

A Brief Overview of Cloud, Edge and Fog Computing

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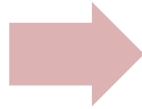
Cloud Computing

- Cloud Computing \approx Grid Computing + Utility Computing
- Outsource utilities (storage, computation etc.) to a third party, called Cloud Service Provider
- Managed by the service provider
- Illusion of unlimited resources
- Pay-as-you-go model
- Accessible through a network

Evolution of Applications

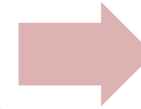
Stand Alone

- Resides on local system
- Local resources
- Self Sustaining
- Not shareable
- Prohibitive costs
- Frequent updates



Web Apps

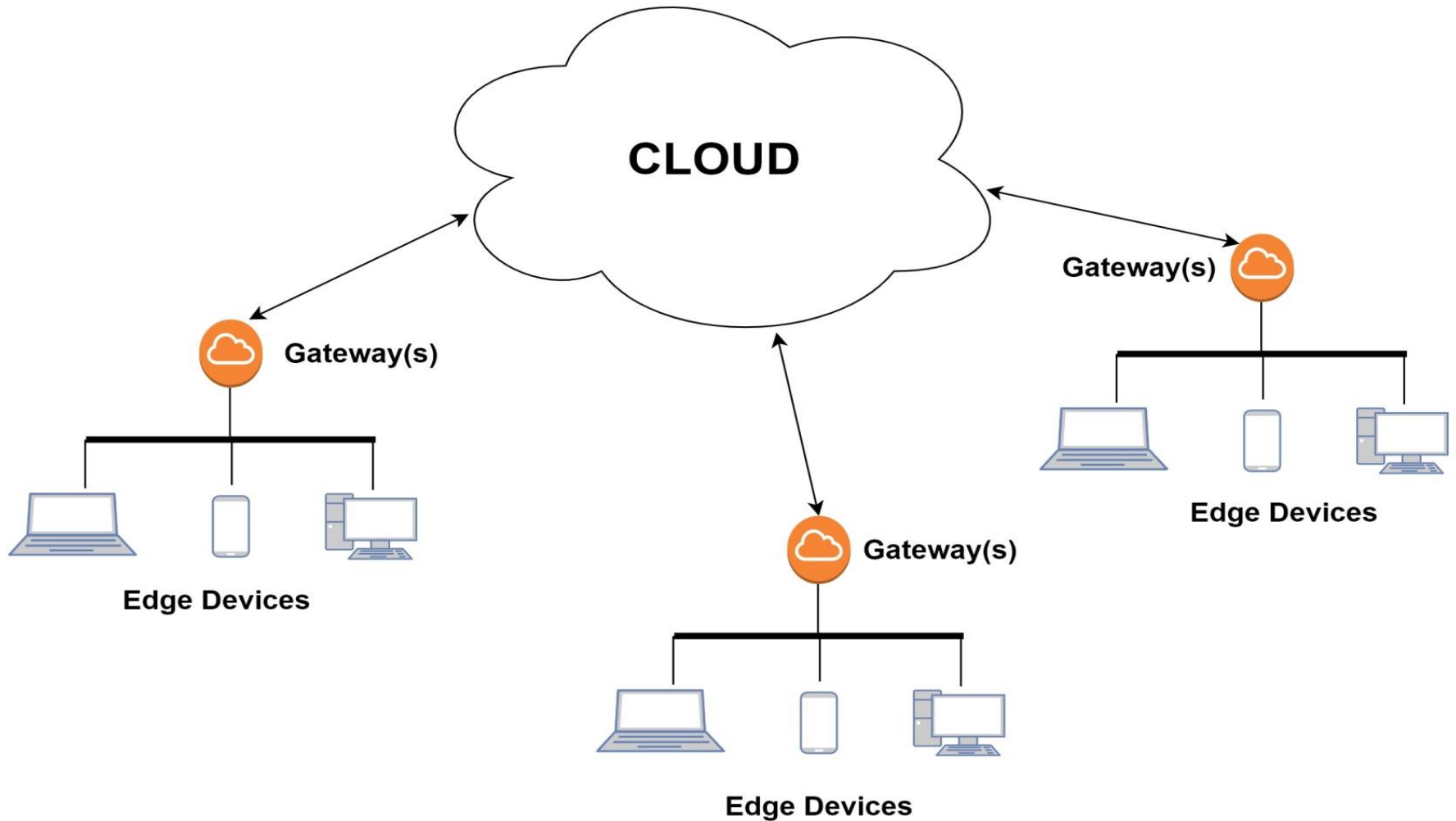
- Resides on remote system
- Client - Server Model
- Network Dependent
- QoS depends on number of users
- Inflexible usage model



