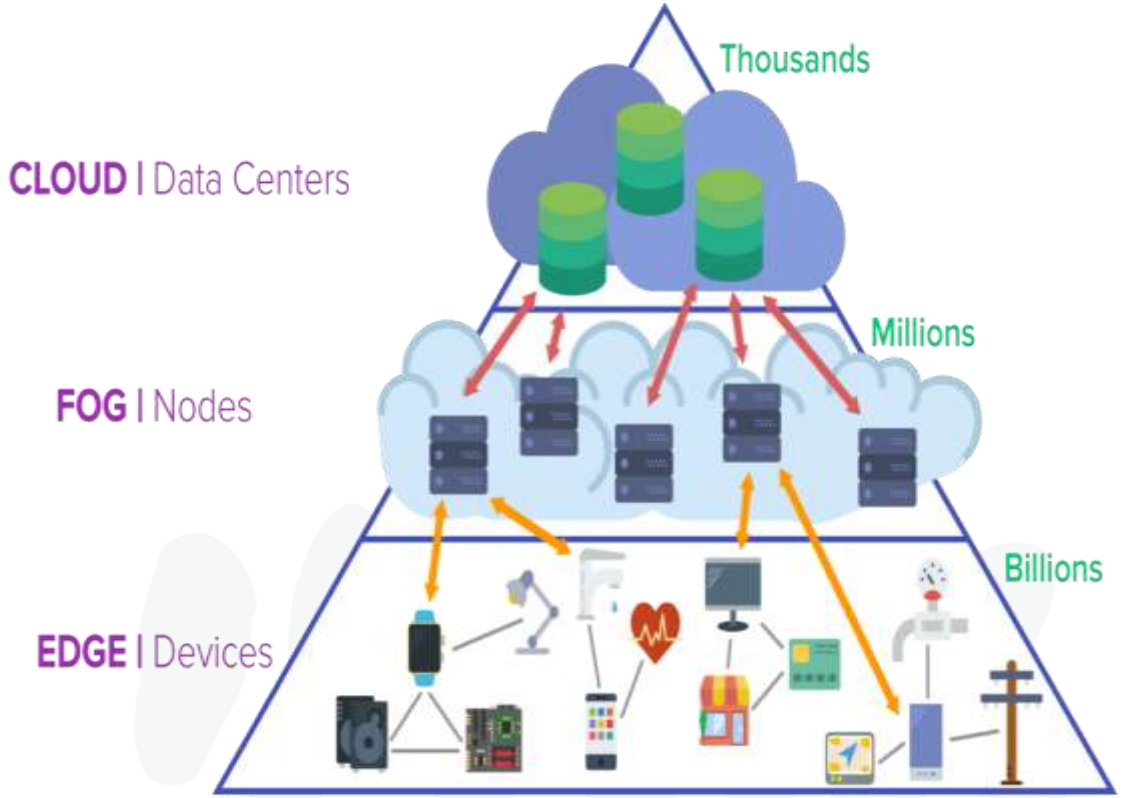
Cloud Computing Limitations

1. Not always connected
2. Not always enough bandwidth
3. Central analytics
4. Security shortcomings
5. Big data
6. Latency

Fog Computing

Fog computing is a **decentralized computing** paradigm that extends cloud computing and its capabilities to the edge of the network, bringing computation and data storage closer to the data sources.

This creates a more responsive and scalable architecture that can handle the growing demands of Internet of Things (IoT) devices and applications.

