Computer Networks Assignment -

**Critique on “5G realising next generation immersive multimedia experiences”**

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## Abstract

This report provides a critique of a whitepaper titled '5G Realising Next-Generation Immersive Multimedia Experiences' generated by ChatGPT-4o, a generative AI chatbot developed by OpenAI. The critique focuses on validating and verifying the analysis provided by ChatGPT in relation to the challenges in delivering immersive XR (Extended Reality) experiences, the role of 5G in enhancing user Quality of Experience (QoE), and the network management strategies required to enable these advancements. By assessing the whitepaper against key criteria and verifying sources of the data provided by ChatGPT, the accuracy and relevance of the AI-generated content can be verified and reported.

## Introduction

The development of 5G technology has created new opportunities for improving immersive Extended Reality experiences, encompassing Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR). Industries such as entertainment, healthcare, education, and manufacturing should be considering how they can implement XR in their organisations. However, for effective implementation of XR, low latency, high bandwidth, and ultra-reliable connectivity is required. 5G networks can provide this. Therefore, it is essential to understand the interconnection of 5G technology and XR.

A whitepaper focused on the challenges of delivering XR experiences, the role of 5G in improving Quality of Experience, and the network management strategies to support these advancements would offer valuable insights into leveraging these technologies to create tangible business assets.

# Discussion on ChatGPT-Generated Whitepaper

## **Abstract and Introduction**

The purpose of the whitepaper is clearly explained in the abstract section, which highlights the exploration of 5G's role in enabling next-generation immersive multimedia experiences and sufficiently outlines the core details of the topic being discussed. Additionally, this section emphasises that the paper leverages specifications from ITU, IEEE, and 3GPP - key organizations responsible for developing and harmonising global telecommunication standards, including those necessary for 5G.

The introduction section effectively establishes the topic of 5G’s role in immersive multimedia experiences by outlining the significance of XR and highlighting challenges that could be addressed by 5G advancements. This creates a strong foundation for discussing 5G's potential in enabling next-generation applications. However, some elaboration on core topics would be beneficial. The introduction also includes detail, such as specific references to the paper's structure and content, that may be more appropriate for the abstract. Additionally, the section misses an opportunity to provide detail on relevant topics like other use cases for 5G and the broader implication of 5G beyond XR e.g. Industry 4.0, IoT and Wearable devices applications. By expanding on this topic, the introduction would better position the paper within the wider context of 5G-related discussion.

## **5G architectures and key aspects**

The whitepaper focuses on 5G architecture and its application to immersive multimedia experiences like XR. It highlights core architectural aspects of 5G that address challenges, including reference to enhanced Mobile Broadband (eMBB), millimeter waves, Ultra-Reliable Low Latency Communications (URLLC), and massive Multiple-Input and Multiple-Output (MIMO) and beamforming. These are relevant technologies that are discussed by data sources referenced on the whitepaper such as the 3rd Generation Partnership Project (3GPP) [1], the International Telecommunication Union (ITU) [2] and the Global System for Mobile Communications Association (GSMA) [3]. The paper links these architectural elements to outlined XR challenges, effectively connecting this architecture to the broader context of immersive multimedia.

Additional research was required to confirm accuracy of some of the content in this section of the whitepaper, such as claimed data delivery speeds using mmWaves. Refer to [4] and [5].

It would be beneficial to have more detail on each architectural element. However, ChatGPT may have limited content based on the request that the whitepaper fit within six pages of text.

## **Network management for 5g**

There is some detailed explanation for key components of 5G network management on the whitepaper. Such as highlighting how Self-Organizing Networks (SONs) optimise 5G networks to ensure high reliability, how machine learning enables predictive resource management to deliver better service, and how network slices are managed to prioritize immersive experiences (e.g. XR / AR use cases). Dynamic Spectrum Management is also discussed, which is relevant to 5G network management as it facilitates intelligent management of Radio Access Network (RAN) frequencies. The whitepaper identifies this as essential for optimising 5G network resources. Again, further discussion on this and other topics would be beneficial to a whitepaper document.

Further research was required to confirm accuracy of the details on the whitepaper. Refer to [6], [7], [8], [9] and [10].

## **How 5G networks support enhanced user QoE of Immersive multimedia experiences**

The ChatGPT-generated document discusses challenges affecting user QoE of immersive experiences such as high bandwidth demand, ultra-low latency, and reliable connectivity. The paper then outlines 5G features which address these challenges: enhanced data-rates enabled by eMBB and mmWave, ultra-low latency enabled by URLLC (through reduced Transmission Time Interval (TTI), and flexible numerology), edge computing, and network slicing, and higher capacity and reliability enabled by Massive MIMO and Beamforming. Edge computing is also discussed as a key 5G capability that enhances QoE by reducing latency through minimising the distance that data needs to travel to centralized cloud servers. This aligns with statements in the whitepaper reference 'Convergence of Edge Computing and Deep Learning: A Comprehensive Survey' [11] and an Ericsson article on edge computing [12]."

The ChatGPT article highlighted a challenge which personally I would not have considered: power efficiency. The advanced architecture of 5G, including features like Massive MIMO, mmWave, along with its high data rates and low latency capabilities, places significant demands on power consumption for both networks (e.g., powering base stations and small cells) and devices. As a result, it may be necessary to improve the design of both networks and devices through energy-efficient hardware, dynamic resource allocation, and AI-driven optimizations to enhance power efficiency and ensure consistent usability, especially for battery-dependent XR devices.

## References

*It should be noted that the ChatGPT-generated whitepaper does not assign correct naming to referenced documents. Naming for the references in this section have been confirmed at source.*

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