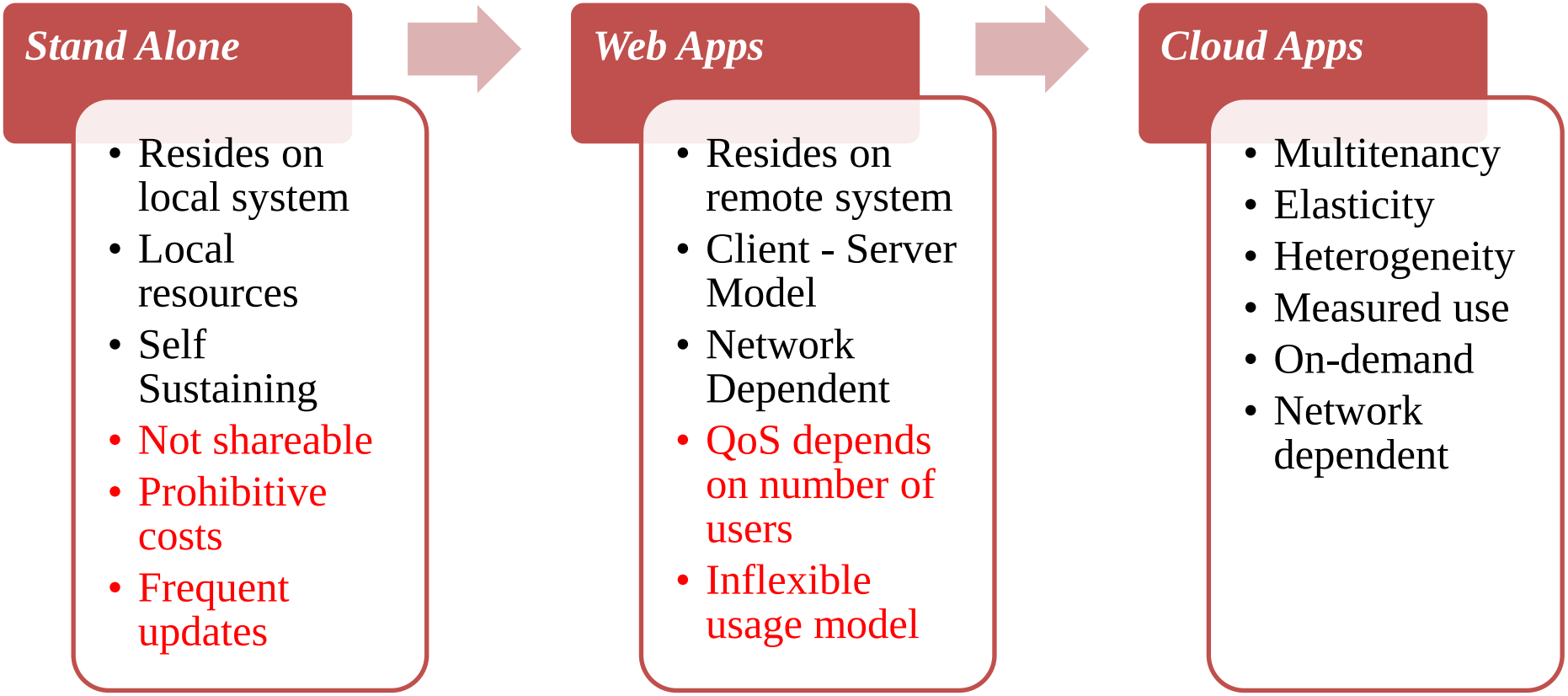
A Brief Overview of Cloud, Edge and Fog Computing