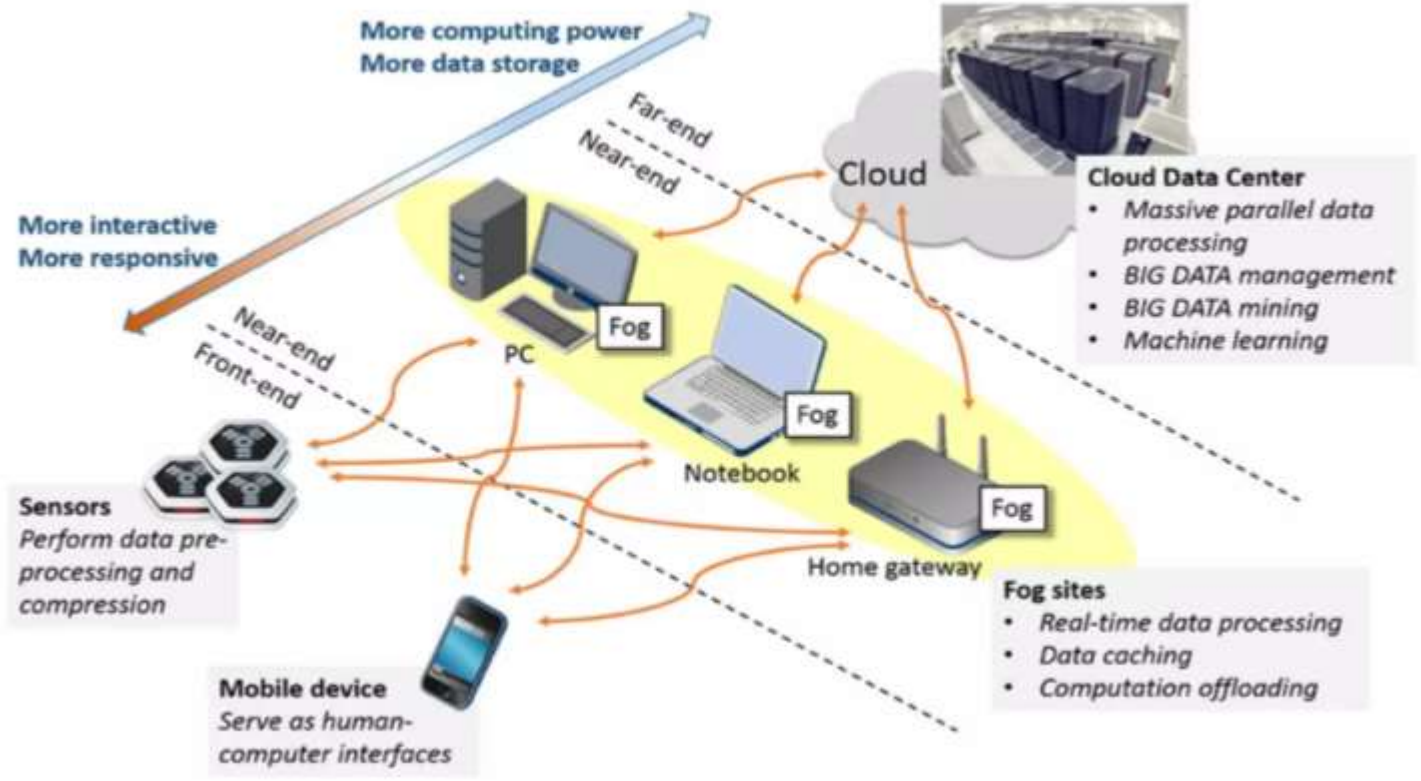


Fog Computing

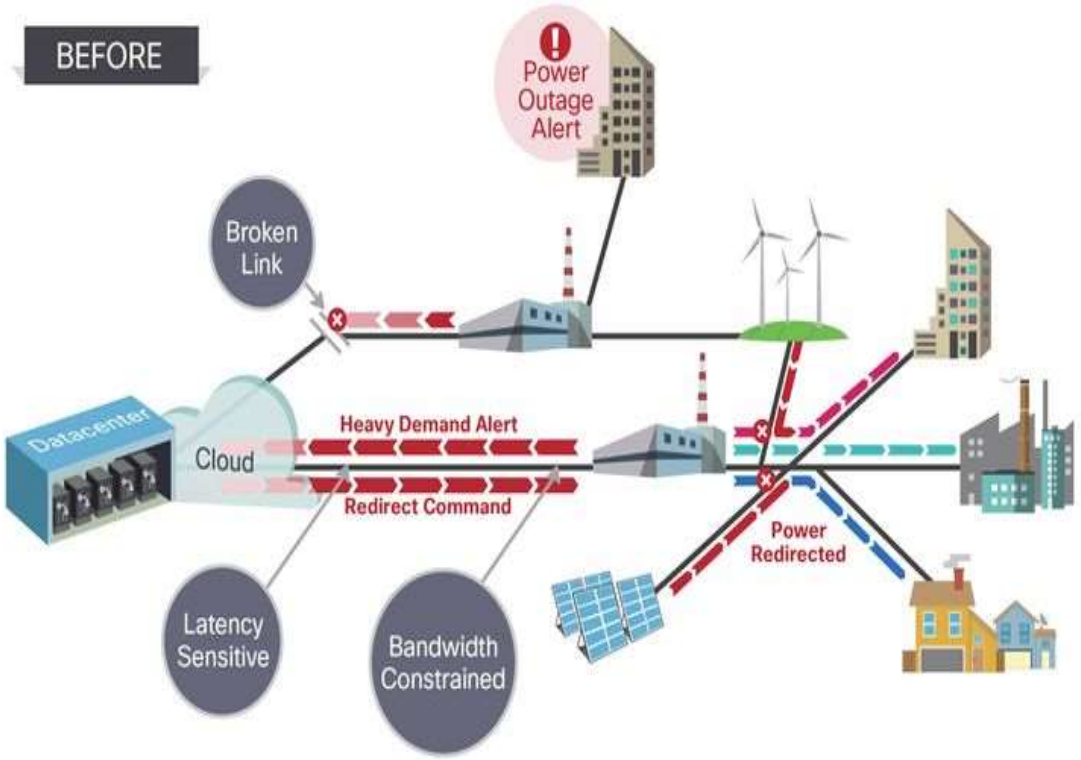
- Fog computing places processes and resources at the edge of the cloud, often on network devices, while data remains stored in the cloud.

