FOG Computing

A New Paradigm to Cloud Computing

Fog computing was introduced to meet objectives like improving efficiency and trim the amount of data to be transmitted for processing, analysis and storage, place the data close to the end user and finally provide security and compliance to the data transmission over cloud. Cloud is located up in the sky, somewhere distant and remote, fog is close to the ground where operations are executed.

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Cloud Computing has been one of the hottest buzzwords over the last few years and using it one can access all information over the internet without having any detailed knowledge of the infrastructure used to enable it. Cloud Computing has transformed the organisations by providing much flexibility, ensured security of operations and data, giving capacity to compete with larger organisation, no maintenance/update fees for hardware and servers and providing facility to access it from anywhere in the world with any device(computer or mobile) any time.

Riding on the success of Cloud Computing, IoT (Internet of Things) owes its explosive growth to the connection of physical things and operation technologies (OT) to analytics and machine learning applications, which can help collect insights from device-generated data and enable devices to make "smart" decisions without human intervention. Currently, such resources are mostly being provided by cloud service providers, where the computation and storage capacity exists.

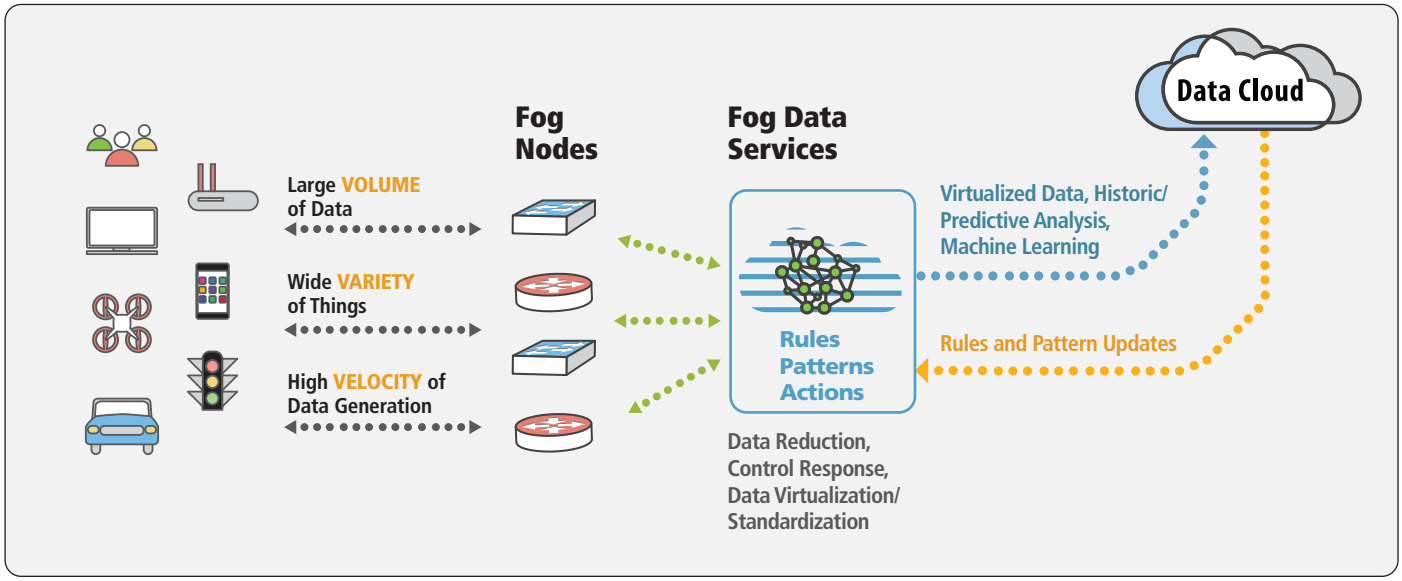
However, despite its power, the cloud model is not applicable to environments where operations are time-critical or internet connectivity is poor. This is especially true in scenarios such as telemedicine and patient care, where milliseconds can have fatal consequences. The same can be said about vehicle to vehicle communications in next generation cars, where the prevention of collisions and accidents can't afford the latency caused by the roundtrip to the cloud server. The cloud paradigm is like having your brain command your limbs from miles away — it won't help you where you need quick reflexes. Moreover, having every device connected to the cloud and sending raw data over the internet can have privacy, security and legal implications, especially when dealing with sensitive data that is subject to separate regulations in different countries.

