EDGE AND FOG COMPUTING

SAMITHA SOMATHILAKA

Department of Computing & Mathematics, WIT

HOW TO MAKE IOT ENVIRONMENTS INTELLIGENT?

- Any IoT environment comprises scores of networked, resource-constrained and intensive, and embedded systems (digital objects, connected devices, and virtualized / containerized infra). IoT artifacts are not individually intelligent. The charter is to make them intelligent individually as well as collectively

- The Internet of Agents (IoA) for empowering each digital object to be adaptive, articulate, reactive, and cognitive through mapping an software agent for each of the participating digital objects

- The concept of Digital Twin / virtual object is also maturing and stabilizing

HOW TO MAKE IOT ENVIRONMENTS INTELLIGENT?

- The proven and potential IoT data analytics at edge and cloud levels is the prominent and dominant aspect for knowledge discovery and dissemination

- The application of artificial intelligence (AI) technologies (machine and deep learning algorithms, computer vision, natural language processing, video processing, etc.) leads to the realization of smarter systems, services and solutions

DATA ANALYTICS TOWARDS SOPHISTICATED IOT ENVIRONMENTS

WHY IOT DATA ANALYTICS?

- Establishes a variety of smarter environments (smarter homes, hotels, hospitals, etc.)

- Uncovers timely and actionable insights for machines and men

- Enables the realization of smart objects, devices, networks and environments,

- Leads to the production of pioneering and people-centric applications and services

- Helps to come out with precise predictions and prescriptions,

WHY IOT DATA ANALYTICS ON CLOUDS?

- WAN Optimization Technologies - There are WAN optimization products for quickly transmitting large quantities of data over the Internet infrastructure

- Anytime, anywhere, any network and any device information and service access is being activated through cloud-based deployment and delivery

- There are products and platforms for seamless interoperability among geographically distributed cloud environments. There are collaborative efforts towards federated clouds and the Intercloud.

- Sensor/Device-to-Cloud Integration Frameworks are available to transmit ground-level data to cloud storages and processing.

WHY CLOUD IS NOT SUITABLE FOR CERTAIN IOT DATA ANALYTICS?

- Cloud is centralized, federated, consolidated, shared, automated, compartmentalized, and programmable Infrastructure

- Latency and Response time is often a critical part, especially when you deal with human life or emergency procedure.

- Bandwidth Cost and Capacity is very often underestimated. If you want to use N smart devices requiring each one to communicate M bytes of data then you can quickly reach huge bandwidth requirements reaching Mbit/s or even Gbit/s at a gateway level.

- Security and Privacy - transmitting device data over any open and public network is risky

WHY CLOUD IS NOT SUITABLE FOR CERTAIN IOT DATA ANALYTICS?

- Power consumption - Cloud computing is energy-hungry and that it is a concern for a low-carbon economy.

- Data obesity – In a traditional cloud approach, huge amount of untreated data are pumped blindly into the cloud that it is supposed to have magical algorithms written by data scientists. This vision is really not the best efficient and it is much more wise to pre-treat data at a local level and to limit the cloud processes at the strict minimum.

- Offline usages versus only-online usages – Pure cloud services do not allow offline usages. It is a major shortcoming since smart cities and industry 4.0 applications require a dual offline/online paradigm.

WHY IOT DATA ANALYTICS HAS TO BE REAL-TIME AND AT EDGE?

- Volume and Velocity – ingesting, processing and storing such huge amounts of data which is gathered in real-time.

- Security – devices can be located in sensitive environments, control vital systems or send private data. With the number of devices and the fact they are not humans who can simply type a password, new paradigms and strict authentication and access control must be implemented.

- Bandwidth – if devices constantly send the sensor and video data, it will hog the internet and cost a fortune. Therefore edge analytics approaches must be deployed to achieve scale and lower response time.

THE DEVICE CATEGORIES

Higher Categories

Cloud (Internet) — Category 6

High-end Computational Devices — Category 5

Low-end Computational Devices — Category 4

Sink Nodes (e.g. Raspberry Pi) — Category 3

Sensor Nodes/Networks (SN) High-end (e.g. Meshlium) — Category 2

Low-end (e.g. Waspmote) — Category 1

Lower Categories

THE DEVICE CATEGORIES