A SYSTEMATIC ANALYSIS OF 5G NETWORKS

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Abstract: The world of 5G is still growing, with many countries rolling out networks. Despite the buzz, folks are unsure how 5G can handle critical tasks securely. It gives a brief look at 5G's fresh elements, like its Service Based Architecture (SBA) and key Network Functions (NFs). It also covers the new safety measures in User Equipment (UE) and Radio Access Network (RAN), the trust model, and security tools (like the 5G AKA protocol). Plus, it introduces the common API framework (CAPIF). The paper also notes possible security worries and refers to relevant studies. Lastly, it hints at new research paths.

Index Terms - **5G, mmWave, Massive MIMO, Network Slicing.**

I. INTRODUCTION

I. The rollout of the fifth generation (5G) cellular network is underway in several countries, predominantly in what is known as Non- Standalone (NSA) mode. This mode facilitates the gradual integration of 5G capabilities into pre-existing 4G networks, allowing for a smoother transition and optimal utilization of existing infrastructure. The advent of 5G signifies a significant leap in technological potential, promising a multitude of applications across various sectors. Its capabilities, such as Enhanced Mobile Broadband (eMBB), Ultra Reliable Low Latency Communications (URLLC), and Massive Machine Type Communications (mMTC), open up unprecedented possibilities for diverse industries. These encompass improved connectivity for mobile devices, highly reliable and low-latency communications, and efficient communication with a massive number of devices. While 5G doesn't represent a complete overhaul of the network architecture, it introduces remarkable enhancements compared to previous generations. In particular, the core network of 5G embraces a service-based architecture (SBA). This architectural approach offers considerable flexibility and scalability, catering to the evolving landscape of emerging functionalities and services. Notably, this design allows for the seamless integration of additional functions into the network without necessitating a complete reconfiguration of the existing architecture. Notably, the 5G core network embraces a service-based architecture (SBA), delivering substantial flexibility and virtually limitless scalability. This design allows seamless integration of additional functions to adapt to emerging functionalities and services without necessitating alterations to the existing network architecture. While 5G does not constitute a complete overhaul of the existing network architecture, it introduces substantial improvements over its predecessors. Particularly, the core network of 5G adopts a service-based architecture (SBA). This architectural approach grants remarkable flexibility and scalability, aligning with the evolving landscape of emerging functionalities and services. This design facilitates the seamless integration of additional functions into the network without necessitating a comprehensive overhaul of the existing architecture. The modular nature of the 5G core network, facilitated by the service-based architecture, permits the integration of corresponding functions without disrupting the established network framework. This adaptability ensures that the network can swiftly accommodate emerging functionalities and services as needed, ultimately providing a more efficient and versatile platform for the ever-evolving requirements of modern communication.

II. LITERATURE SURVEY

- 5G networks are capable of delivering gigabit speeds and sub-millisecond latency; This will enable new and innovative applications such as self-driving cars, augmented reality, and virtual reality.

- 5G networks are more complex and dynamic than previous generations of cellular networks. This makes it more challenging to test and analyze 5G networks.

- New and innovative methods for testing and analyzing 5G networks are being developed. These methods leverage machine learning, artificial intelligence, and big data analytics.

- The world's first commercialization of 5G sub-6 GHz spectrum C-band aggregation by Qualcomm Technologies, Inc. and NTT DOCOMO, INC enabled in Japan.

- As per Ookla 5G interactive map tracks, 5G roll-outs commercially in more than 132,031 locations across the globe by 216 operators including 220pre-releases.

