UNITED STATES OF AMERICA

FEDERAL COMMUNICATIONS COMMISSION

TECHNOLOGICAL ADVISORY COUNCIL MEETING

Thursday, December 19, 2024

The advisory committee met in-person at the FCC (45 L Street NE, Washington, D.C. 20554) and via Microsoft Teams video teleconference, at 10:00 AM Eastern time, Dean Brenner, Chair, presiding.

COMMITTEE MEMBERS PRESENT

First Name	Last Name	Company Representing
Shahid	Ahmed	NTT Ltd
Rob	Alderfer	Charter Communications, Inc.
Mark	Bayliss	Visual Link Internet
Donna	Bethea-Murphy	Viasat
Dean	Brenner	Aira Technologies
Michael	Cataletto	Scientel Solutions, LLC
Lynn	Claudy	NAB
Andrew	Clegg	Wireless Innovation Forum
Brian	Daly	AT&T
Bill	Davenport	Cisco Systems, Inc.
David	Kaufman	Amazon (Alternate Member)
Adam	Drobot	Stealth Software Technologies, Inc.
Peter	Gammel	Ubilite, Inc.
Monisha	Ghosh	Wireless Insitute, Notre Dame
Iain	Gillott	Wireless Infrastructure Association
Abhimanyu	Gosain	Northeastern University
Lisa	Guess	Ericsson
Sachin	Gupta	National Rural Electric Cooperative Association
David	Gurney	Motorola Solutions Inc.
Dale	Hatfield	University of Colorado at Boulder
Jason	Jackson	Kyndryl
Karri	Kuoppamaki	T-Mobile USA
Tian	Lan	George Washington University
Gregory	Lapin	ARRL
Dan	Mansergh	Apple Inc.
Brian	Markwalter	Consumer Technology Association
Lynn	Merrill	NTCA - The Rural Broadband Association
Amit	Mukhopadhyay	Nokia
Jack	Nasielski	Qualcomm Incorporated

Eric	Klein	Sirius XM Radio Inc. (Alternate Member)
Roger	Nichols	Keysight Technologies, Inc.
Madeleine	Noland	ATSC
Jon	Peha	Metro 21, Smart Cities Institute
Michael	Regan	Telecommunications Industry Association
Thomas	Sawanobori	CTIA
Henning	Schulzrinne	Columbia University
Marvin	Sirbu	Carnegie Mellon University
LiChing	Sung	NTIA
Ardavan	Tehrani	Samsung
Rikin	Thakker	NCTA - The Internet & Television Association
Michelle	Thompson	Open Research Institute
David	Young	ATIS

COMMISSION STAFF PRESENT

First Name	Last Name	Title
Ira	Keltz	Acting Chief, Office of Engineering and Technology
Martin	Doczkat	Designated Federal Officer
Sean	Yun	Alternate Designated Federal Officer

AGENDA

10:00 am – 10:15 am	Opening Remarks
10:15 am – 11:30 am	Advanced Spectrum Sharing WG Presentation
11:30 am – 12:45 pm	AI/ML WG Presentation
12:45 pm – 02:00 pm	Lunch
02:00 pm – 03:15 pm	6G WG Presentation
03:15 pm – 03:30 pm	Closing Remarks
03:30 pm	Adjourned

SUMMARY

Dean Brenner, the chairman of the FCC's Technological Advisory Council (TAC), welcomes attendees to the meeting explaining the group’s role as advisors on technological issues to the FCC. He highlights that the TAC was formed under a charter established earlier in the year, serving as a Federal Advisory Committee. Brenner outlines the committee's mission, which involves collaborating in working groups to generate recommendations aimed at enhancing technological advancements in the United States. He expresses pride in leading the TAC for three years, noting the commitment to delivering top-notch

advice. The session is set to feature insights from three specific working groups focused on advanced spectrum sharing, artificial intelligence and machine learning, and the upcoming 6G technology. The emphasis is on providing substantial guidance to the FCC to navigate significant technological challenges and opportunities ahead.

As 6G is currently in its formative stages, the chair emphasizes the critical need for ensuring that U.S. interests are effectively represented in the global development of this technology. Beyond 6G, the conversation acknowledges the importance of spectrum sharing in the context of spectrum management, highlighting its relevance across various federal agencies. The chair also notes the increasing significance of AI/ML, despite the FCC lacking a dedicated bureau for these technologies. The discussion underscores the broad implications of these topics, encouraging participation from all attendees, who contribute as volunteers in this collaborative effort to provide unbiased advice. This quarterly meeting represents the culmination of extensive efforts from multiple working groups, all supported by the diligent FCC staff who ensure that the committee's output is effective and relevant.

