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Telco Data Analytics using Open-Source Data Pipeline: Detailed Architecture and Technology Stack

Abirami T[1], Dr. Chandrasekar[2]
[1, 2]*B S, Jain University, Bangalore*

Abstract: ***Open-source technology has influenced data analytics at each step from data storage to data analysis, and visualization. Open source for telco big data analytics enables sharp insights by enhancing problem discoverability and solution feasibility. This research paper talks about different technology stacks using open source for telco big data analytics that are used to deploy various tools including data collection, data storage, data processing, data analysis, and data visualization. This open source pipeline micro-services architecture built with modular technology stack and orchestrated by Kubernetes, can ingest data from multiple sources, process real-time data and provide business and network intelligence. Major idea of using open source technology in our architecture is to reduce cost and manage easily. Kubernetes is an industry adopted open source container orchestrator that offers fault-tolerance, application scaling, and load-balancing. The results can be displayed on the intuitive open source dashboard like Grafana for telecom operators. Our architecture is flexible and can be easily customized based on the telecommunication industry needs. Using the proposed architecture, the telecommunication sectors can get quick decision making with nearly 30% lower CapEX which is made possible using COTS hardware.***

Index Terms: ***Big data analytics, Data pipeline architecture, Open Source technologies, Real-time data processing, Fault-tolerance, Load-balancing, Kubernetes, BDA, Open source dashboard***

I. INTRODUCTION

OVER the next five years, 71% of the global population, or 5.7 billion people, will be mobile subscribers. This will require Communications Service Providers (CSPs) to process an exceptional amount of data – somewhere in the vicinity of several exabytes per month. And the advent of 5G and the expectation that billions of new IoT devices will be added to the network, means incredible volumes of data from multiple sources will increase the complexity of networks.

The need for a robust big data analytics solution has never been more profound. The right analytics solution would uncover insights from big data to understand network and customer behaviors, preferences, service usage patterns and interests, which enable CSPs to better manage and monetize their networks.

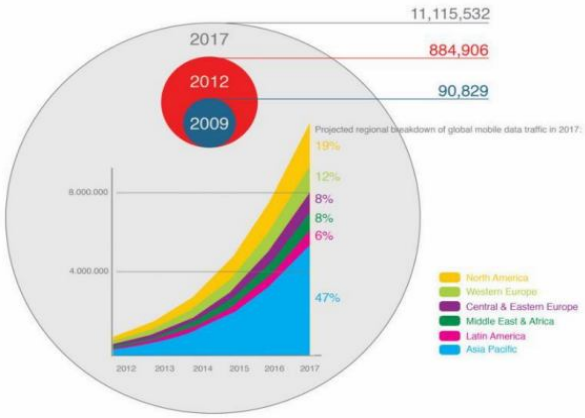

Fig. 1. Global mobile data – traffic growth and forecast

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CSPs are limited by the scalability and flexibility of today's analytics tools. The proprietary nature of these solutions means they are not open-ended, and they inherently lack essential features that are vital to the CSP. Another limitation of these tools is the inability to analyze petabyte scale and streaming data, due to the cost of the hardware and software components involved. The introduction of a new analytics solutions would translate to data being re-gathered, causing potential loss of vital insights to improve network performance and thus, impeding monetization. Improving operational efficiencies to benefit end users is of the utmost importance to CSPs, and thus constantly find themselves in search of new and improved analytics solutions.

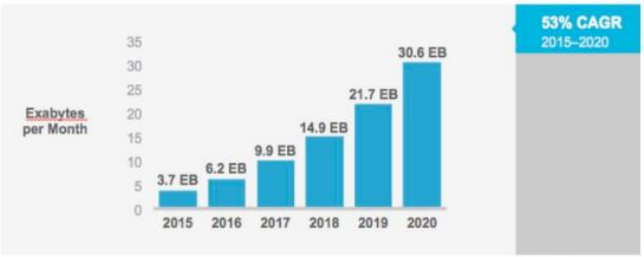

Fig. 2. Global mobile data – traffic forecast (2015 – 2020)

The Telecommunication industry is undergoing a major transformation using advanced data analytics and artificial intelligence. A Data analytics pipeline solution is an effective solution built from open source components, capable of real-time data processing. The major objective of Telecommunications has remained the same over the years: to transmit voice and data over long distances. But in recent years, big data and data analytics is ingrained into the DNA of modern Telcos.

