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The Age of "Intelligent" Networks

Role of analytics and Telecom in IoT

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In 1980s to late 1990s when people imagined how technology would shape the 21st century human life-style, their thoughts ranged from flying cars to voice-controlled devices. Although many of these are still distant dreams in our reality, Telecom and Data analytics have been pivotal in the evolution of several innovations. This article briefly explains about the interdependency of Telecom, Data Analytics and the role they'll play for IoT development in Industrial Revolution 4.0. Before delving into the main story, let's discuss the past development and recent milestones.

Sixty Starlink satellites were successfully launched by SpaceX on 23rd May,2019 as a part of their Satellite internet project. CEO Elon Musk revealed that using Starlink network, even the remotest parts of the world can enjoy high data speeds without the necessity of any optical fiber connection.

The "Digital India" campaign launched by the Government of India on 1st July,2015 has given a great impetus for internet usage in India. During the same period, Reliance-Jio entered and disrupted the entire Telecom industry, causing severe discounting in data prices. As Jio offered free data, internet usage deeply penetrated to the rural and remote areas of India. In addition, Tech-giants like Google offered free Wi-Fi (railwire) in many public places. Facebook also initiated "internet.org" on similar lines. This all together drove the single agenda of making Internet a part of everyday human life, thereby increasing the internet user base considerably. This lays the path for the widespread deployment of mobile and IoT devices thereby increasing data collection. This "Big Data" will be used for the development of several analytics models worldwide.

The Rise of Telecom

Telecommunication or Telecom has evolved from using pigeons to the invention of wired systems (Landline, Broadband) and wireless communication (Mobile). The journey of wireless communication has always been in-accordance to the needs of the users. The next few paragraphs discuss briefly about evolution of Telecom over the years.

Terminology Alert! (see glossary)

Initially, "1G" started with Analog Modulated signals being transmitted from mobiles. However, there were issues of poor voice quality and limited capacity. Then came the widely accepted Global System for Mobile communication or GSM, the "2G" which used FDD, FDMA and TDMA together for the mobile to communicate with the Core Network. Only call & SMS options were available with GSM. In order to cater the need to use internet in mobile devices, GPRS was launched with the limitation of the user not being able to use data during calls. With the growing demand for high-speed data and improved capacity standards, the WCDMA and FDD technique was used in radio networks of 3G/UMTS, which allows the user to access call and data services simultaneously with increased data speed.

With growing consumption of data and need for better performance, 4G-LTE systems were developed, which use OFDMA

in Downlink, SC-FDMA in Uplink along with FDD/ TDD in radio network. The LTE has a specification of throughput of more than 100Mbps and a latency of less than 10ms attained under ideal conditions. With voice call not being intrinsic in 4G, the CSFB feature enabled the user to switch to 2G/3G technology in order to make or receive call. To have good data speed even with voice call in progress, IMS was introduced as the much needed addition to 4G, the "VoLTE", where a shared channel is allotted for voice call unlike 2G/3G with HD voice transmission at ~64 Kbps.

IMS is not a new development. It existed much earlier theoretically as a part of 3G architectures. But it was not implemented due to heavy costs and limited impact. IMS was implemented for making VoLTE calls feasible and thereby finally meeting user needs. Throughout the journey, we observe that telecom industry has always moved in ways that best satisfy the user needs and expectations.