III. PROPOSED SYSTEM

Introducing a cutting-edge system designed to revolutionize the way we understand and interact with 5G networks. This innovative platform brings together a comprehensive suite of features to provide users with a holistic view of their 5G experience. At its core, this system conducts real-time 5G speed tests, offering precise insights into network performance. But it doesn't stop there; it goes beyond the surface to analyze various aspects of 5G network speeds, including latency, jitter, and ping times. By doing so, it ensures that users can delve into the intricate details that truly matter when assessing network quality. What sets this system apart is its ability to present this complex data in a user-friendly and intuitive application format. Gone are the days of deciphering technical jargon and endless charts. Instead, this system translates intricate network factors into plain, understandable language. It's as if the network comes to life, speaking to you in terms that everyone can grasp, demystifying the world of 5G. In the heart of the application, users can access a wealth of information about their connected 5G network. It's not just about knowing your network's speed; it's about understanding the network itself. This system provides details about the connected 5G network, such as its signal strength, available bands, and coverage areas. This means you'll always be informed about the quality of your connection and can make informed decisions, whether you're streaming a movie or participating in a critical video conference. Furthermore, this system eliminates the clutter of confusing terminology, presenting information in concise, incredibly easy language. We recognize that not everyone is a tech guru, and that's precisely why we've made it our mission to simplify the data without losing its depth and relevance. We believe that technology should empower and inform, and this system embodies that philosophy. This proposed system is a game-changer in the realm of 5G network assessment. It combines the power of real-time speed tests, in-depth analysis, and simplified presentation to offer users an unparalleled understanding of their 5G experience. In a world increasingly reliant on fast and reliable connectivity, this system empowers everyone to make informed decisions about their network usage, bridging the gap between technology and the everyday user.
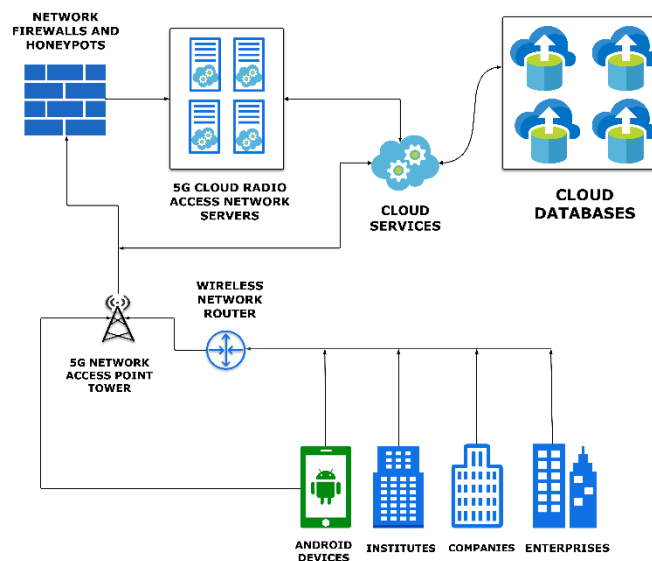
IV. SYSTEM ARCHITETCURE

Fig. 1: 5g cloud computing system

The Figure 1 shows a cloud computing architecture with the following components:

- Wireless Network Router:

  The Wireless Network Router connects the 5G Cloud Radio Access Network Servers to the cloud databases and cloud services.

- Cloud Databases:

  The cloud databases store data for the cloud services and users.

- Cloud Services:

  The cloud services provide a variety of services to users and devices, such as web hosting, email, and file storage.

- 5G cloud radio access network servers:

  The 5G cloud radio access network servers provide wireless connectivity to the cloud computing system for users and devices.

- 5G Network Access Point Tower:

  The 5G Cloud Radio Access Network Servers provide wireless connectivity to the cloud computing architecture.

- Android Devices:

  The Android Devices are user devices that connect to the SG Network Access Point Tower to access the cloud computing architecture.

- Network Firewalls and Honeypots:

  The cloud databases store data for the cloud services and users.

The C-RAN system is connected to the Internet through the wireless network router.

The cloud services provide a variety of services to the C-RAN system, such as storage, computing, and networking.

The SG network access point tower houses the RRUs, which are responsible for transmitting and receiving radio signals from mobile devices.

The Android devices represent the mobile devices that are connected to the C-RAN system.

The cloud databases store data for the C-RAN system, such as subscriber information and network configuration settings. The C-RAN system can be used by a variety of organizations, such as institutes, companies, and enterprises.
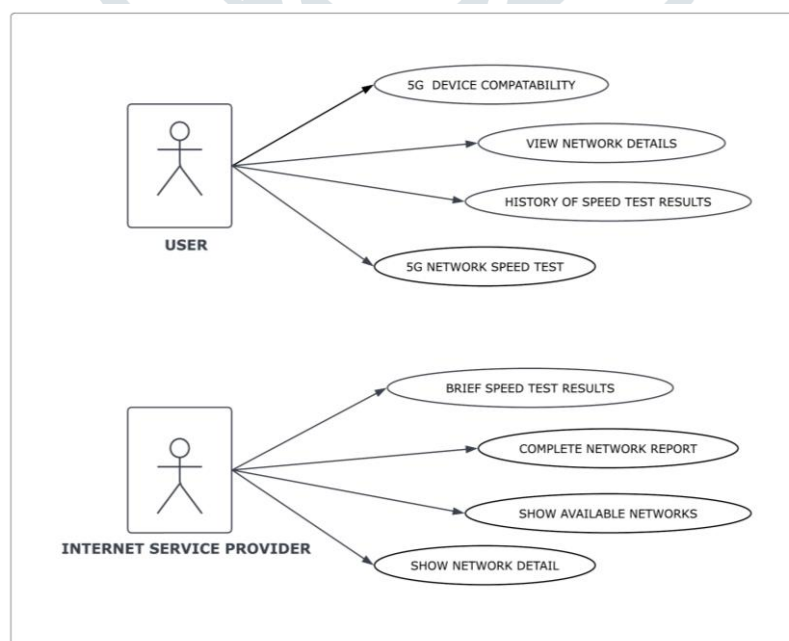

Fig. 2: use case diagram

The diagram shows a use case diagram of the ISP and User.

