1. What new possibilities will be created by the development of this application?

The development of software-based 5G networking is poised to create a wide array of new possibilities and opportunities (MIT Technology Review, 2021). I think these are some of the key possibilities that are expected to arise from this technological advancement:

1. **Real-Time, Closed-Loop Network Control**: The shift towards software-based 5G networking will enable the introduction of previously unimaginable ideas, such as automatic, real-time, closed-loop control of entire networks. This means networks can be dynamically adjusted and optimized without human intervention, based on real-time data and conditions.
2. **Enhanced Industrial Applications**: In industrial settings, software-based 5G networking will allow for greater observability and fine timescale responses to mechanical errors and equipment failures. Which could lead to significant improvements in efficiency and safety, as networks can automatically respond to issues as they arise.
3. **Innovation in Network Technology**: The advancement in network technology will encourage students and programmers to experiment with new ideas through academic projects. This could lead to the development of new applications and services that leverage the capabilities of 5G networks in ways that are currently unforeseen.
4. **Real-Time Network Verification**: One of the groundbreaking possibilities is the ability to verify in real time that the network is operating according to a specific set of specifications. This could significantly enhance network reliability and security, as issues can be identified and addressed instantaneously.
5. **A Cambrian Explosion of New Ideas**: The combination of new IoT applications with public and private 5G networks is expected to lead to a surge in innovation, resulting in a wide range of new applications and services that are difficult to predict at this stage. This could transform various sectors, including manufacturing, transportation, healthcare, and more.
6. **Edge Computing and AI Applications**: The development of software-based 5G networking will also accelerate the growth of edge computing, where data is processed closer to where it is generated rather than in a centralized data center. This, combined with AI, will enable real-time data analysis and decision-making, opening up new possibilities for smart cities, autonomous vehicles, and personalized healthcare, among others.

Reference: MIT Technology Review. (2021). Building the future with software-based 5g networking. <https://www.technologyreview.com/2021/12/15/1042187/building-the-future-with-software-based-5g-networking/>

2. What vacuum of policies/standards existed concerning this applications?

The FCC's agency has been actively addressing the vacuum of policies and standards concerning 5G applications through a comprehensive approach that spans over different things like spectrum allocation, infrastructure policy, modernization of regulations, and other innovative actions (FCC, 2023). Here's how these efforts relate to the potential vacuums:

1. **Spectrum Allocation and Management**: The FCC has made significant strides in making additional spectrum available for 5G services across various bands (high-band, mid-band, low-band, and unlicensed spectrum). This directly addresses the vacuum in efficiently allocating and managing the spectrum necessary for 5G deployment, ensuring that there is enough bandwidth to support the wide range of 5G applications and user’s/customer’s.
2. **Infrastructure Policy**: By updating infrastructure policies FCC has encouraged investors to invest in 5G networks and aiming to streamline the state and local approval process, the FCC is tackling the need for policies that guide the deployment of 5G infrastructure, such as small cells, which are crucial for the dense network fabric required by 5G.
3. **Modernizing Outdated Regulations**: The FCC's efforts to modernize regulations, including the establishment of the 5G Fund for Rural America and updating rules for utility pole attachments, address the need for updated regulatory frameworks that support the deployment and expansion of 5G networks, including the wired backbone that these networks rely on.
4. **Supply Chain Integrity**: By adopting rules that prevent the use of taxpayer dollars for purchasing equipment from companies posing a national security threat, the FCC is addressing the vacuum in security standards for 5G networks. This ensures the integrity and security of American communications networks and their supply chains.
5. **Promotion of Open and Interoperable Networks**: The FCC's Forum on 5G Open Radio Access Networks and the creation of Innovation Zones are steps towards fostering an environment that supports the development of open, interoperable, and virtualized network architectures. This addresses the need for standards ensuring interoperability and compatibility across different 5G devices, networks, and services.

These actions by the FCC demonstrate a proactive approach to filling the policy and standard vacuums that could hinder the deployment and adoption of 5G technology. By making more spectrum available, modernizing infrastructure policies, updating regulations, ensuring supply chain integrity, and promoting innovation.

Reference: FCC. (2023). America's 5g future. <https://www.fcc.gov/5G>

1. What conceptual muddles exist concerning this application?

In "5G Security Challenges and Solutions: A Review by OSI Layers" (Kumar, 2021) delves into the complex security landscape of 5G technology, identifying different conceptual muddles/challenges that arise with the advanced features and widespread application of 5G across various sectors. It’s characterized by its high data rate, low latency, and massive connectivity, necessitates a reevaluation of traditional security measures. The paper outlines how 5G's integration into critical infrastructure and services introduces multiple security challenges, needing a layered approach to security as per the OSI model. It highlights the unique vulnerabilities and threats at each layer in the OSI model, by telling the importance of collaborative efforts across these layers to ensure comprehensive security.

The shift in security paradigms from centralized to distributed architectures, emphasizing the need for dynamic, flexible security solutions that can adapt to the evolving threat landscape of 5G networks. It also points to the increased surface for cyber-attacks due to the extensive use of software-defined networking (SDN) and network function virtualization (NFV), which, while enabling greater efficiency and flexibility, also introduce new vulnerabilities. I think it’s the same case in to increase user by increasing the available band has suggest by FCC which can help in having more room for development and introducing new security measures.

The ongoing research and development to address the identified security gaps and challenges. It calls for an approach of combining advancements in cryptography, network security and policy regulation to develop robust security frameworks that can protect against both current and emerging threats in the 5G Network.

Reference:

Vidhani, S. M., & Vidhate, A. V. (2022). Security challenges in 5g network: a technical features survey and analysis. In 2022 5th international conference on advances in science and technology (icast). (pp. 592-597). 10.1109/ICAST55766.2022.10039654

Sullivan, S., Brighente, A., & Kumar, S. (2021). 5G Security Challenges and Solutions: A Review by OSI Layers. <https://engagedscholarship.csuohio.edu/cgi/viewcontent.cgi?article=1506&context=enece_facpub>

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