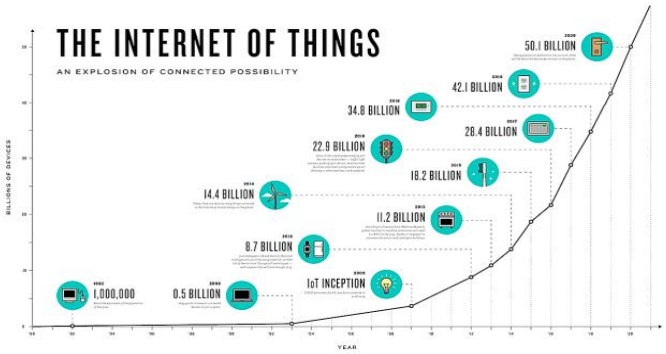

Fig. 3. Network usage traffic over the years

A huge amount of data is generated from Telco data centers that run many software and hardware infrastructures. With the rapid increase in the number of connected mobile devices and smart phones for internet access, there is a strong requirement for Telcos to analyse the infrastructure, network insights, and customer behaviors. A potential Data analytics solution can help Telco providers to enhance profitability through network service optimization, security, and improved customer experiences.
The Telecommunication industry is undergoing a major transformation using advanced data analytics and artificial intelligence. Our proposed Data analytics pipeline solution is an effective solution built from open source components, capable of real-time data processing.

II. TEL POD

An authentic data analytics solution can lower service costs, provide valuable insights on KPIs, drive expansion and generate profit. Telpod is a plug and play telco analytics solution which is built using industry-adopted, mature Open Source technologies. It is a single-entry point for a variety of data from multiple sources. Collected data does not need to be regathered and it is a fully automated solution which is horizontally scalable. A solution that can be fully managed by the individuals, allowing CSPs to focus on their customers. It is flexible solution, built using Open-Source components that makes it easy to customize and add new capabilities. It is a solution that provides actionable insights through real time data processing. provides actionable insights through real time data processing.

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We propose Telemetry-POD, a fully managed, plug-and-play analytics platform that provides the complete Data Pipeline, Data Ingestion, Data Processing, Data Storage, Data
Visualization. Telco-POD provides standard interfaces for integration with Data Sources and Provides Restful Interfaces to integrate with any existing OSS/BSS application.

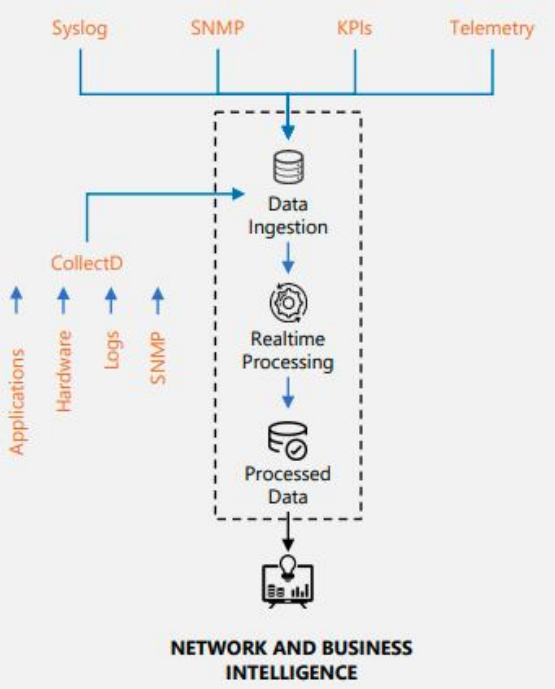

Fig. 4. Network and Business Intelligence

Our proposed Telemetry-POD solution supports open architecture and is built from Open-source components to provide a Scalable, Secure, Future Proof, Resilient. The Platform to Analyze Data from Multiple Sources in the Network and give Actionable Insights are Open collector & add-on functionality interfaces, Leverage industry standard open-source solutions and save significantly on your CAPEX and OPEX, Shift gears from proprietary analytics system towards open solutions that best-fit your business needs.

III. ARCHITECTURE

The data analytics pipeline is built with opensource software components that ingest data from multiple data sources. This pipeline consists of modular blocks that process and correlate data to provide network and business intelligence. Open-source technology allows our analytics solution to be cost-effective and easier to manage. This solution processes data in real-time and generates meaningful results that can be displayed on the Dashboard for Telco operators or shared in the form of reports. Our solution is based on a micro-services architecture, orchestrated by Kubernetes. Kubernetes is an industry adopted container orchestrator that provides application scaling, fault-tolerance, and load-balancing.

