A study on Fog Computing and IoTs

Divya Gautam
Department of CSE
Amity University, Gwalior, Madhya Pradesh

ABSTRACT
Fog computing extends the Cloud Computing model to the edge of the network, hence emerging a new technology with same model. Fog has low latency along with location detection technology. Fog computing plays a vital role in wireless access. It also provides heterogeneity. This paper comprises of the number of benefits achieved by using Fog Computing over cloud computing for IoT(Internet of Things) services and its applications viz smart grid, smart cities, wireless sensor networks.

Keywords: Fog Computing, Cloud Computing, IoT, WSAN, Software Defined Networks, Real Time Systems, Analytics.

1. INTRODUCTION

The “pay-as-you-go” Cloud Computing model is an e fficient alternative to owning and managing private data centers (DCs) for customers facing Web applications and batch processing. Several factors contribute to the economy of scale of mega DCs: higher predictability of massive aggregation, which allows higher utilization without degrading performance; convenient location that takes advantage of inexpensive power; and lower OPEX achieved through the deployment of homogeneous compute, storage, and networking components. Cloud computing frees the enterprise and the end user from the specification of many details. This bliss becomes a problem for latency-sensitive applications, which requirenodes in the vicinity to meet their delay requirements. An emerging wave of Internet deployments, most notably the Internet of Things (IoTs), requires mobility support and geo-distribution in addition to location awareness and low latency. We argue that a new platform is needed to meet these requirements; a platform we call Fog Computing [1], or, briefly, Fog, simply because the fog is a cloud close to the ground. We also claim that rather than cannibalizing Cloud Computing, Fog Computing enables a new breed of applications and services, and that there is a fruitful interplay between the Cloud and the Fog, particularly when it comes to data management and analytics. This paper is organized as follows. In the second section we introduce the Fog Computing paradigm, delineate its characteristics, and those of the platform that supports Fog services. The following section takes a close look at a few

key applications and services of interest that substantiate our argument in favor of the Fog as the natural component of the platform required for the support for the Internet of Things. In the fourth section we examine analytics and big data in the context of applications of interest. The recognition that some of these applications demand real-time analytics as well as long-term global data mining illustrates the interplay and complementary roles of Fog and Cloud. We conclude with comments about the state of the Fog Computing and discussion of future work.

2. THE FOG COMPUTING PLATFORM

Fog Computing is a highly virtualized platform that provides compute, storage, and networking services between end devices and traditional Cloud Computing Data Centers, typically, but not exclusively located at the edge of network. Figure 1 presents the idealized information and computing architecture supporting the future IoT applications, and illustrates the role of Fog Computing. Compute, storage, and networking resources are the building blocks of both the Cloud and the Fog . “Edge of the Network”, however, implies a number of characteristics that make the Fog a non-trivial extension of the Cloud. Let us list them with pointers to motivating examples.

1. Edge location, location awareness, and low latency. The origins of the Fog can be traced to early proposals to support endpoints with rich services at the edge of the network, including applications with low latency requirements (e.g. gaming, video streaming, augmented reality).

2. Geographical distribution. In sharp contrast to the more centralized Cloud, the services and applications targeted by the Fog demand widely distributed deployments. The Fog, for instance, will play an active role in delivering high quality streaming to moving vehicles, through proxies and access points positioned along highways and tracks.

3. Large-scale sensor networks to monitor the environment and the Smart Grid are other examples of inherently distributed systems, requiring distributed computing and storage resources.
4. Very large number of nodes, as a consequence of the wide geo-distribution, as evidenced in sensor networks in general, and the Smart Grid in particular.

5. Support for mobility. It is essential for many Fog applications to communicate directly with mobile devices, and therefore support mobility techniques, such as the LISP protocol 1, that decouple host identity from location identity, and require a distributed directory system.

6. Real-time interactions. Important Fog applications involve real-time interactions rather than batch processing.

7. Predominance of wireless access.

8. Heterogeneity. Fog nodes come in different form factors, and will be deployed in a wide variety of environments.

9. Interoperability and federation. Seamless support of certain services (streaming is a good example) requires the cooperation of different providers. Hence, Fog components must be able to interoperate, and services must be federated across domains.

10. Support for on-line analytic and interplay with the Cloud. The Fog is positioned to play a significant role in the ingestion and processing of the data close to the source.

11. It is not easy to determine at this early stage how the different Fog Computing players will align. Based on the nature of the major services and applications, however, we anticipate that:
Subscriber models will play a major role in the Fog (Infotainment in Connected Vehicle, Smart Grid, Smart Cities, Health Care, etc.)

12. The Fog will give rise to new forms of competition and cooperation between providers angling to provide global services. New incumbents will enter the arena as users and providers, including utilities, car manufacturers, public administrations and transportation agencies.

3. FOG COMPUTING AND THE INTERNET OF THINGS

The Internet of Things (IoT) is driving business transformation by connecting everyday objects and devices to one another and to cloud-hosted services. Current deployment models emphasize mandatory cloud connectivity; however, this is not feasible in many real-world situations. These are two of the primary issues with connecting edge devices to the cloud for all services:
Connected devices are creating data at an exponentially growing rate, which will drive performance and network congestion challenges at the edge of infrastructure. There are performance, security, bandwidth, reliability, and many other concerns that make cloud-only solutions impractical for many use cases.

Unfettered cloud-only architectural approaches cannot sustain the projected data velocity and volume requirements of the IoT. To sustain IoT momentum, the OpenFog Consortium is defining an architecture to address infrastructure and connectivity challenges by emphasizing information processing and intelligence at the logical edge.

While the cloud itself may play a vital role in many deployments, fog computing represents a shift from traditional closed systems and a reliance on cloud-only focused models. Fog computing is complementary to, and an extension of, traditional cloud-based models.

The fog computing model moves computation from the cloud closer the edge, and potentially right up to the IoT sensors and actuators. The computational, networking, storage and acceleration elements of this new model are known as fog nodes. These are not completely fixed to the physical edge, but should be seen as fluid system of connectivity.

CONCLUSIONS

We have outlined the vision and defined key characteristics of Fog Computing, a platform to deliver a rich portfolio of new services and applications at the edge of the network. The motivating examples peppered throughout the discussion range from conceptual visions to existing point solution prototypes. We envision the Fog to be a unifying platform, rich enough to deliver this new breed of emerging services and enable the development of new applications. We welcome collaborations on the substantial body of work ahead:

1) Architecture of this massive infrastructure of compute, storage, and networking devices.
2) Orchestration and resource management of the Fog nodes;
3) Innovative services and applications to be supported by the Fog.

REFERENCES:-

[1] F. Bonomi. Connected vehicles, the internet of things, and fog computing. VANET 2011, 2011.

[2] M. Bowman, S. K. Debray, and L. L. Peterson. Reasoning about naming systems. ACM Trans. Program. Lang. Syst., 15(5):795–825, November 1993.

[3] G. Forman. An extensive empirical study of feature selection metrics for text classification. J. Mach. Learn. Res., 3:1289–1305, Mar. 2003.

[4] B. Fr¨ohlich and J. Plate. The cubic mouse: a new device for three-dimensional input. In Proceedings of the SIGCHI conference on Human factors in computing systems, CHI '00, pages 526–531, New York, NY, USA, 2000. ACM.

[5] M. J. Sannella. Constraint satisfaction and debugging for interactive user interfaces. 2003.

[6] P. Tavel. Modeling and simulation design. 2007.