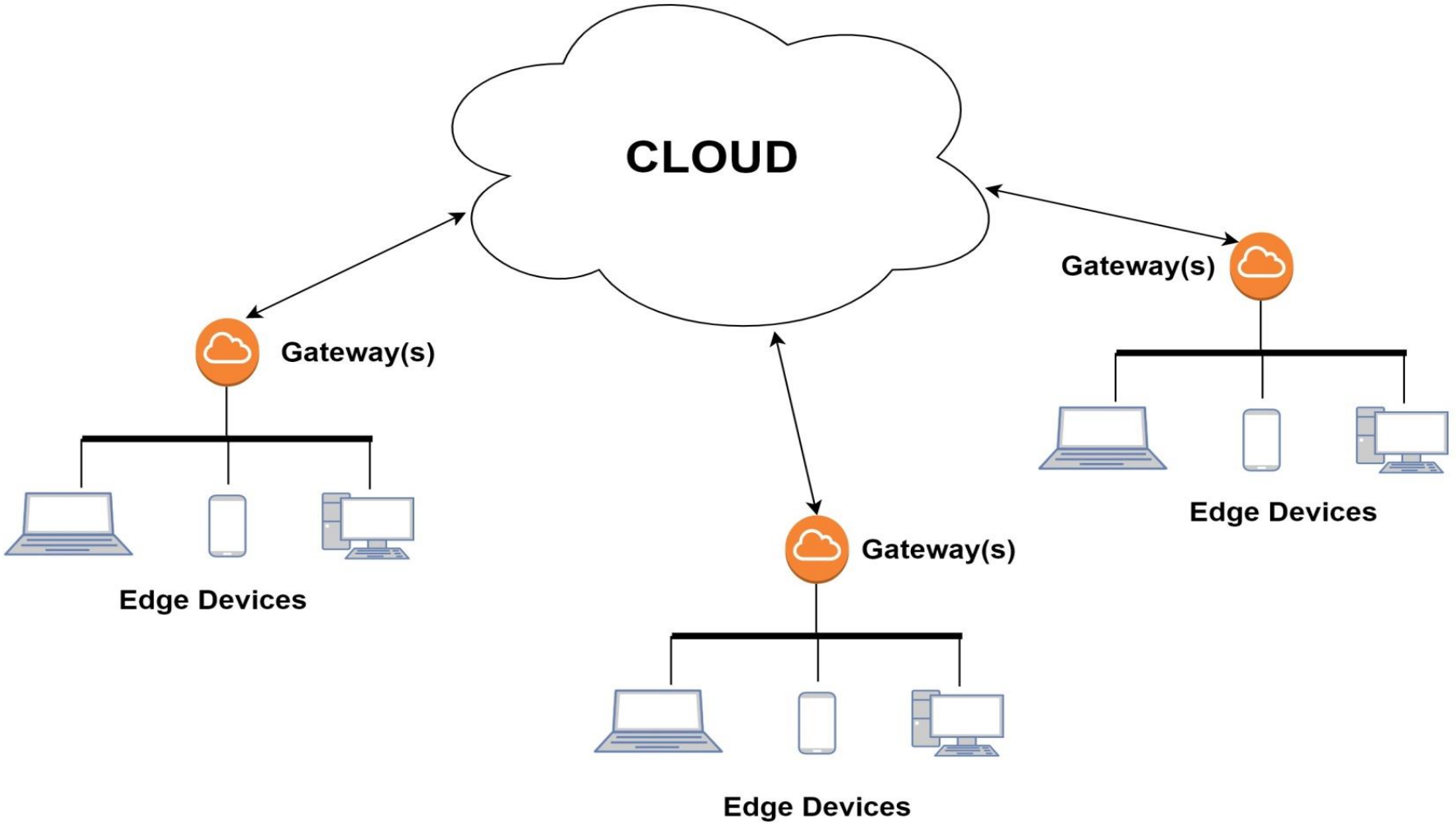
Cloud Computing

- Cloud Computing ≈ 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

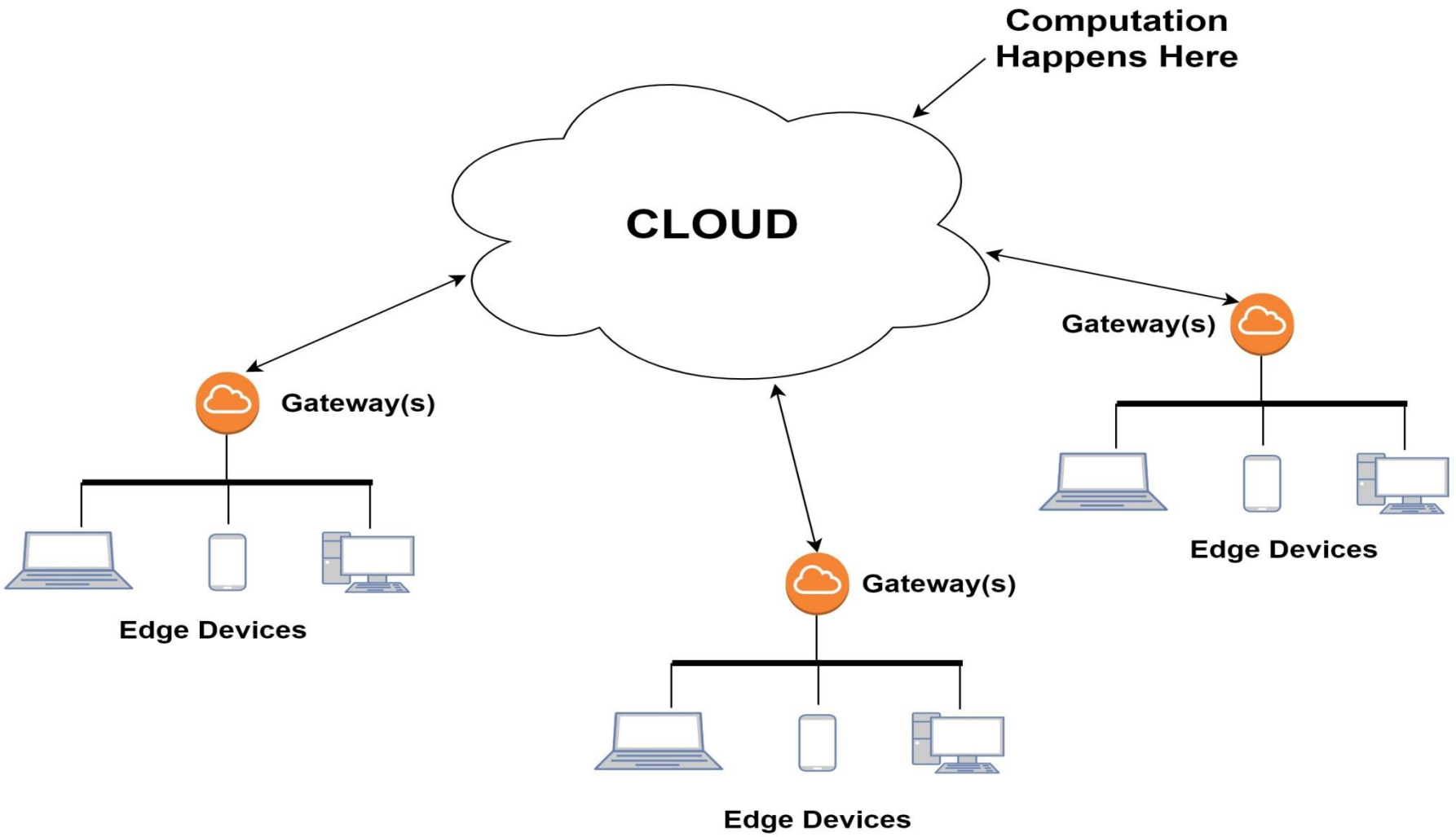
Evolution of Applications



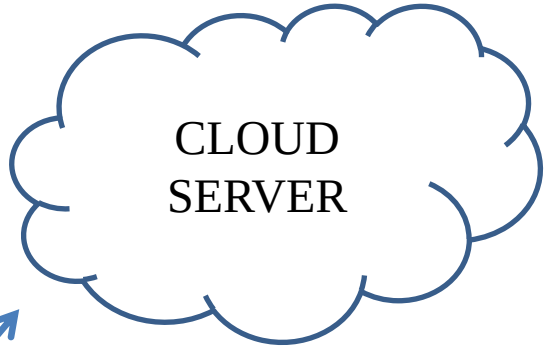
A Simple Architecture



Cloud Computing



Is Cloud Computing the Best Choice Always?