Ira Keltz, the acting chief of the Office of Engineering and Technology, acknowledges the importance of the TAC's work and its impact on U.S. telecom policies. He emphasizes the need to maintain the U.S.'s competitive edge. Keltz expresses gratitude for the ongoing efforts of the various working groups, highlighting their critical role in shaping effective policies. He emphasizes the collaborative relationship between the TAC and the larger telecom industry, indicating that their work not only assists governmental processes but also helps ensure that the U.S. maintains its competitive edge in the telecommunications sector. The acting chief conveys eagerness to hear the upcoming presentations, signaling a focus on actionable insights and strategies that will advance the objectives of the council and the industry as a whole.

Martin Doczkat, the designated federal officer of the TAC, outlines the progress made thus far and the goals for the upcoming year as they approach the conclusion of the current charter. Doczkat provides logistical details for the meeting and encourages participation in discussions from both in-person and online attendees. He notes the substantial work accomplished throughout the year, leading towards the completion of the charter by September of the following year. As the meeting progresses, he expresses anticipation for a fruitful discussion aimed at developing actionable recommendations, setting a collaborative tone for the conversations to follow. Following this, Sean Yun expresses gratitude for the collaborative efforts over the past year, leading into a presentation from the co-chairs of the Advanced Spectrum Sharing working group.

- **ADVANCED SPECTRUM SHARING WG**

Monisha Ghosh and Andrew Clegg, co-chairs of the advanced spectrum sharing working group, share insights about their progress over the past nine months. They express enthusiasm for concluding various items in their agenda. Highlighting the group's strong engagement, they note that meetings are held weekly, attracting nearly thirty participants from diverse sectors including industry representatives, academics, and other stakeholders. This extensive involvement demonstrates a collaborative effort to address spectrum sharing challenges. The group has benefited from presentations by subject matter experts, enhancing their understanding of complex issues as summarized below.

- Mike Marcus contributed insights on coexistence and spectrum sharing above 100 GHz, while David Willis and Steve Leach provided valuable information on spectrum sharing practices in the UK's upper 6 GHz band. The discussions aim to align with the group's charter items, emphasizing a thorough exploration of advanced spectrum sharing strategies.
- Research presented by representatives from UCSD examined how network topology influences energy efficiency, specifically addressing charter item 9. Discussions included presentations on clutter and propagation loss, critical for understanding interference among different spectrum users. Additional insights were provided on the 3.7 GHz frequency concerning radio altimeters. A DARPA program aimed at enhancing receiver performance through "Compact Front-End Filters," was also introduced.

The meeting then focuses on the intricate discussions surrounding propagation models and their critical role in enhancing spectrum sharing efficiency. Initial charter items are introduced, highlighting the collaborative efforts of the group in drafting white papers and preliminary recommendations. The first item addresses future advancements in sharing frameworks, while the second item examines the evolving nature of spectrum sharing models to meet increasing demands across various services. The conversation then shifts to the third charter item, which explores optimizing propagation models to enable less conservative and more realistic assumptions, thus supporting improved sharing capabilities. Further discussions involve facilitating spectrum repurposing and addressing inter-band issues to better accommodate new spectrum environments. The meeting also delves into cutting-edge receiver technologies, emphasizing potential advancements in interference reduction through active antenna arrays and filters. The aim is to conduct comprehensive surveys on current technologies and their future potential, linking these efforts to ongoing government projects.

A discussion led by Andrew Clegg highlights candidate bands for low power indoor operations, particularly in contexts like factory automation, and the exploration of effective sharing mechanisms for these bands. There is also a significant emphasis on the challenges associated with sharing services above 95 GHz, particularly in the millimeter wave and THz regions, where spectrum demand is high. Jason Jackson leads this effort, collaborating with experts like Mike Marcus to navigate the complexities involved. Another topic addresses the potential role of sensors in enhancing spectrum use and database management. Additionally, considerations are made regarding the trade-offs between effective spectrum utilization, sustainability, and energy efficiency, specifically noting the substantial power consumption associated with 5G base stations.

Rob Alderfer contributes initial thoughts on these sustainability issues, underscoring the importance of energy efficiency in future developments to support the FCC in identifying potential spectrum bands for sharing and repurposing. The discussion highlights the surprising power consumption of typical 5G base stations, underscoring the urgency of addressing these concerns. The agenda also includes exploring methods that could aid the FCC in pinpointing spectrum bands ripe for sharing and repurposing, along with considerations for prioritizing these bands. The conversation extends to optimal coordination processes among stakeholders, which will be further examined in subsequent months.

