Data Mining on 5G Technology IOT

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1. Introduction

Currently, data mining is regarded as one of the essential factors for the next generation of mobile networks. Through research and data analysis, there are expectations that complexity of these networks will be overcome and it will be possible to carry out dynamic management and operation activities. In order to full comprehend the particulars of 5G network, there are certain kind of information that should be gathered by network components in order to be analyzed by a data mining scheme [1]

Mobile networks are already part of our daily lives, but what we expect from them is ever changing. Transforming today's networks to 5G is key to keeping pace with the demands of an evolving Networked Society, where opportunities span new high-bandwidth applications, low latency powered Internet of Things (IoT) services and beyond. 5G aims to satisfy these evolving needs by providing ubiquitous connectivity for any device or application that may benefit.

The business models and applications that will be powered by 5G represent a significant opportunity for operators. Ericsson expects that in 2026, there will be a USD 582 billion global markets as telecom operators leverage 5G technology for industry digitalization. For operators, this represents the potential to add 34 percent growth in revenues by 2026.The journey to 5G begins now.4G/LTE has become one of the most successful mobile communication technologies worldwide. It is well-positioned to deliver on the most critical 5G requirements and will continue to play a significant role in mobile communications for years to come.

While LTE continues to evolve, operators need solutions they can deploy within today's networks to manage the growth of current services as they prepare for 5G. Operators can take advantage of 5G technology concepts and reap benefits now while future-proofing networks for 5G.
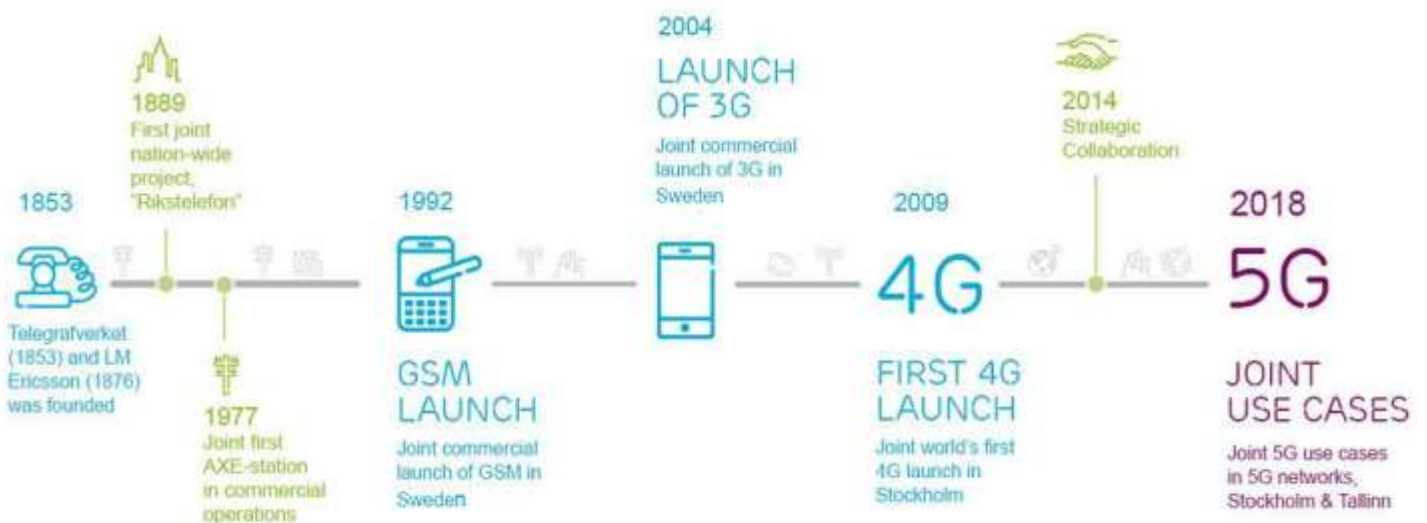
1. Relationship between data mining and 5G

The recent years have seen a tremendous effort put in the course of designing the 5th Generation of mobile networks (5G). The innovation of 5G mobile networks have been aimed at providing tailor cut solution for different kinds of industries particularly the telecommunication sector, intelligent transportation industries, health sector and even in smart factories [2]. On the other hand, the scientific community has realized that big data solutions can significantly enhance the operation and management of both current and future mobile networks. Usually, data mining is employed in the course of discovering patterns and relationships between different variables particularly in large data sets. Through the use of statistical analysis, machine learning and artificial intelligence are used in the data set in the course of extracting necessary knowledge from the examined data [4].