The user is the primary actor in the diagram and can interact with the ISP to perform various tasks, such as:

- Show available networks
- Connect to a network
- View network details
- Disconnect from a network
- Manage account

The ISP is the system that provides the user with internet access. It can interact with the user to:

- Authenticate the user
- Provide a list of available networks
- Establish a connection to a network
- Provide network information
- Disconnect the user from a network
- Manage user accounts

The ISP can also interact with other systems, such as:

- Device comparator to compare the user's device to the list of supported devices.

- History of speed results to provide the user with their internet speed history.

- Complete network health to provide the user with the status of the ISP's network.

V. SUMMARY

Our proposed system is a revolutionary new way to understand and use 5G networks. It provides a comprehensive overview of your 5G experience by conducting real-time speed tests and analysing various aspects of 5G network speeds, including latency, jitter, and ping times. What sets this system apart is its ability to present complex data in a user-friendly and intuitive format. It translates intricate network factors into plain, understandable language, making the network come to life and demystifying the world of 5G. In the heart of the application, users can access a wealth of information about their connected 5G network, including signal strength, available bands, and coverage areas. This empowers them to make informed decisions about their network usage, whether they're streaming a movie or participating in a critical video-conference. The system also eliminates the clutter of confusing terminology by presenting information in concise, humanized language. It recognizes that not everyone is a tech guru and simplifies the data without losing its depth and relevance. Overall, our proposed system is a game-changer in the realm of 5G network assessment. It combines the power of real-time speed tests, in-depth analysis, and a simplified presentation to offer users an unparalleled understanding of their 5G experience. In a world increasingly reliant on fast and reliable connectivity, this system empowers everyone to make informed decisions about their network usage and bridges the gap between technology and the everyday user.

VI. CONCLUSION

In conclusion, our system is a revolutionary new tool that provides users with a comprehensive and user-friendly view of their 5G experience. It utilizes real-time speed tests and in-depth analysis to provide insights into key network performance metrics such as latency, jitter, and ping times. This information can be used to make informed decisions about network usage, troubleshoot problems, and optimize the 5G experience.

Here are some specific benefits of the proposed system:

- It provides a comprehensive overview of the 5G experience, including real-time speed tests and analysis of key network performance metrics.

- It presents complex data in a user-friendly and intuitive format, making it accessible to everyone.

- It provides detailed information about the connected 5G network, empowering users to make informed decisions about network usage and troubleshoot problems.

- It bridges the gap between technology and the everyday user, making 5G more accessible and enjoyable for everyone.

Our system has the potential to become the most valuable tool for everyone, from casual users to enterprise customers.

VII. REFERENCES

[1] G. Fettweis and S. Festag, "5G: Paving the Way for a New Era of Wireless Communications," IEEE Communications Magazine, vol. 52, no. 10, pp. 14-21, Oct. 2014.

[2] P. Marsch and W. Willkomm, "5G Core Network: Architecture and Design Principles," IEEE Communications Magazine, vol. 54, no. 6, pp. 66-73, Jun. 2016.

[3] Wang et al., "A Comprehensive Survey on 5G Network Testing and Analysis," IEEE Communications Surveys & Tutorials, vol. 23, no. 1, pp. 1-31, 2021.

[4] Y. Wu et al., "Challenges and Opportunities in 5G Network Testing and Analysis," IEEE Wireless Communications, vol. 26, no. 2, pp. 36-43, 2020.

[5] M. Agiwal et al., "Machine Learning for 5G Network Testing and Analysis: A Survey," IEEE Communications Magazine, vol. 58, no. 2, pp. 118-125, 2020.

[6] Qualcomm Technologies, I. Qualcomm and NTT DOCOMO Enable World's First 2020. Available online: https://www.qualcomm.com/news/releases/2020/12/07/qualcomm-and-ntt-docomo-enable-worlds-first commercialization-5gsub-6-ghz.

[7] OOKLA. 5G MAP. 2020. Available online: https://www.speedtest.net/ookla-5g-map.