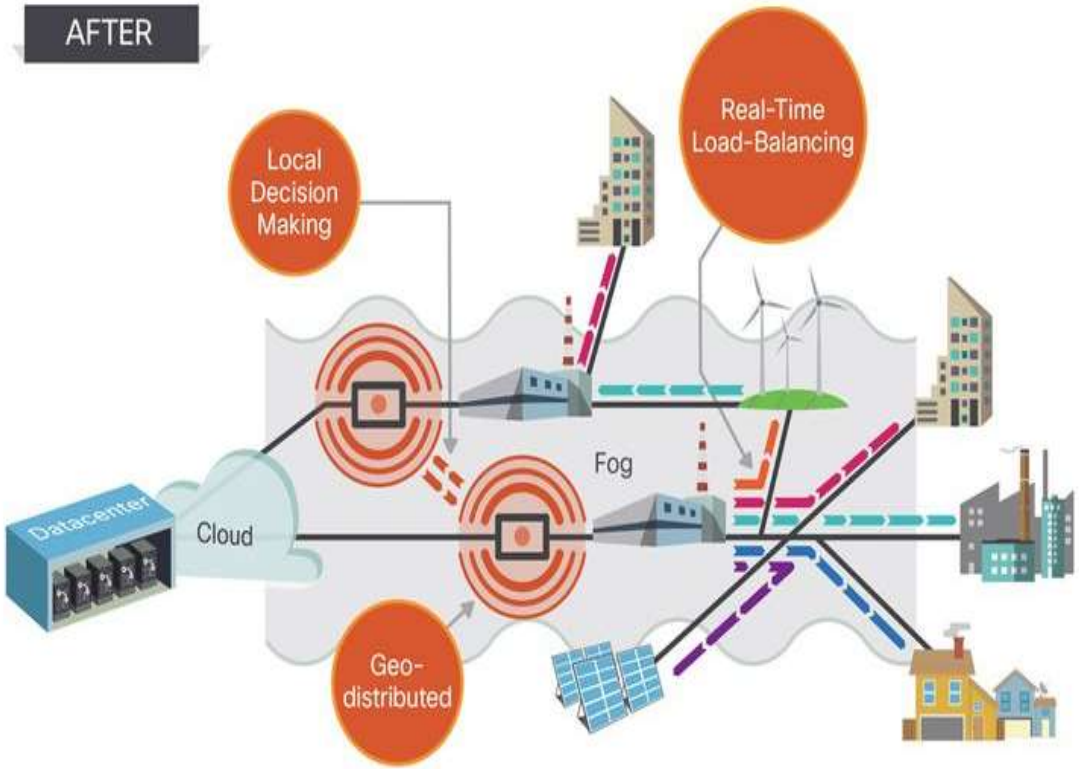
- Faster processing fewer resources consumed