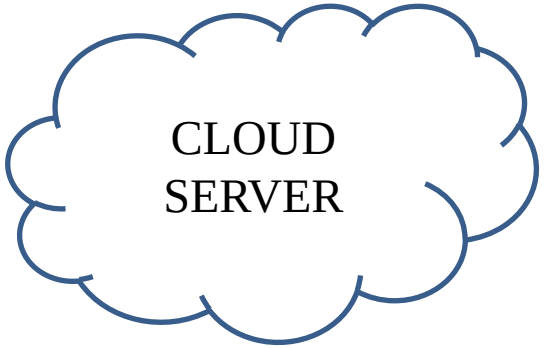


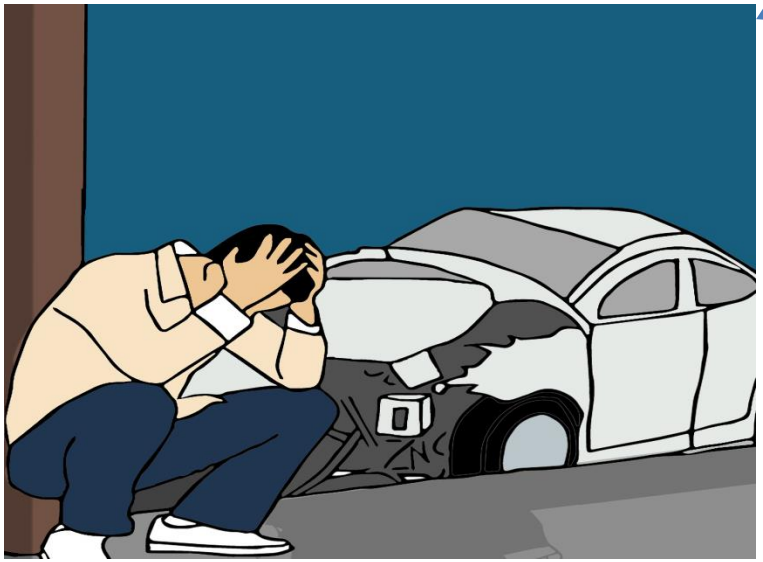
The car in front of me is braking! What should I do?

Consider the scenario of driverless cars

Is Cloud Computing the Best Choice Always?