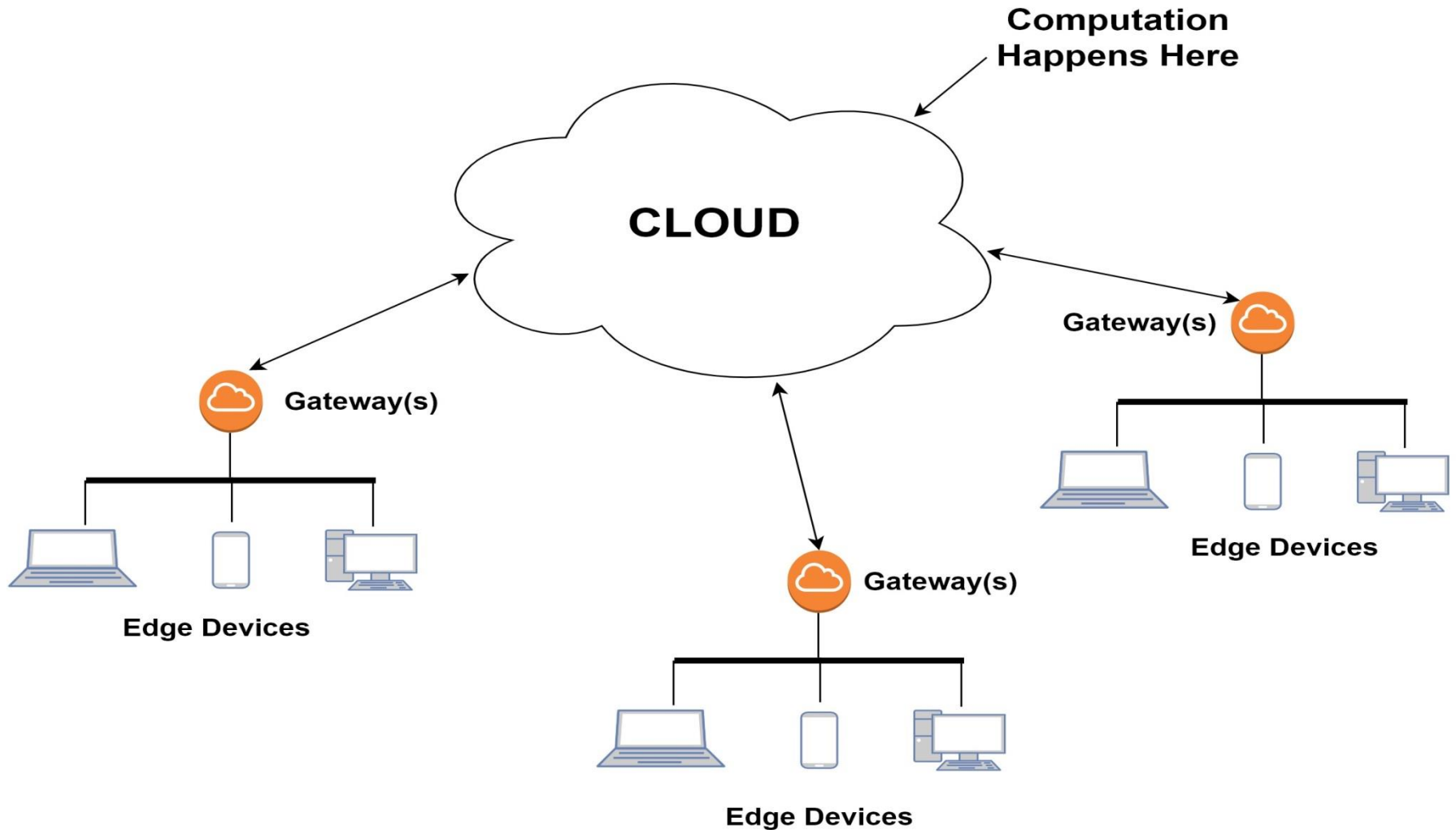
Cloud Apps

- Multitenancy
- Elasticity
- Heterogeneity
- Measured use
- On-demand
- Network dependent