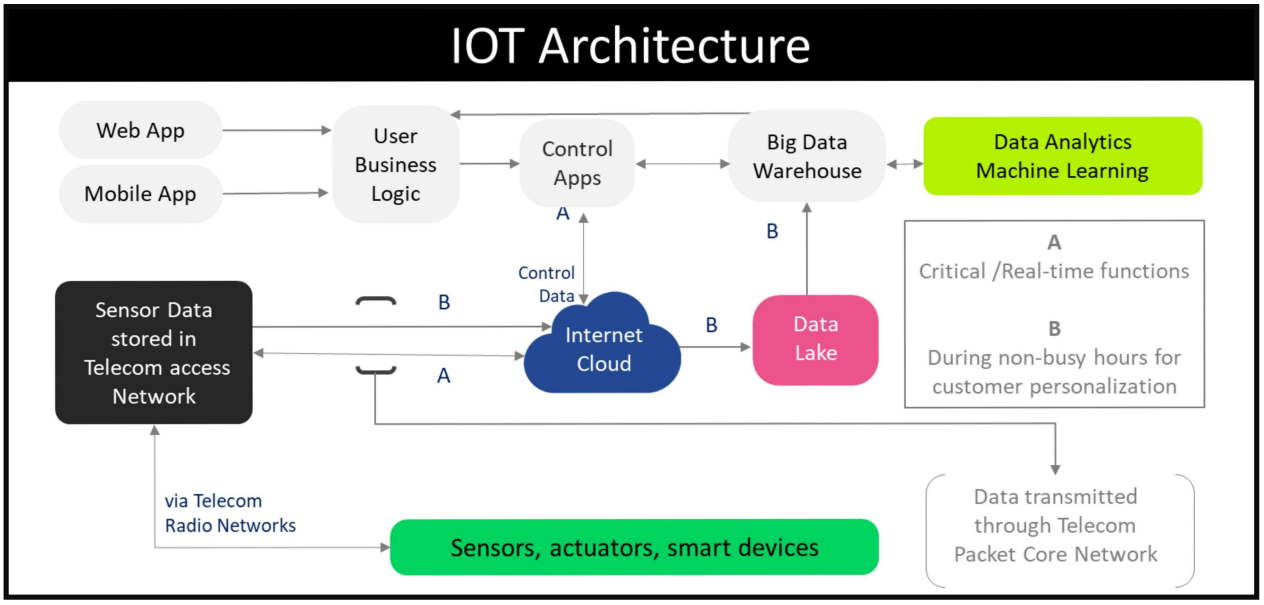
The all-pervasive Analytics

Analytics is not a new entrant in the field of Tele-communication. Widely used in many activities, analytics has many applications in telecom such as drafting site deployment plans, identification of underperforming cells, etc. In ground applications, there are a wide range of case studies, for example, descriptive analytics is very useful for customer complaint data to identify poor coverage locations. Predictive analytics can predict the churn rate and expected revenue generation. Prioritizing the locations can be done using Prescriptive analytics.

Of course, The next "BIG" thing

Internet of Things (IoT) refers to objects, devices, and/or machines in daily human usage which utilize mechanical and computing resources, often using sensors and actuators. They transfer this data over a network through the internet. IoT gives humans, the power to control things remotely, provided all the devices are connected over the single platform of internet.

The utilization of IoT smart devices will rapidly increase in the future as they are pivotal for smart cities and smart home developments in Industry 4.0. Hence, the IPv6 addresses (128-bit) will be allocated to accommodate the numerous devices that are to come in the near future. These smart devices can be among the below two types:



- Devices that can be remotely controlled.

Eg: A person wanting to switch off devices at home after he reached office, using an application in Mobile/Web server.

- Devices that auto-adapt to the scenario.

Eg: Self-driving car, automatic power switches using motion-sensing, etc. These devices might need internet connection as providing processing power to every IoT device would make them costly and heavy.

Two important features in evaluating the effectiveness of IoT devices are: 1) Last mile connection: How does it connect to the Internet? 2) Latency: How fast and effective is it functioning?

Last Mile Connection

In general, Bluetooth/Wi-Fi can be used for connecting IoT devices to the internet. But the most standard way is to use mobile networks, as they are already connected across the world and are capable of maintaining the connection even when the object is moving.

Latency

Latency can be defined as the round-trip time between the communicators. It is the time taken for a request to travel from the sender to the receiver, for the receiver to process that request and send back the response to the sender. Latency is highly crucial in real-time service applications like remotely operated devices, as a few milliseconds delay in decision-making may lead to very drastic consequences.