Fog Computing

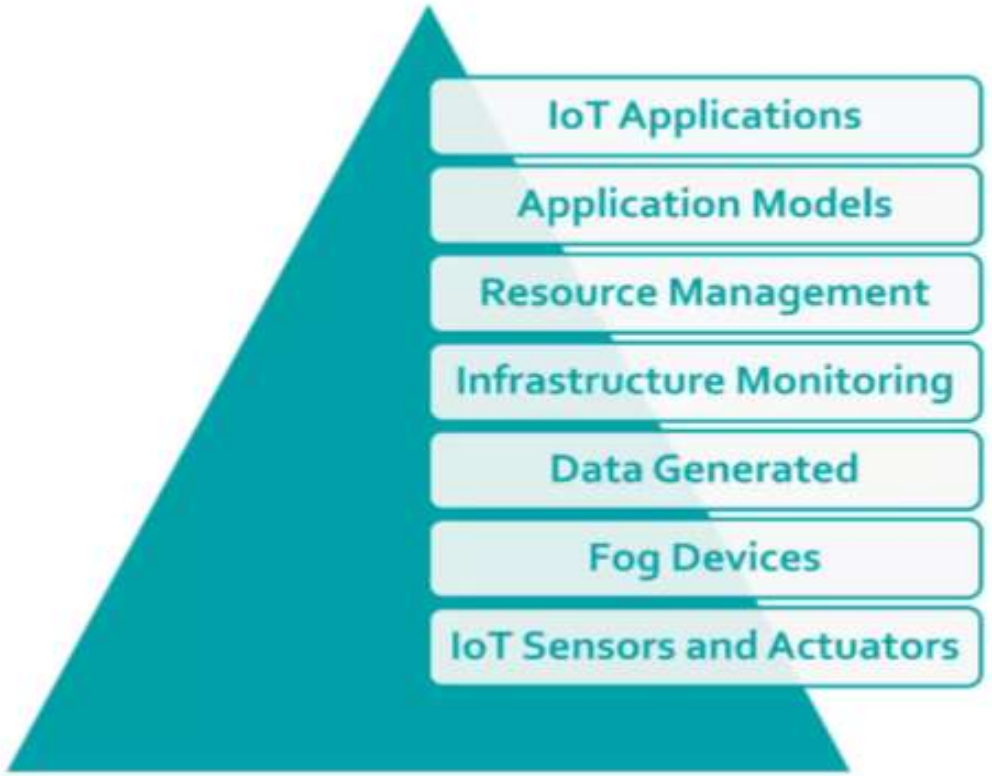


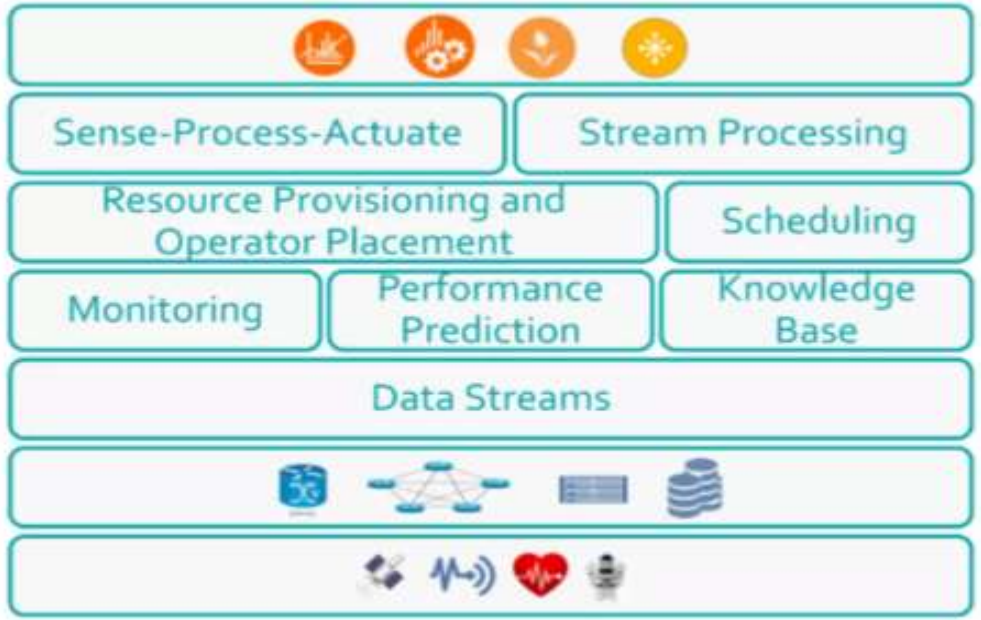
Fog Computing





Fog Computing Architecture





Fog Computing Architecture

- IoT Sensors
  - Are placed at the bottommost layer of the architecture and distributed geographically, sensing the environment, and emitting observed values to upper layers via gateways for further processing and filtering.
- IoT Actuators:
  - Similarly operate at the bottommost layer of the architecture and are responsible for controlling a mechanism or system. Actuators are usually designed to respond to changes in environments that are captured by sensors.
- Fog Device:
  - In the architecture any element in the network that is capable of hosting application modules is called Fog Device. Fog devices that connect sensors to the Internet are generally called gateways.

Fog Computing Architecture

- Three main services-
  - Monitoring components
  - Resource management
  - Power monitoring

Fog Computing Case Study: Healthcare

- Challenges-
  - Healthcare systems in most countries face enormous challenges that will increase due to aging population and the rise of chronic diseases.