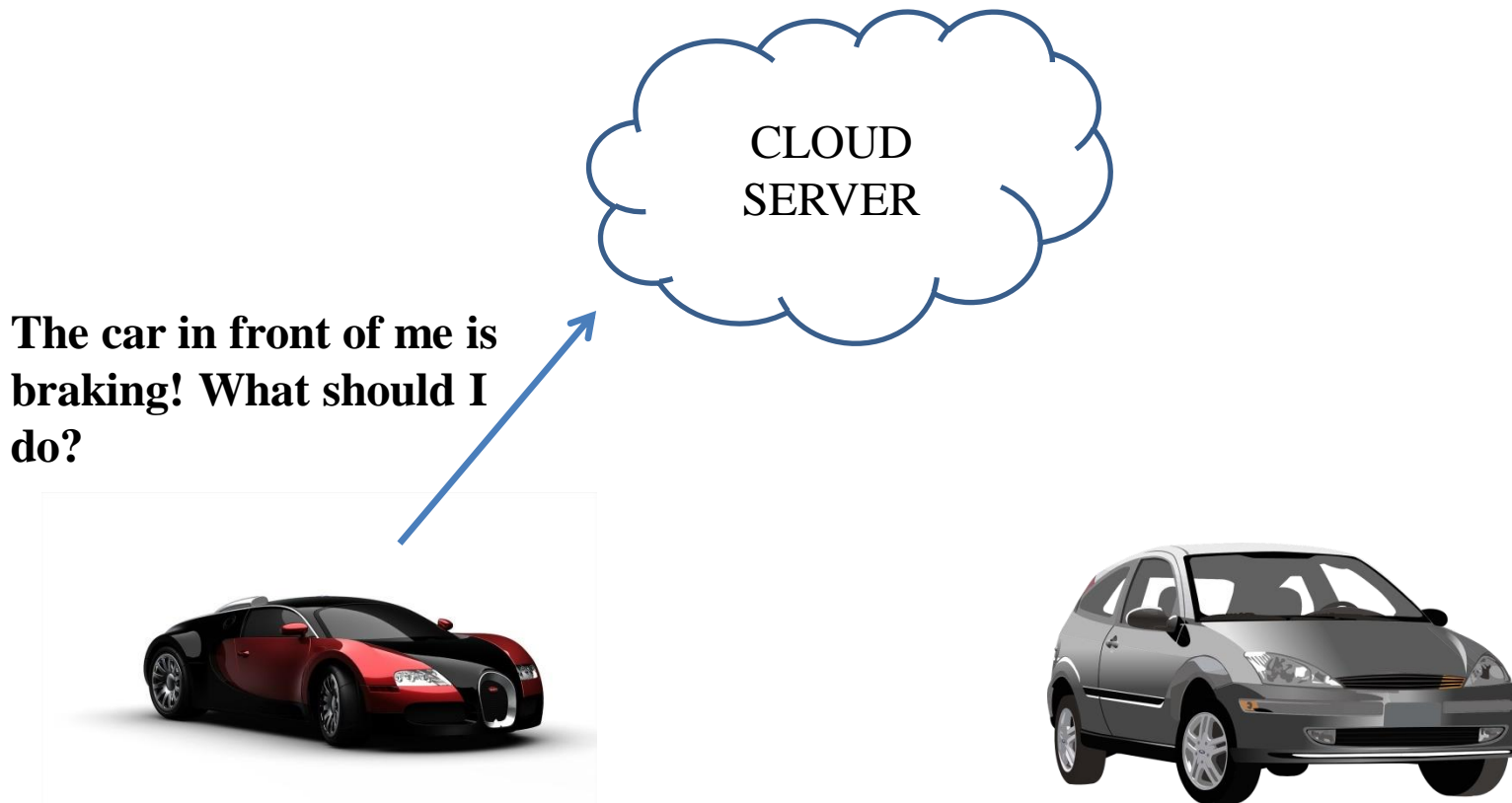
A Simple Architecture



Cloud Computing

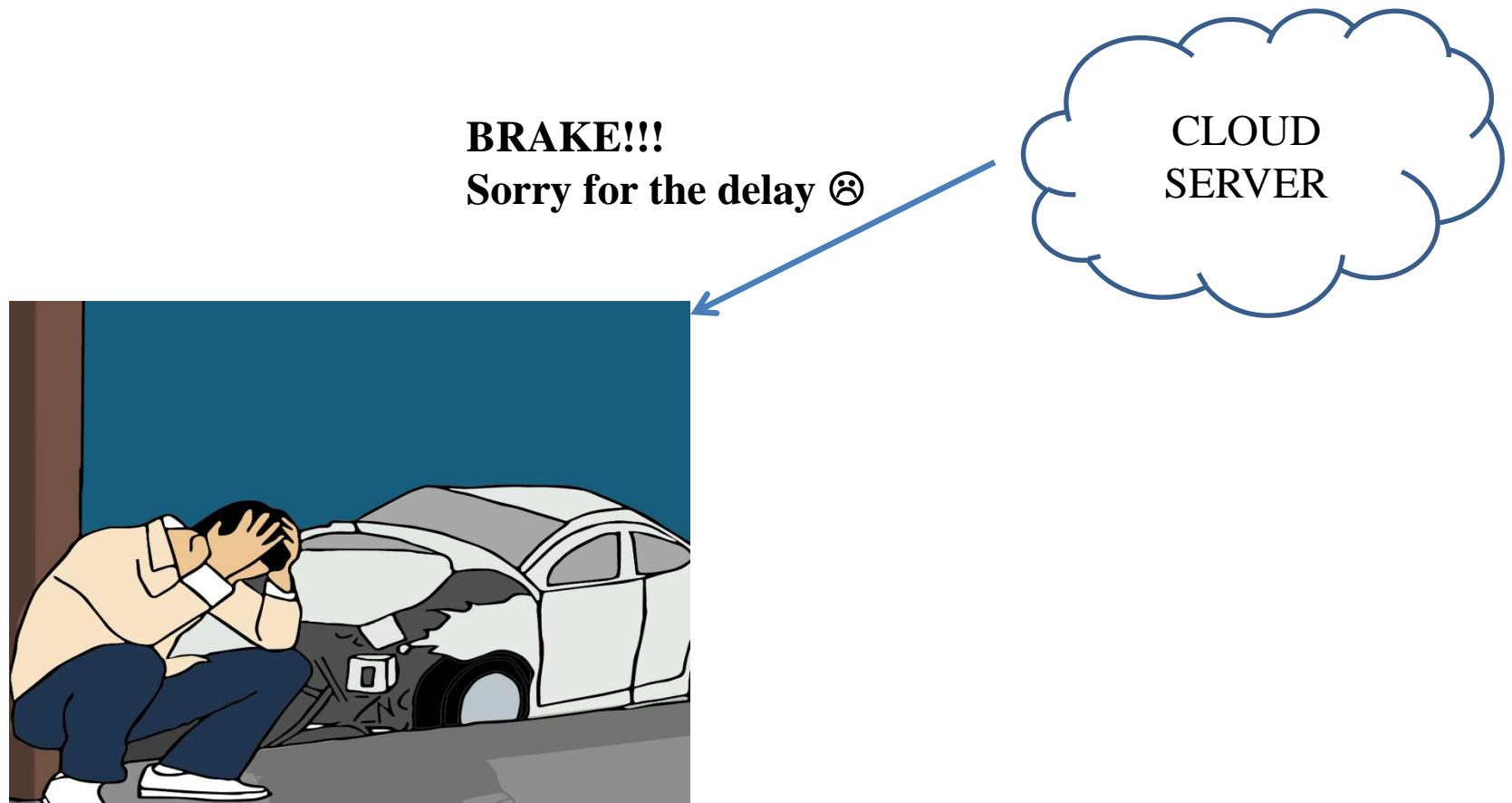


Is Cloud Computing the Best Choice Always?



Consider the scenario of driverless cars

Is Cloud Computing the Best Choice Always?