Note: Although IoT is capable of working on the upcoming 5G networks, the 5G Architecture is not yet standardized completely. Kindly refer to the 4G architecture for a better understanding of Radio & Packet Core.

The Business Perspective

The Telecom companies currently have high penetration in terms of connectivity which makes them suitable partners for entering into the IoT business in terms of connectivity, sales & marketing. Moreover, the telecom industry has already connected even rural areas with optical fiber network. Telecom firms have stores/agents all over the country through which they can now sell IoT devices to their customers. This gives Telecom companies an edge to expand their business.

The revenue boost can be attained not only by selling but also by providing O&M services to small-scale IoT devices. Most importantly, in the IoT architecture the B-part sensor data, which has less priority during transmission forms a Data Lake. This "Big Data" can be used for many purposes by leveraging analytics alongside.

> " The latency of 1 ms is still an unfulfilled dream and achieving it remains a challenge "

Customer behavior analysis using Big Data can help in market segmentation, need and demand identification, allowing telecom companies in designing more economical and profitable recharge plans for customers whilst introducing new products targeting different customer segments. These actions might help in increasing customer satisfaction and company revenues. This is a perfect example where analytics helps telecom companies to improve their standards.

Analytics models are always data hungry. These models become more robust with increasing data. The Data Lake in the IoT architecture provides a lot of quality and real-time data which helps in developing efficient models that can be deployed in the real-world. This is the complementary example where telecom helps analytics industry to improve their models.

Let us consider the example of a burglar alarm that's being widely used in homes

these days. The sensors detect the actions and send the input to a distributed Controller via the radio network of telecom. The "distributed controller" has the computational power to run the machine learning model developed by analytics teams. The output is sent to sensors and the users accordingly. This is one scenario where both telecom & analytics together serve customer needs.

The above examples clearly show that both the analytics and telecom industries should go hand-in-hand for their overall development, which then assists the usage of IoT in Industry 4.0.

The Verdict

The "International Telecommunication Union" (ITU), sets the 5G standards keeping in view the requirements of IoT deployment in the future. 5G network standards prescribe a throughput of 1 Gbps and latency of 1ms. The said data speed can be obtained easily at optical fiber connected locations. But the latency of 1ms is still an unfulfilled dream and achieving it remains a challenge till date. Also, the 5G spectrum would be selected in chunks according to the necessity of different IoT devices as per their priority between data speed and coverage/latency. Say, for some IoT devices data speed may not be as important as coverage like a simple smart electric bulb needing an 'ON' message. Also, some IoT devices of non-real-time applications need faster data speeds than coverage to procure assimilated data at the earliest (eg: O&M data of smart devices). But many real-time applications require both high data speed and minimum Latency. (eg: self-driving cars, real-time holograms). Many unfulfilled dreams of 20th century can be realized by the magical convergence of analytics, telecom and computation fields. Yet, these are the bottlenecks for Industrial Revolution 4.0:

- Low network latency
- Requirement of huge computational resources over a distributed network
- Access to and processing capacity to handle huge amounts of data
- Faster processing times
- High model accuracies

Many experts believe that the "Self-driving Car" that is completely autonomous and can has the ability to communicate with its surroundings without any human intervention, will be the greatest achievement of Industry 4.0. This dream demands all the aforementioned things to be realized in reality.

The main limitation from the telecom Industry in IoT deployment is attaining **1ms latency**, the 5G standard. Hence, 5G development along with real-time, highly accurate and effectively deployed analytics models will determine the future of IoT deployment and Industry 4.0.

Glossary	
FDD	Frequency Division Duplexing
FDMA	Frequency Division Multiple Access
TDMA	Time Division Multiple Access
GPRS	General Packet Radio Service
WCDMA	Wideband Code Division Multiple Access
TDD	Time Division Duplexing
LTE	Long Term Evolution
OFDMA	Orthogonal FDMA
SC-FDMA	Single Carrier- FDMA
CSFB	Circuit Switch Fall Back
IMS	IP Multimedia System
VoLTE	Voice over LTE