  - Growing nursing staff shortage.
  - Much time is wasted in hospitals by manually measuring biometric parameters and transferring the data between systems.

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Fog Computing Case Study: Healthcare

Bandwidth	require a bandwidth of at least 20.48 kbit/s and 96 kbit/s. A192-leadEEGcan demand 921.6 kbit/s bandwidth.
Latency	For ECG, latencies of up to 2 to 4 seconds in real-time monitoring are acceptable.
Energy-Efficiency	some in-body sensors rely on energy-harvesting, either by heat or kinetic energy. some sensors may require an operation of the patient when battery needs replacement.
Dependability	Depending on what data is used for, system failures have different consequences, from minor inconvenience to serious threat to the patients' lives.
Security	the security requirements in healthcare are high.
Interoperability	Systems, even when provided by different vendors, should be interoperable with each other.

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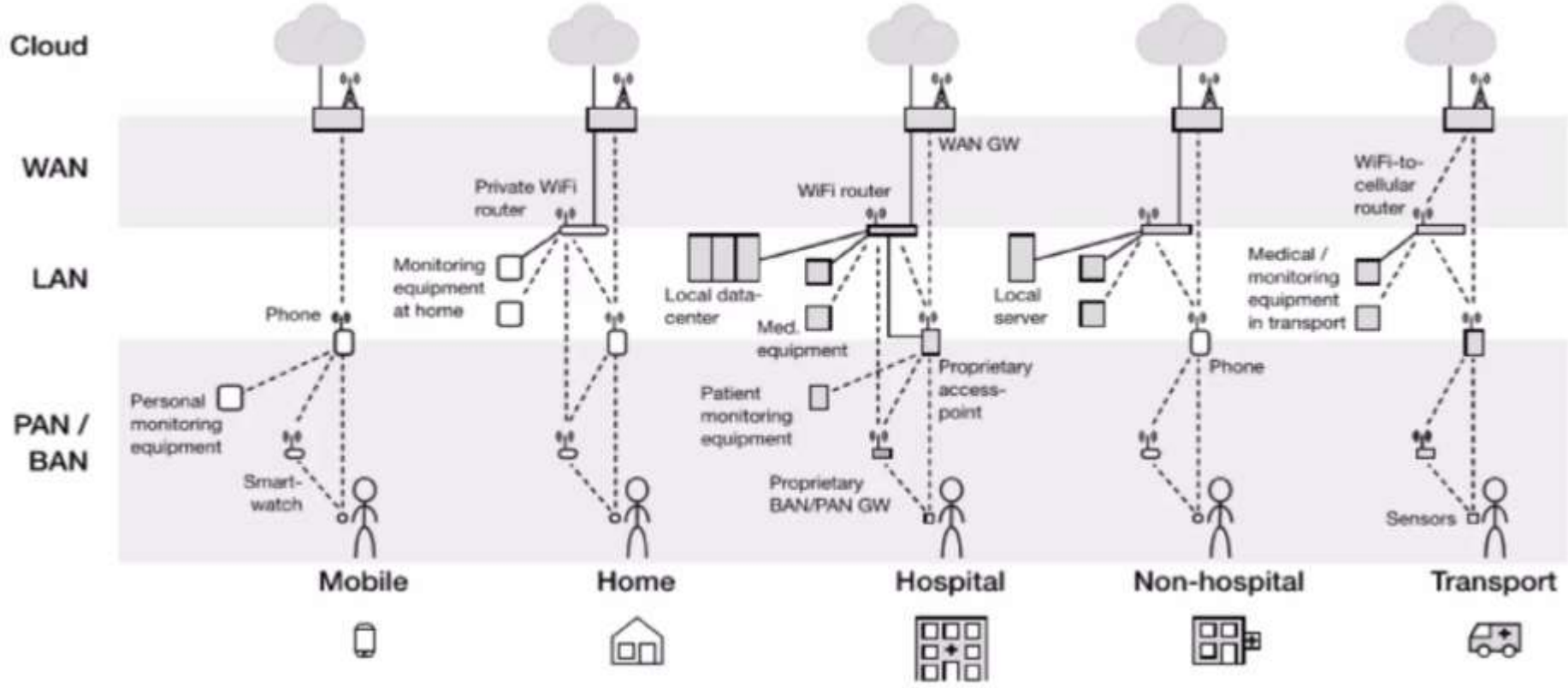
The Vision of Fog Computing in Healthcare