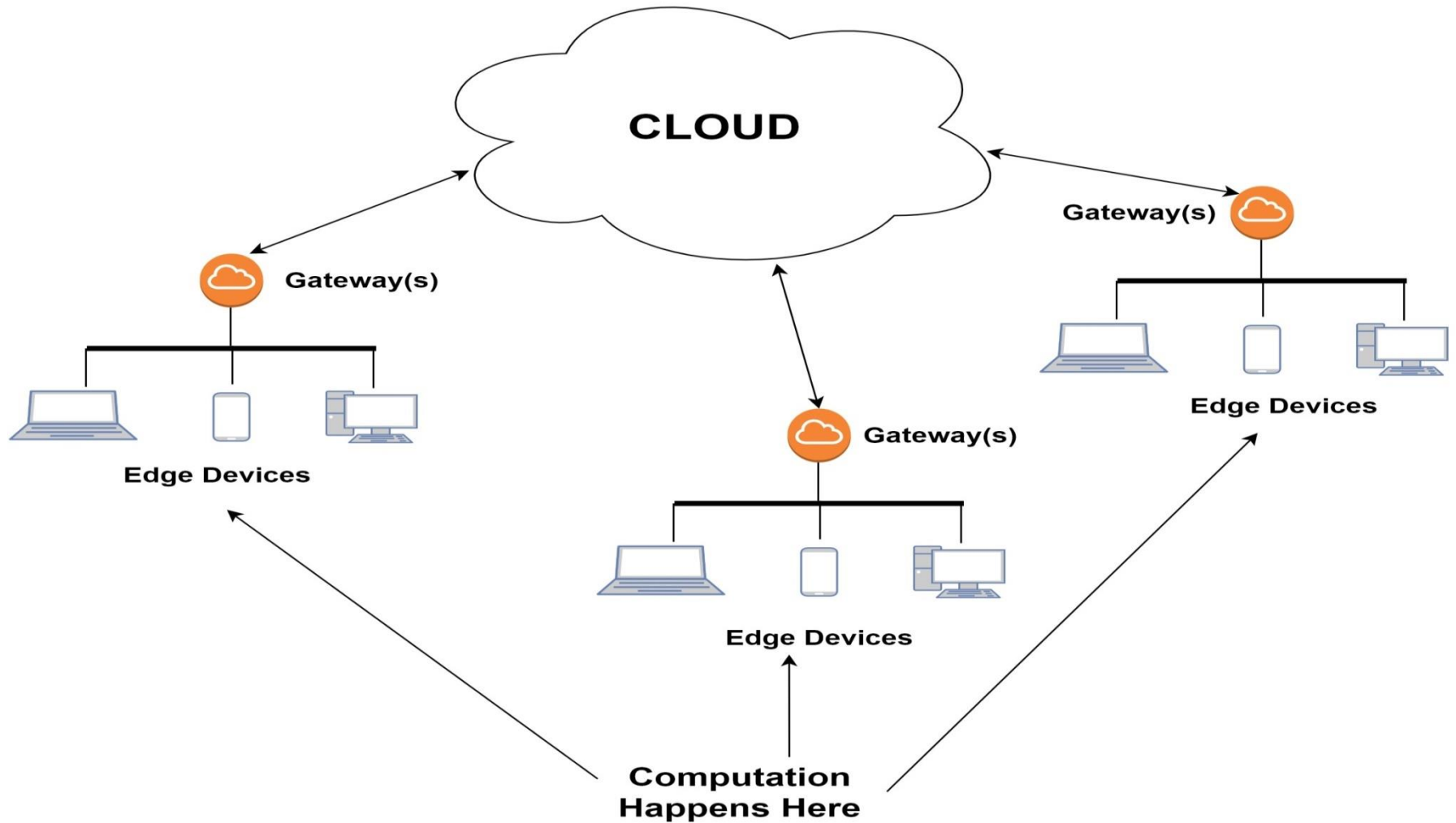
Consider the scenario of driverless cars

Problem: Self Driving Cars



- In real time systems, would there be enough time for data to be processed by a cloud server?
- In such cases, wouldn't it be better if data was processed closer to the source?

Edge Computing



Features of Edge Computing

- **Advantages**

- Low Latency
- Faster Decisions
- Privacy

- **Disadvantages**

- Edge devices will have lower computational power
- Lack of a global (or network level) view