BRAKE!!!
Sorry for the delay ☹



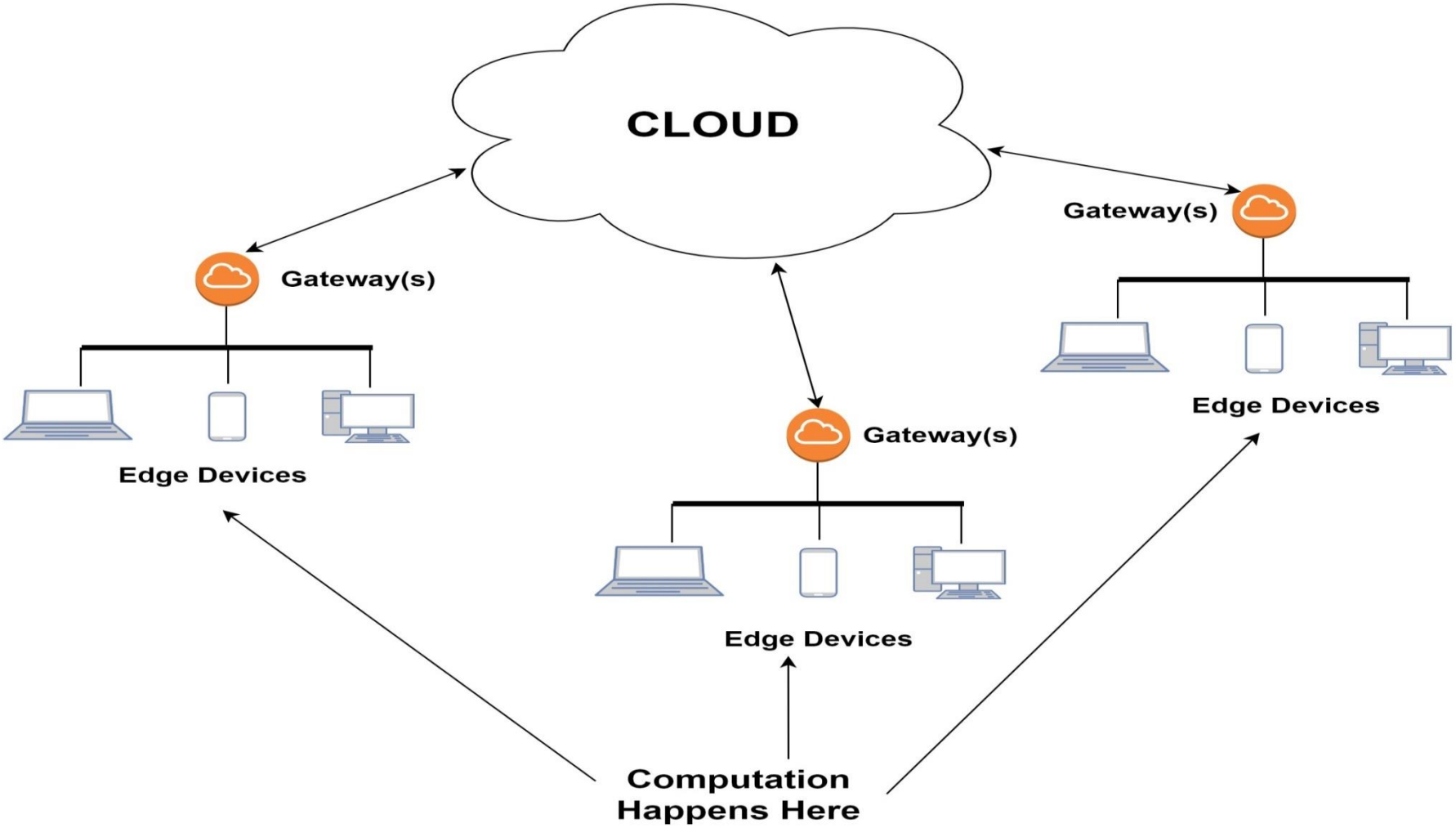


Consider the scenario of driverless cars

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

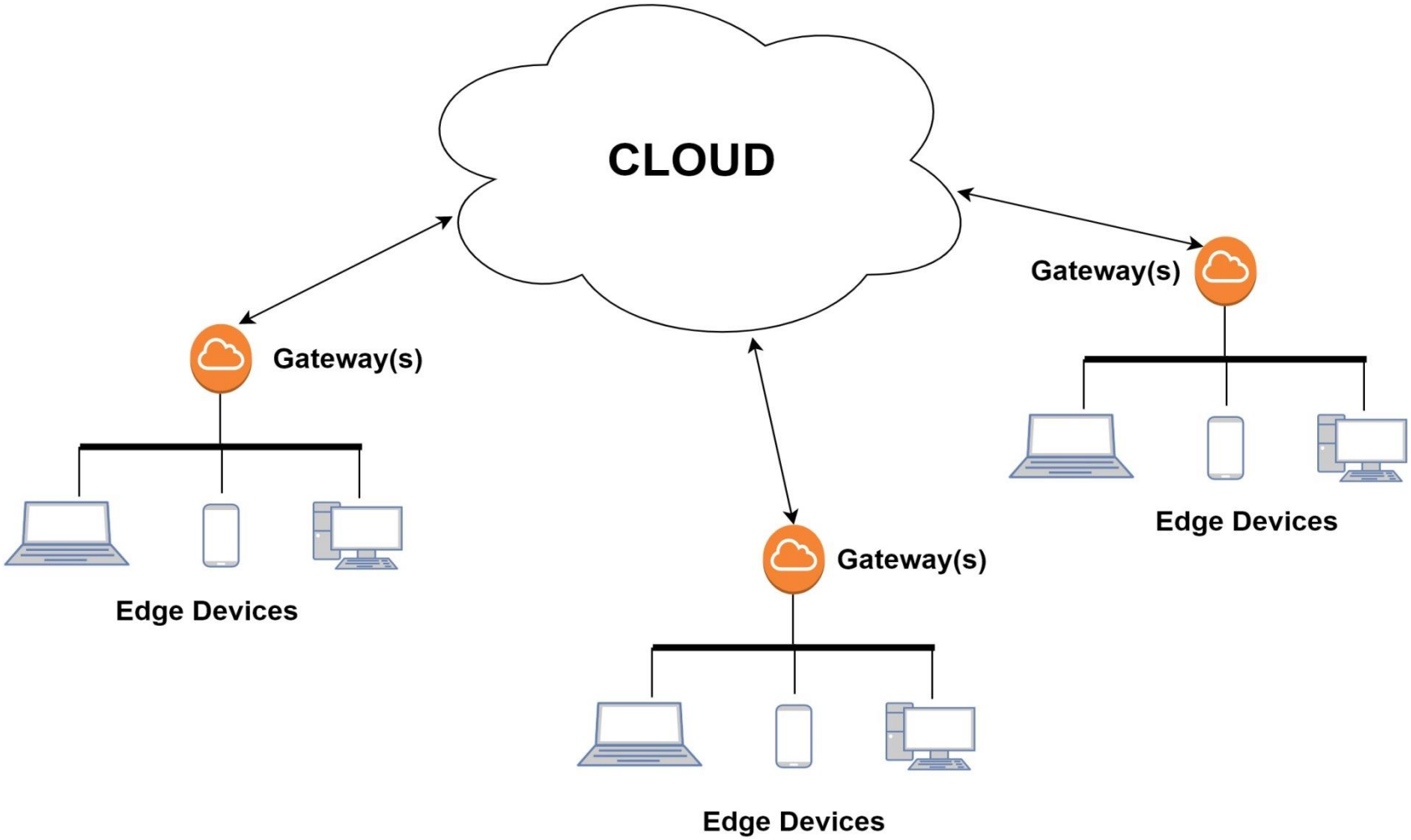