- Flexibility of Computation locus: The location can be dynamic and depend on the current context, environment and application requirements.
- Integration: Within fog computing architecture, new sensors can be added to the existing infrastructure. Fog computing can also serve as a compatibility layer to translate between various standards.
- Patient mobility: Application-specific infrastructure also limits the area where patients can be monitored. the transitions between different environments can be managed more gradually.
- New Applications: Fog computing will provide latency and response time improvements, as well as energy savings for wearable and low-cost devices, while performing complex tasks such as fall detection. Internet of Health care things.

Health Application: Without fog



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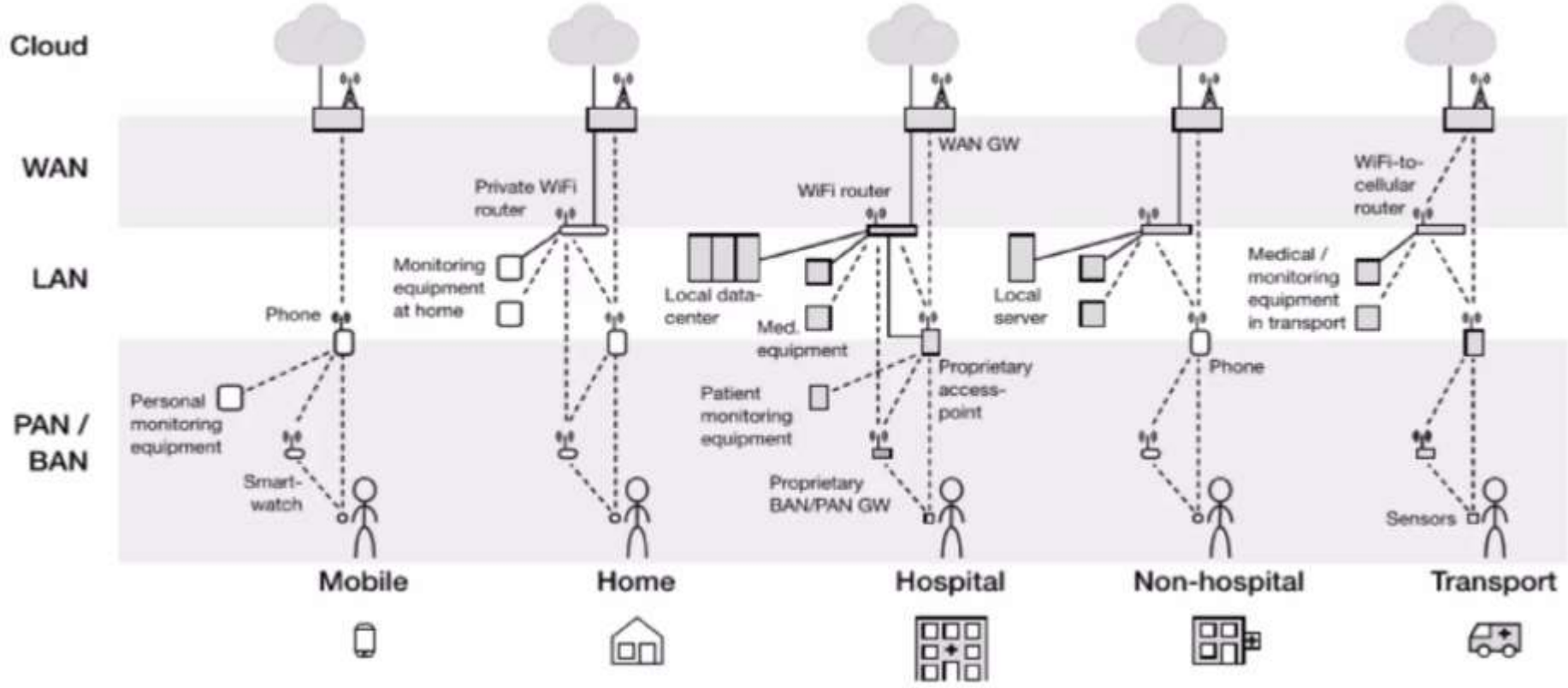