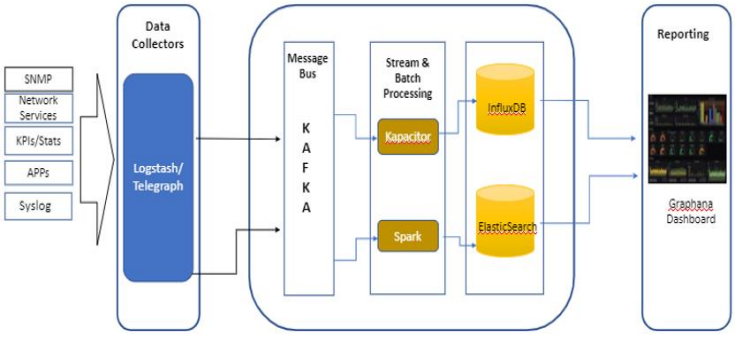

Fig. 5. Data Analytics Architecture

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With the proposed novel architecture, we can insert new analytics capabilities seamlessly & effortlessly. It Collect data once – use it for any future applications. The proposed solution takes complete control, no vendor lock-in.
Customer sees value in using an open-source solution to implement analytics solution by in which at least 30% lower Capex and Significantly reduced Opex – no annual license fee for analytics pipeline components.

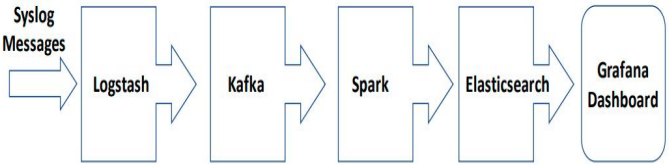

Fig. 6. End-to-end Real-time Data Analytics Pipeline

Kubernetes Master is an industry adopted container orchestrator. It promotes application scaling, fault-tolerance, load-balancing.

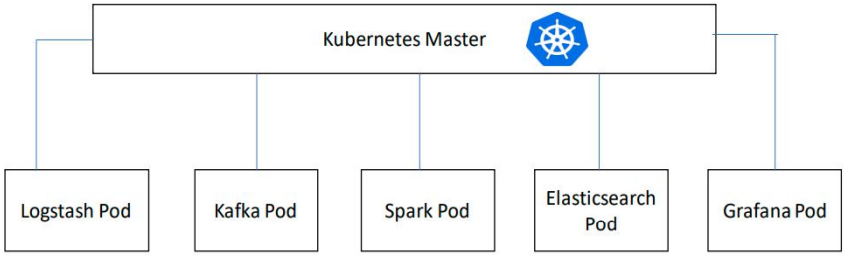

Fig. 7. Kubernetes master flow

The major objective of Telecommunications has remained the same over the years: to transmit voice and data over long distances. But in recent years, big data and data analytics is ingrained into the DNA of modern Telcos. A huge amount of data is generated from Telco data centres that run many software and hardware infrastructures. With the rapid increase in the number of connected mobile devices and smart phones for internet access, there is a strong requirement for Telcos to analyse the infrastructure, network insights, and customer behaviours. A potential Data analytics solution can help Telco providers to enhance profitability through network service optimization, security, and improved customer experiences.

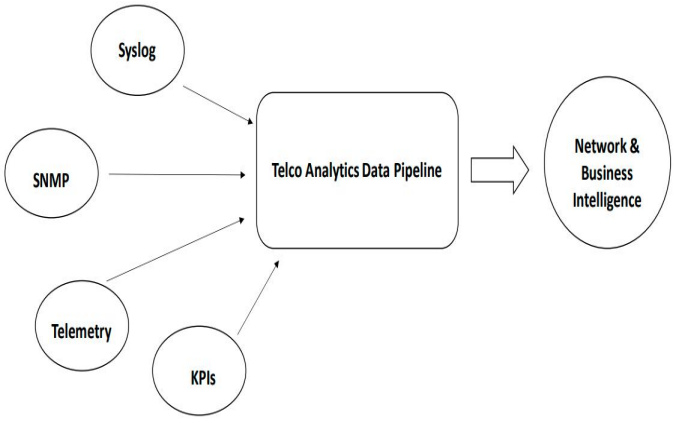

Fig. 8. Multiple data ingestion points

The data analytics application area for Telcos includes network management optimization, security, real time analysis, price optimization, customer churn prevention.