Automated Museum Tour Guides

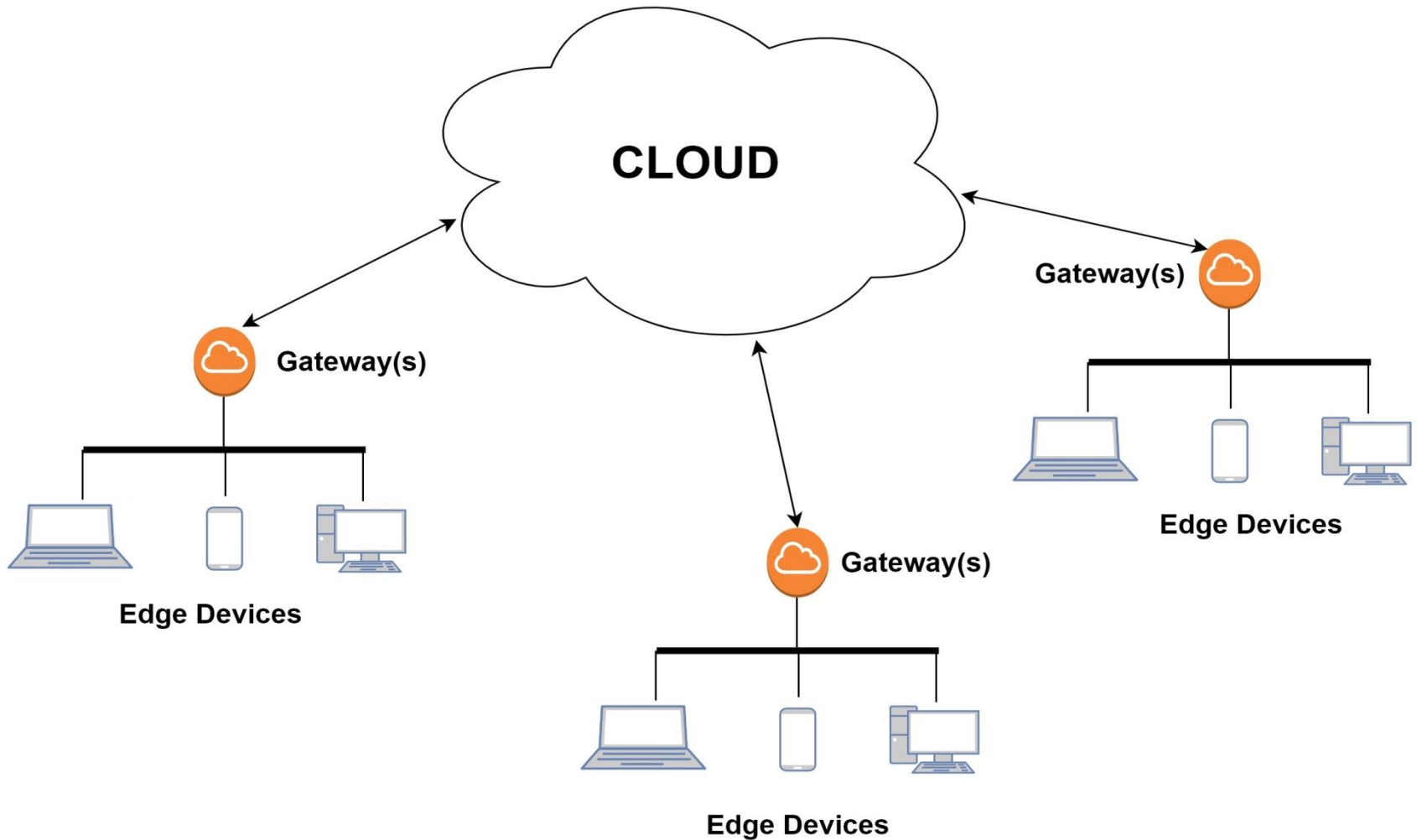


More and more museums are now relying on automated robots to replace museum tour guides. For example, the Smithsonian Museum launched a robot named “Pepper” in 2018

An Issue with Edge Computing

- Consider the case of the automated museum tour guides:
 - All information that the robot needs is localized – need not use the “cloud” realistically
 - Interaction with tourists – need for local processing power
 - What if some exhibits are closed? Or the order changes?
 - There is a need for a broader, museum-level view for efficient functioning