Automated Museum Tour Guides

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



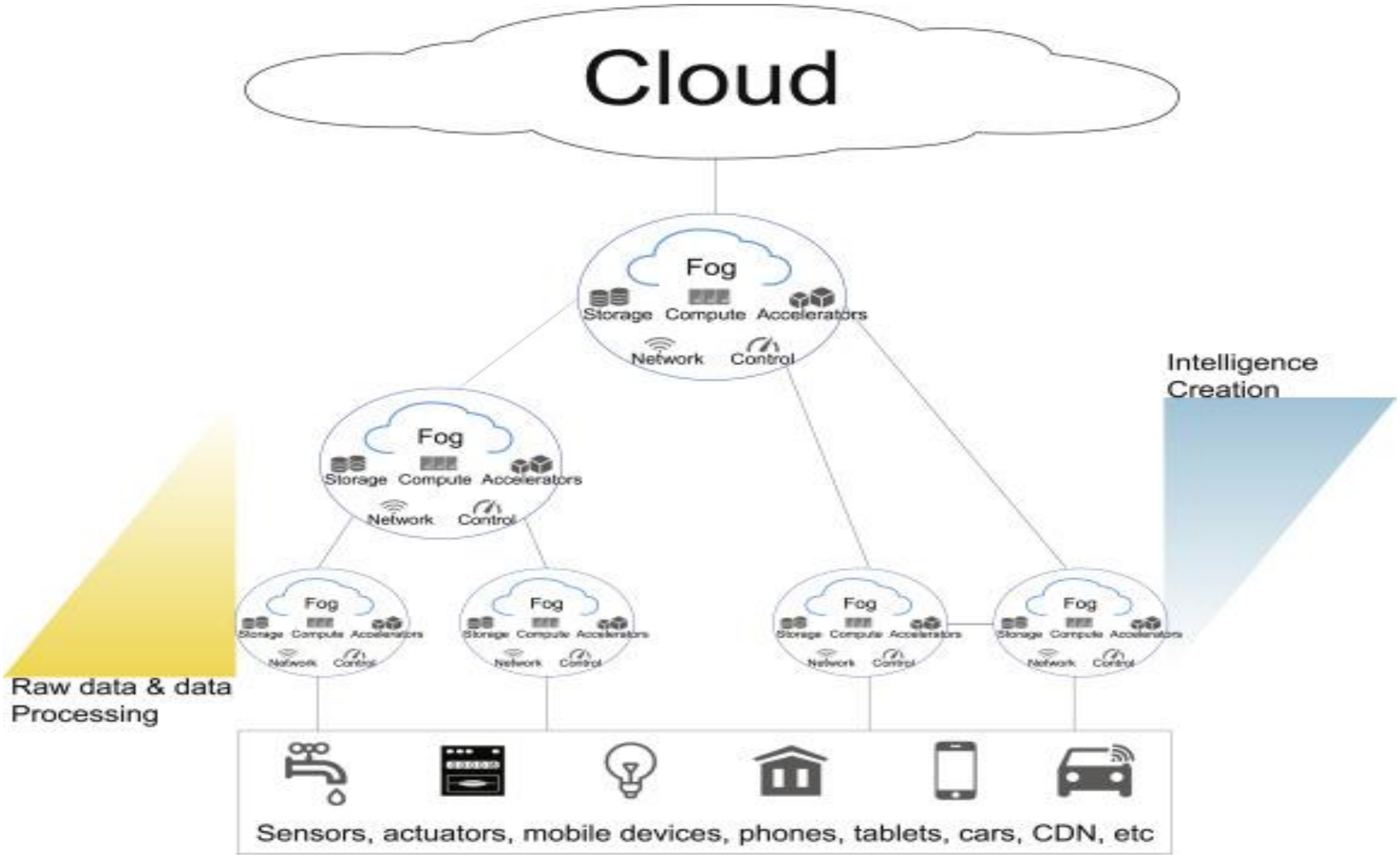
Fog Computing

- 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