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IV. TECHNOLOGY STACK

The Technology involves contanarized technogy, automated solution, matured, industry-adopted, open-source components, single entry point for different data sources, real-time decision making.

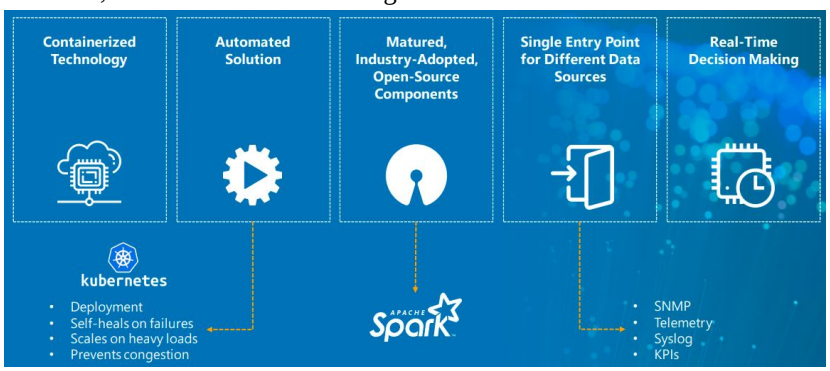

Fig. 9. Technology Highlights

Automated solution involves deployment self-heals on failures, scales on heavy loads and prevents congestion. Single entry point for different data sources involves SNMP, Telemetry, Syslog, and KPIs.

V. ADVANTAGES & SALIENT FEATURES

TelPod is a fully managed, plug-and-play analytics platform that provides complete data pipeline analytics solutions for Data Ingestion, Data Processing, Data Storage, and Data Visualization.

Fig. 10. Data Processing Pipeline

The Key advantages are no vender lock-in and low entry barrier,fully managed solution with hassle-free,24/7 support,ability to start small and seamlessly scaleup,customizable,open source,single-solution for heterogenus networks,Lower CapEx and OpEx costs,Built-in security for data privacy and add-on functionality interfaces.

The Customization Services are specific use case implementations,Integration with OSS/BSS ticketing systems,Machine Learning and Artificial Intelligence use cases,Integration with third-party tools, Interoperability with legacy analytics systems.

Using TelPod, the things which can be built are uptime analysis, bandwidth utilization, latency analysis, network congestion, predictive failures, geographical origination and termination of data endpoints,network traffic insights,from Layer-2 to Layer-7,alerts for unusual events,such as critical logs and network faults,insights for network and infrastructure planning. Customers gain value in using an open-source solution for data analytics in which atleast 30% lower CapEx and Significant reduction in OpEx by using COTS hardware.

The Salient features built with open source software
components are allows data ingestion from multiple sources.

It performs real-time data analytics, data curated by Apache Spark,each services running within a Docker Container orchestrated by K8S,streaming graph available on Grafana
Dashboard.The Salient feautures for this solution are plug-n-play,quick decision-making with real time data analytics,intuitive dashboard providing network and business
Insights,built with industry adopted open source software components.It supports variety of data sources such as Syslog, sFlow, Net Flow, SNMP, KPIs, Libvirt, and so on.It permits
customizations for specific needs.

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VI. USE CASE

The EPC and IMS nodes of 4G mobile networks are distributed nodes (also known as services) that handle the control and data plane of mobile subscriber sessions. These nodes previously ran on proprietary hardware platforms but now with the advent of NFV and SDN, they are designed to run on COTS hardware using virtualized infrastructure. These services handle a tremendous amount of signaling and subscriber data traffic. Statistical data is retained to provide network insights to the operators. These services are generating log messages for debugging and tracing purposes. Additionally, the platform running these services generates its own set of data to monitor its availability and performance. The data pipeline has the capacity to process collected data for Data visualization, Subscriber QOE for volte calls, Capacity planning, Network optimization, Closed loop optimization, and Find RCA.