Storage and computing power increases according to Moore's law that is they double about every 18 months but as per rough estimates bandwidth increases only 40% per year, there will be more data wanting being sent to the cloud then there will be bandwidth. This issue has given rise to evolution of Fog Computing.

FOG COMPUTING

Fog computing, also known as fogging, is a disseminated computing infrastructure in which application and its services are handled either at the network edge or in a remote data centre- cloud. Fog computing was introduced to meet objectives like improving efficiency and trim the amount of data to be transmitted for processing, analysis and storage, place the data close to the end user and finally provide security and compliance to the data transmission over cloud. Cloud is located up in the sky, somewhere distant and remote, fog is close to the ground where operations are executed.

In fog computing, much of the processing takes place in a local device. This type of computing creates a virtual platform that provides networking, compute and storage services and functions in the middle of cloud data centres and end devices. Since most of the information will be processed by the local end user, only tailored amount of summarized information can be transmitted up to the cloud and also down from the cloud to the local operation. This reduced the burden of cloud bandwidth as 80% of data is needed within the local context. This further makes fog computing a practical solution to latency, delivering high



Fog Computing- flow diagram

quality multimedia application process data with low delay and packet loss.

Fog computing has its own supporting body, the OpenFog Consortium, founded in November 2015, whose mission is to drive industry and academic leadership in fog computing architecture. The consortium offers reference architectures, guides, samples and SDKs that help developers and IT teams understand the true value of fog computing. Mainstream hardware manufacturers such as Cisco, Dell and Intel are teaming up with IoT analytics and machine learning vendors to deliver IoT gateways and routers that can support fog computing.

USE CASES OF FOG COMPUTING

The concept of Fog computing has found its live use in terms of its applicability in every domain where the data processing is required to be done in real time to take quick machine based solution. A US based renewable energy company Envision has been able to obtain a 15 percent productivity improvement from the vast network of wind turbines it operates. The company is processing as much as 20 terabytes of data at a time, generated by 3 million sensors installed on the 20,000 turbines it manages. Moving computation to the edge has enabled Envision to cut down data analysis time from 10 minutes to mere seconds, providing them with actionable insights and significant business benefits. Another IoT company Plat One is using Fog Computing to improve data processing for the more than 1 million sensors it manages. The company uses the ParStream platform to publish real-time sensor measurements for hundreds of thousands of devices, including smart lighting and parking, port and transportation management and a network of 50,000 coffee machines.

Fog computing also has several use cases in smart cities where in it is possible to enable traffic lights to integrate with connected vehicles, hopefully creating a future in which people won't be waiting in their cars at empty intersections for no reason.

WILL FOG COMPUTING REPLACE CLOUD?

Fog computing improves efficiency and reduces the amount of data that needs to be sent to the cloud for processing. But it's here to complement the cloud, not replace it.

The cloud will continue to have a pertinent role in the IoT cycle. In fact, with fog computing shouldering the burden of short-term analytics at the edge, cloud resources will be freed to take on the heavier tasks, especially where the analysis of historical data and large datasets is concerned. Insights obtained by the cloud can help update and tweak policies and functionality at the fog layer. And there are still many cases where the centralized, highly efficient computing infrastructure of the cloud will outperform decentralized systems in performance, scalability and costs. This includes environments where data needs to be analysed from largely dispersed sources. It is the combination of fog and cloud computing that will accelerate the adoption of IoT, especially for the enterprise.

FUTURE OF FOG COMPUTING

The current trend shows that fog computing will continue to grow in usage and importance as the Internet of Things expands and conquers new grounds. With inexpensive, low-power processing and storage becoming more available, one can expect computation to move even closer to the edge and become ingrained in the same devices that are generating the data, creating even greater possibilities for inter-device intelligence and interactions.

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