5G Technology

2.   Significance of data mining in 5G Technology
Data mining is integral in 5G technology because it is through data mining that 5G is considered different particularly through the ease in decision making process that has been offered by the system in order to mitigate some common challenges through a dynamic and proactive mechanism [3].

Data analysis offers the means to process a wide amount of machine generated and frequently unstructured data. Subsequently, big data technologies and predictive analysis allow streamlining of industrial processes. Therefore, the integration of the two sees that there is an enhancement in decision making which is the sole purpose of both unstructured data and internet of things (IOT) technologies [2]. Current studies explore how data mining can feed knowledge on control and management modules. However, a challenge that exists between the two drawing from the current research is that most of the studies focus on data mining algorithms to be employed in cellular mobile communications. However, they rarely produce detailed examples of the necessary information that ought to be collected, the frequency of time that the information should be collected and the mechanisms that can be used in the course of minimizing the data that needs to be exchanged among network constituents and functions [1].

4. Massive MIMO

Today's 4G base stations have a dozen ports for antennas that handle all cellular traffic: eight for transmitters and four for receivers. However, 5G base stations can support about a hundred ports, which means many more antennas can fit on a single array. That capability means a base station could send and receive signals from many more users at once, increasing the capacity of mobile networks by a factor of 22 or higher.

This technology is called massive MIMO. It all starts with MIMO, which stands for multiple-input-multiple-output. MIMO describes wireless systems that use two or more transmitters and receivers to send and receive more data at once. Massive MIMO takes this concept to a new level by featuring dozens of antennas on a single array.

MIMO evolution some 4G base stations. However, so far, massive MIMO has only been tested in labs and a few field trials. In early tests, it has set new records for spectrum efficiency, which is a measure of how many bits of data cable transmitted to a certain number of users per second.

Massive MIMO looks very promising for the future of 5G. However, installing so many more antennas to handle cellular traffic also causes more interference if those signals cross. That is why 5G stations must incorporate beamforming

5.Beamforming
Beamforming is a traffic-signaling system for cellular base stations that identifies the most efficient data-delivery route to a particular user, and it reduces interference for nearby users in the process. Depending on the situation and the technology, there are several ways for 5G networks to implement it.

Beamforming can help massive MIMO arrays make more efficient use of the spectrum around them. The primary challenge for massive MIMO is to reduce interference while transmitting more information from many more antennas at once. At massive MIMO base stations, signal-processing algorithms plot

the best transmission route through the air to each user. Then they can send individual data packets in many different directions, bouncing them off buildings and other objects in a precisely coordinated pattern. By choreographing the packets' movements and arrival time, beamforming allows many users and antennas on a massive MIMO array to exchange much more information at once.

For millimeter waves, beamforming is primarily used to address a different set of problems: Cellular signals by objects and tend to weaken over long distances. In this case, beamforming can help by focusing a signal in a concentrated beam that points only in the direction of a user, rather than broadcasting in many directions at once. This approach can strengthen the signal's chances of arriving intact and reduce interference for everyone else.
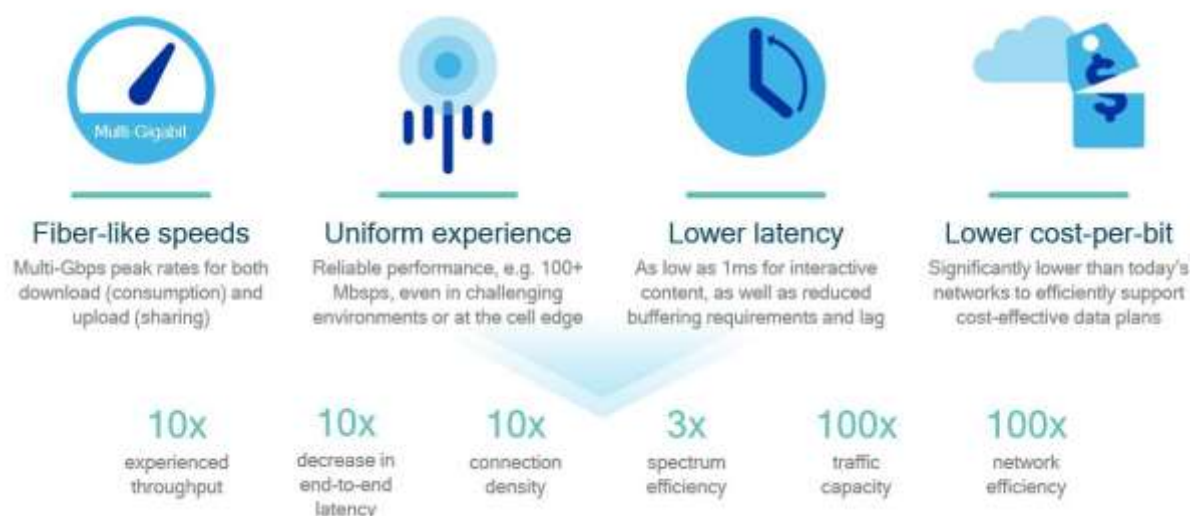
Besides boosting data rates by broadcasting over millimeter waves and beefing up spectrum efficiency with massive MIMO, wireless engineers are also trying to achieve the high throughput and low latency required for 5G through a technology called full duplex, which modifies the way antennas deliver and receive data.