Fog Computing



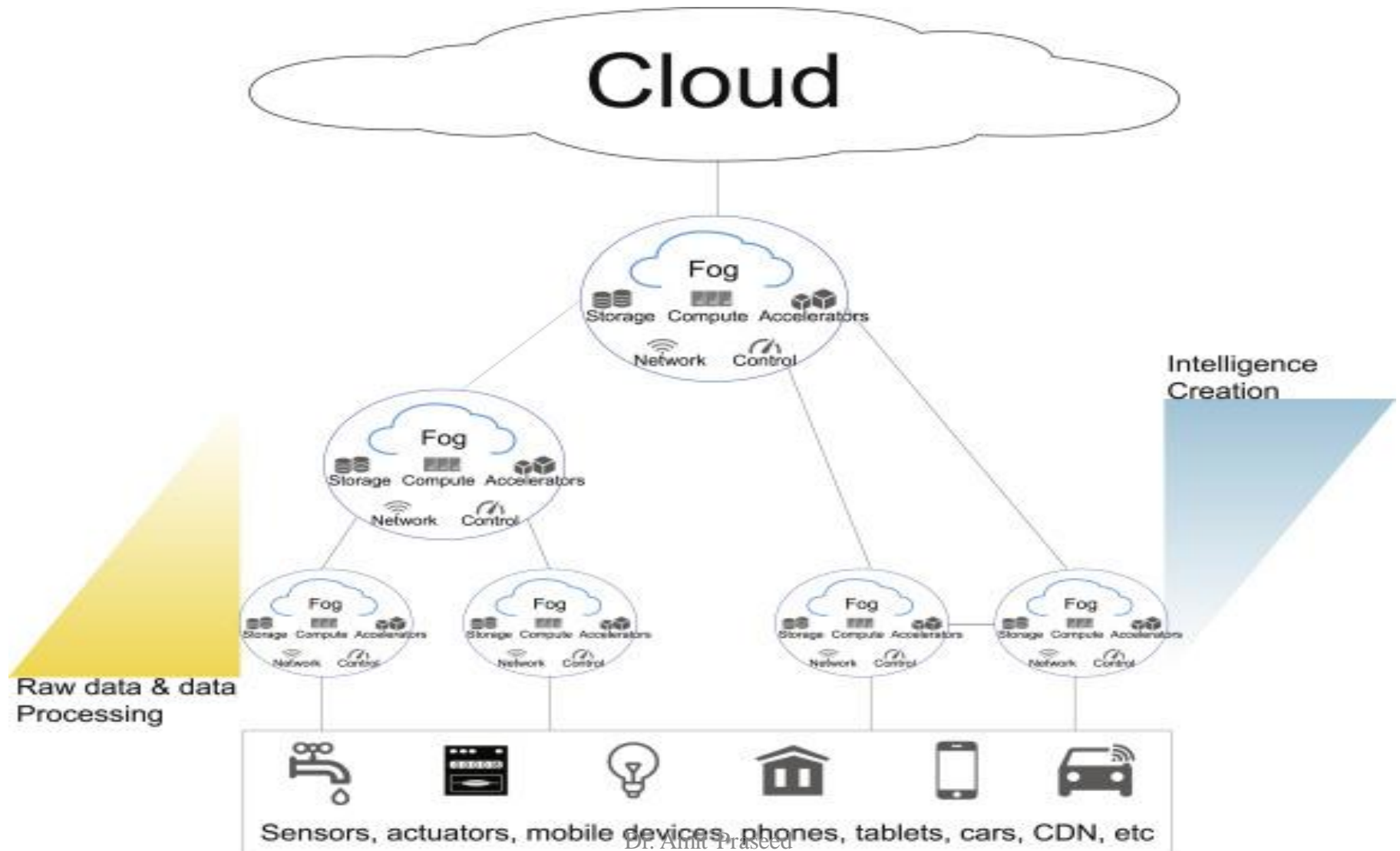
Fog Computing

- Move computation to a location between the nodes and the cloud
- Mobile users have predictable service demands subject to their locations
- Fog Servers can periodically connect with cloud servers and cache location specific information
- Information from edge devices can be processed by fog servers to provide an interactive experience

Features of Fog Computing

- Contextual location awareness + low latency
- Geographical distribution
- Heterogeneity
- Interoperability and federation
- Real-time interactions
- Scalability and agility of federated, fog-node clusters

Hierarchy of Edge, Fog and Cloud



A Note on Mist Computing

- **Mist computing** is a lightweight and rudimentary form of fog computing that resides directly within the network fabric at the edge of the network fabric
- Uses microcomputers and microcontrollers to feed into fog computing nodes and cloud computing services.

[Widely varying definitions of fog, mist and edge computing can be seen in literature. The definitions used here are adopted from NIST specifications]

A Note on Dew Computing

- What happens to cloud computing when you lose network access?
- Dew Computing is a framework wherein a version of the cloud architecture is replicated on a local system – immune to loss of connectivity
- Applicable to systems with direct human interaction, such as laptops, desktops and mobile devices
- Eg: Dropbox