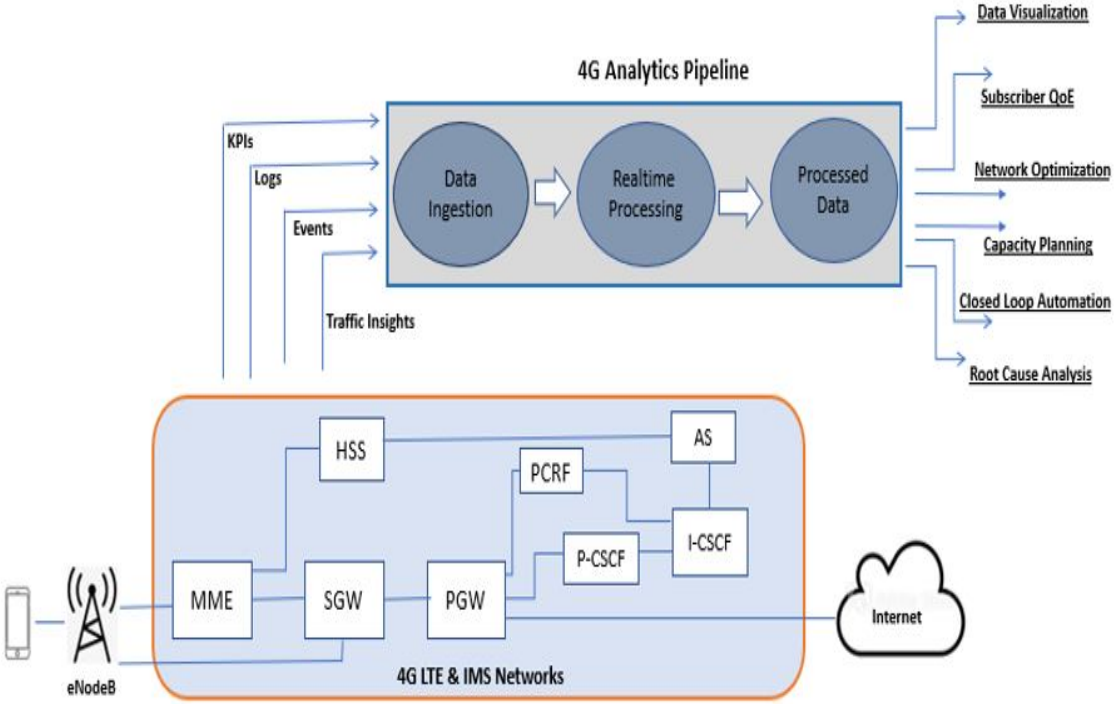

Fig. 4. 4G Data Analytics Pipeline

VII. CONCLUSION AND FEATURE WORK

Data analytics will benefit tremendously from fifth-generation networks because the promise of faster download speeds combined with low latency makes it possible for analysts to collect, clean and analyze large data volumes in a shorter period.

In the context of cloud-ready telecommunications networks, 5G mobile NFs can be deployed as VNFs over geo-distributed cloud infrastructures with low effort. This decoupling of the computing and storage hardware from functionality embedded in software allows the easy deployment, maintenance, updating, and extension of 5GS functionality and offers unprecedented levels of network flexibility. Complementing network function virtualization (NFV), 3GPP has specified a SBA for the 5GS. It standardizes the 5G CN domain, mandating SBI to expose services of the CP functions, including NWDAF. Similarly, 3GPP has also followed a service-based approach in the Network Management domain, where Management Functions shall expose Management Services (e.g., Performance or Configuration Management service) to other consuming functions. Significant limitations currently comprise the lack of SBA support of NG RAN NFs as well as the service exposure and consumption across different network domains (e.g., RAN and CN) or across different planes, e.g., for interactions between CP and management plane services. The necessity for new analytics functionality in 5GS may become reality, preferably using SBA, since both network operators and verticals may easily deploy analytics on demand. For example, analytics functions may be realized as (part of) a new AF, which can closely interact with, e.g., CN functions using SBI, or as CN/RAN functions which can interact with MDAF using the control-to-management interfaces, as shown in the figure below:

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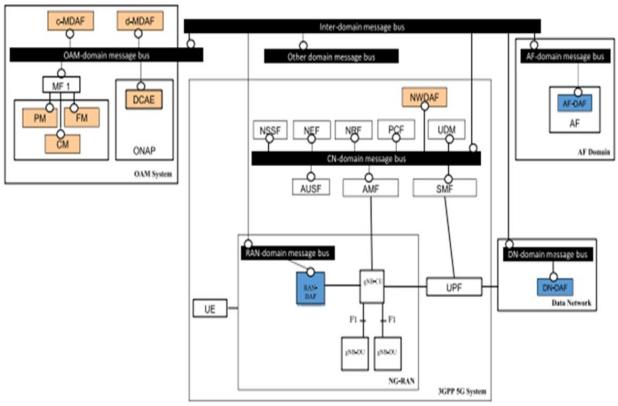

Fig 11: 5G Data Analytics Pipeline

This framework introduces new functional entities for application-level, data network, and access-related analytics to be integrated into the already existing analytics functionalities and examines their interactions in a service-oriented manner.