6. Designing 5G New Radio (NR)

Work has begun on defining, standardizing and designing the new OFDM-based 5G New Radio (NR) as part of the global 3GPP standard. 5G NR technology is being designed to support a wide variation of device-types, services, and deployments. It is also being designed to get the most out of every bit of spectrum across a wide array of available spectrum bands and regulatory paradigms.
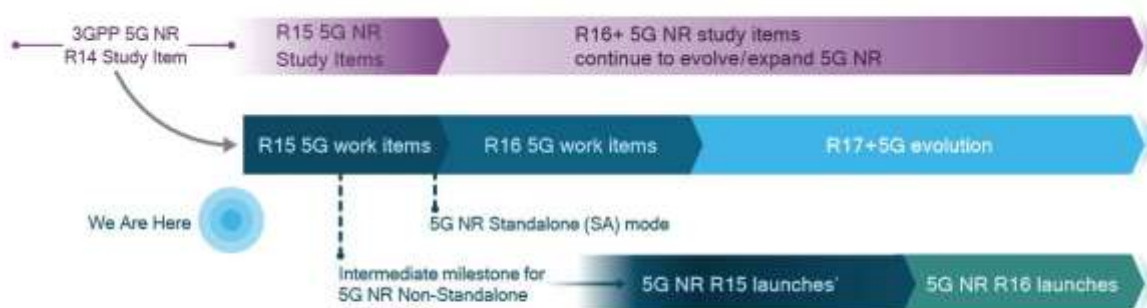

5G NR will deliver new levels of capability and efficiency
For enhanced mobile broadband and beyond

Fiber-like speeds	Uniform experience	Lower latency	Lower cost-per-bit
Multi-Gbps peak rates for both download (consumption) and upload (sharing)	Reliable performance, e.g. 100+ Mbsps, even in challenging environments or at the cell edge	As low as 1ms for interactive content, as well as reduced buffering requirements and lag	Significantly lower than today's networks to efficiently support cost-effective data plans

10x experienced throughput	10x decrease in end-to-end latency	10x connection density	3x spectrum efficiency	100x traffic capacity	100x network efficiency

5G development efforts are focused on creating a 5G network that takes on a much more significant role than previous cellular generations—connecting new industries, enabling new services and empowering new user experiences. At the foundation of this next generation, the cellular network is 5G New Radio (NR), the global 5G standard for a new OFDM-based air interface designed to support the wide variation of 5G device-types, services, deployments, and spectrum.


Accelerating 5G NR, the global standard for 5G

3GPP 5G NR R14 Study Item

R15 5G NR Study Items

R16+ 5G NR study items continue to evolve/expand 5G NR

R15 5G work items

R16 5G work items

R17+5G evolution

We Are Here

5G NR Standalone (SA) mode

Intermediate milestone for 5G NR Non-Standalone

5G NR R15 launches'

5G NR R16 launches

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5G NR acceleration based on NSA architecture
Ensuring commonality with Standalone 5G NR, plus forward compatibility
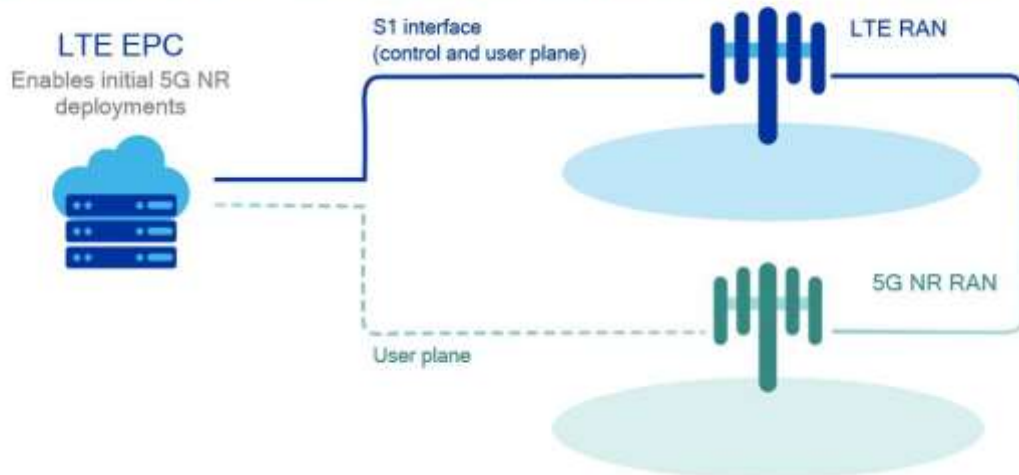
New 5G-CN for Standalone deployments starting 2020
Leveraging virtualized network functions to create optimized network slices