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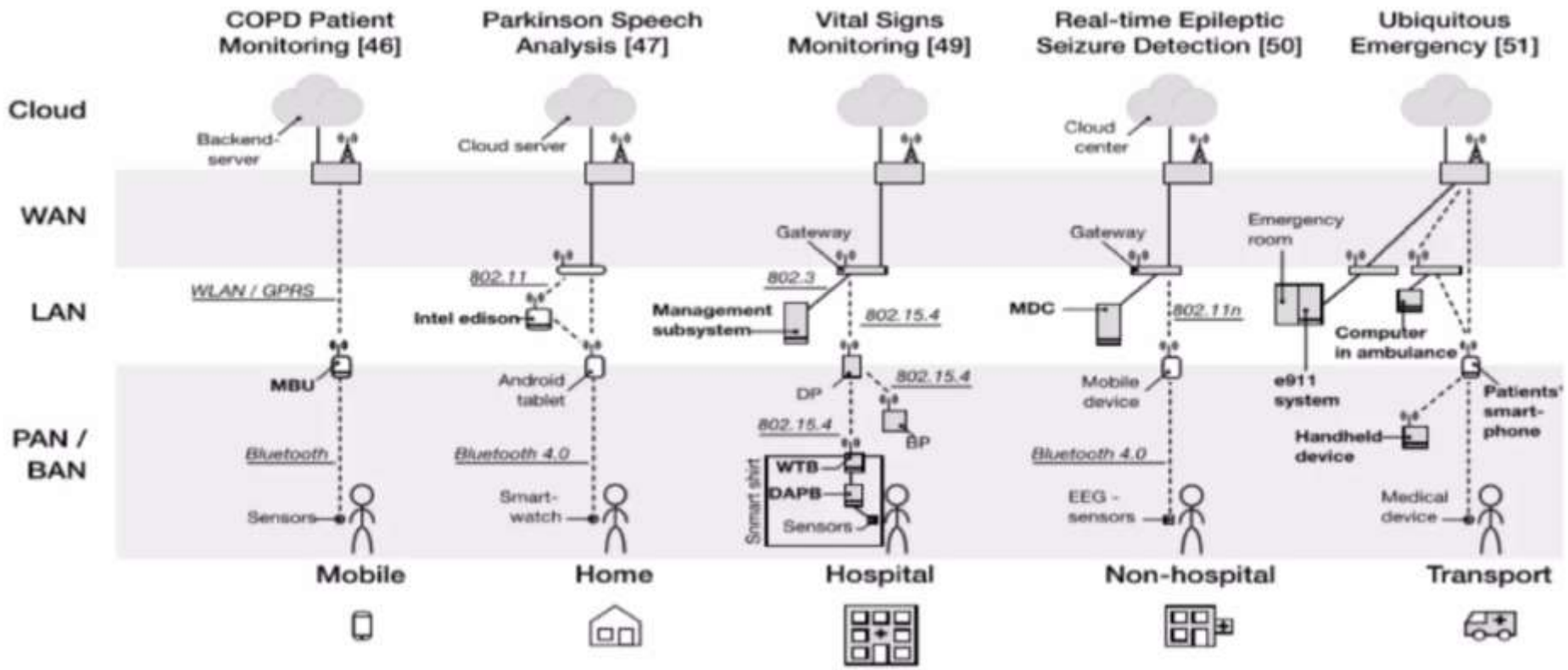

More case studies

- Smart grid
- Smart connected cars
- Smart cities

References

- **Fog Computing by Joud Khattab**