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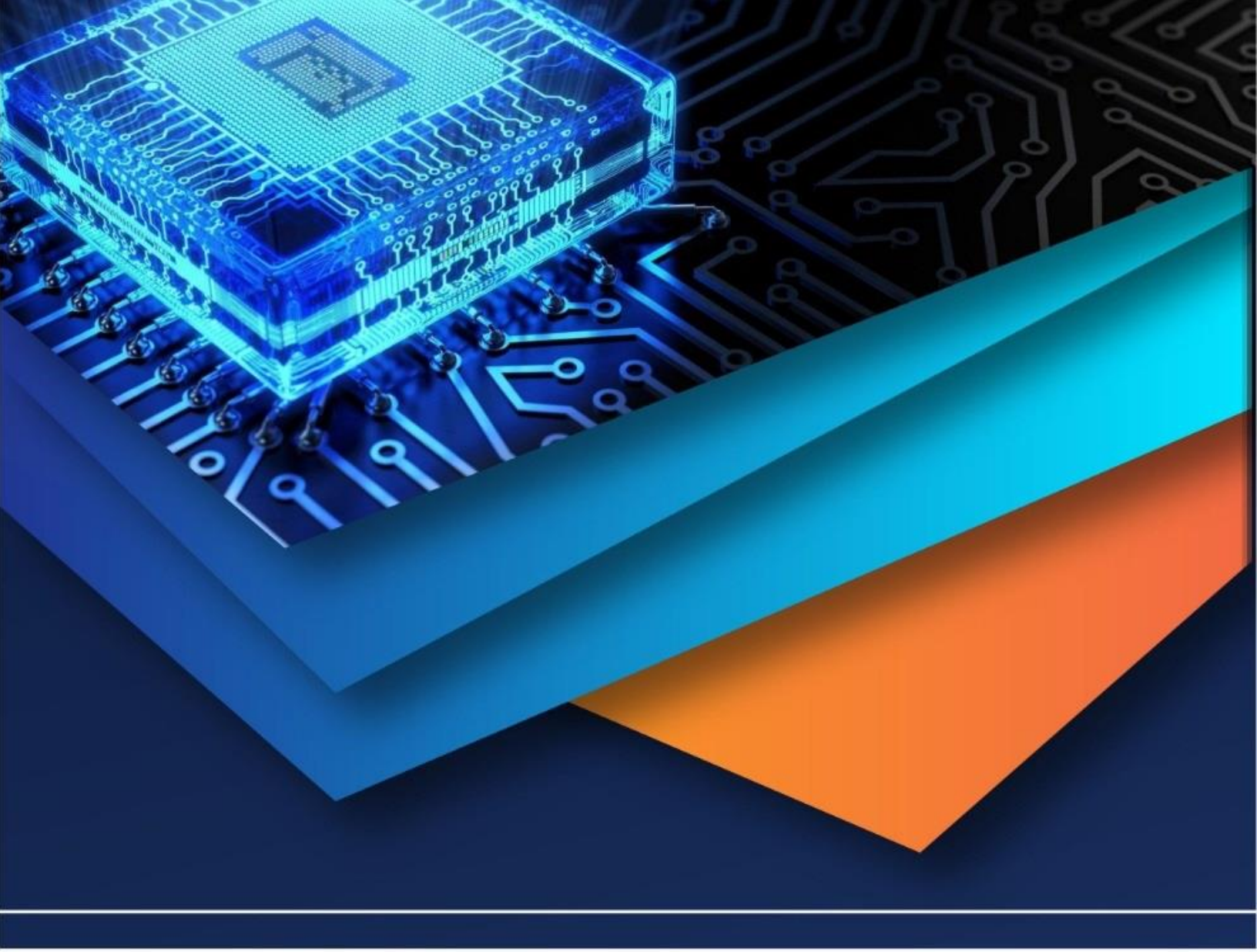

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