- Configurable end-to-end connectivity per vertical
- Modular, specialized network functions per services
- Flexible subscription models
- Dynamic control and user planes with more functionality at the edge

| Better cost/energy efficiency | Optimized performance | Flexible biz models and deployments | Dynamic creation of services |

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Scalable numerology with 2^n scaling of subcarrier spacing
Efficiently address diverse spectrum, deployments and services
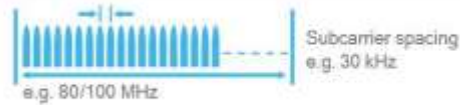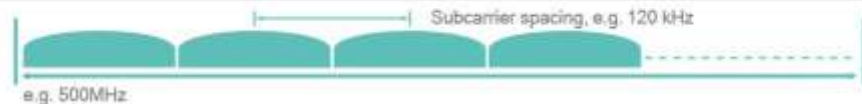
5G new radio is being designed to operate across the vast array of available spectrum regulatory paradigms and spectrum bands – from low bands below 1GHz, to mid bands from 1GHz to 6GHz, to high bands known as the wave. 5G devices will bring the next level of convergence, with the ability to work on a licensed, unlicensed and shared spectrum concurrently.

New self-contained TDD subframe design
UL/DL scheduling info, data and acknowledgement in the same sub-frame
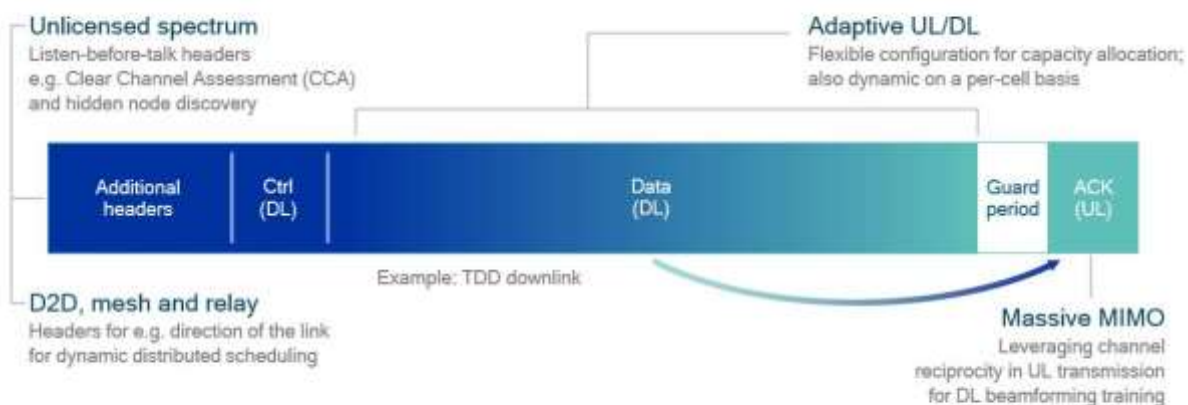
5G NR promises to make wireless broadband indistinguishable from wireline with a fiber-like performance at significantly lower cost-per-bit. However, 5G NR will also scale to efficiently connect the massive Internet of Things, and enable new types of mission-critical services which

Conclusion
Within the latest specifications of 5G, there is a dedicated function known as NetWork Data Analytics Function which is presently limited in functionality. Therefore, there is need of more studies on the subject that will see that the new technology provides information that influences aspects such as real time and policies that operators employ. Therefore, drawing from the overview of the two technologies, it can be ascertained that there is need of more studies to be conducted in order to ascertain how data

mining can be efficiently integrated into 5G technologies [3]. In conclusion, it is certain that the application of data mining in 5G will see the cellular network technologies transformed into proactive rather than

reactive networks. Some of the areas that will benefit from this integration comprise of the quality of network load, profile of subscribers, accounting information and configuration of fault indications among others.

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