A high-level overview indicates the group's ongoing engagement with ten charter items over a span of nine months, with a focus shifting to five specific items that hold preliminary recommendations or considerations. To aid in understanding the relationships among these items, a chart is presented,

illustrating the interconnectedness of many charter items. This visual representation underscores the complexity of the topics at hand and suggests that addressing these interconnected items will require continued collaboration and focus in the months to come. The atmosphere is one of diligent engagement, reflecting a commitment to thorough examination and thoughtful consideration of the various elements at play.

Amit Mukhopadhyay presents on emerging frameworks and architectures for spectrum sharing, focusing on intersystem sharing and its economic viability. Amit elaborates on the advancements in small cell deployment, emphasizing the significant growth in this sector, with a notable increase of around 100,000 nodes in the past year. The discussion highlights the synergy between spectrum sharing and energy efficiency, as lower power networks are designed to coexist with federal incumbents, facilitating more effective spectrum use. The presentation points out that the majority of mobile device usage occurs indoors, where users typically rely on local Wi-Fi networks, which are becoming increasingly efficient due to new technological standards. This indoor traffic is predominantly driven by video consumption, reinforcing the need for enhanced network capabilities to manage high data loads. By focusing on serving traffic closer to users, the growth of small cells is further supported, creating opportunities for both increased spectrum availability and improved energy efficiency in wireless communications.

The meeting then focuses on the discussions surrounding emerging technologies and their potential to enhance spectrum sharing, particularly through innovations like digital twins and spectrum sensing capabilities. A detailed analysis highlighted the increasing data demands in both fixed and mobile networks, emphasizing how stationary activities, such as video consumption, place heavier loads on fixed networks. The dialogue explored advancements in mobile network architectures that could lead to greater energy efficiency, notably through shared spectrum infrastructures and optimization techniques. Participants noted that while mobile networks may see increased energy use with the addition of spectrum bands, optimizations could mitigate such effects. Furthermore, there was consensus on the importance of energy efficiency strategies across various technologies, including artificial intelligence and Open RAN. The conversation underscored the ongoing need to validate energy utilization patterns and explore the implications of new network architectures, while also considering the energy consumption of devices in relation to uplink traffic.

Final conclusions and recommendations include emphasizing techno-economic impacts and the adoption of closed-loop systems for spectrum sharing. The meeting delves into the critical discussion surrounding energy efficiency in communications networks, particularly focusing on the distinctions between unicast and broadcast methods. Participants explore the implications of energy consumption per data unit, hypothesizing that during peak demand events, broadcast may prove more efficient. The conversation shifts to the challenges of understanding the energy footprint associated with idle devices, especially in larger homes equipped with mesh networks, which often consume power without active use. Emphasis is placed on the need for better energy efficiency practices, and the role of state energy regulators in establishing efficiency standards for consumer devices is highlighted. This regulatory involvement, while beneficial, has not fully addressed the broader energy efficiency needs within the telecommunications sector. The meeting ultimately underscores the importance of adopting closed-loop systems for spectrum sharing and the techno-economic impacts these developments could bring to the industry.

The dialogue regarding Amit's recent presentation is extended, emphasizing the importance of addressing questions and comments. The conversation quickly pivots to explore economic implications associated with spectrum sharing, a topic that garners significant interest among attendees. As various points of view are expressed, the discussion delves into the necessity of fostering trust in the spectrum sharing framework. Participants examine how economic factors can influence perceptions and the overall effectiveness of spectrum sharing initiatives. The atmosphere is one of collaborative inquiry, with a focus on finding solutions that balance economic viability and public trust, ultimately aiming to enhance the operational efficiency of spectrum use in the telecommunications sector. This exchange highlights the critical role of economic considerations in shaping policies and practices within the technological landscape.

Discussion on lessons learned focuses on the progress and achievements in spectrum sharing initiatives, particularly emphasizing the collaborative efforts surrounding the AFC and low power indoor frameworks. These frameworks have been pivotal in preventing interference while facilitating innovative applications. An in-depth technical process was undertaken, allowing engineers and stakeholders to collaborate effectively, ensuring that indoor usage would maintain sufficient signal separation and loss to prevent disruptions to existing systems. This straightforward approach has proven successful, with no reported interference affecting incumbent users, and has fostered commercial opportunities, particularly as most activity occurs indoors. Additionally, the discussion touched on the importance of utilizing reputable and experienced entities for analysis to avoid conflicts arising from biased evaluations by competing consultants. Overall, the meeting underscored the effectiveness of these frameworks in promoting efficient spectrum usage while maintaining system integrity.

During the meeting, significant concerns were raised regarding the need for reliable analysis to prevent biases that may arise from financially motivated consulting. It was emphasized that utilizing established and impartial entities, such as FCC Lab or university consortia, could foster trustworthy evaluations. A recurring theme was the lack of consensus on critical operating parameters, which included discussions on the proximity to airports, tower characteristics, and the specifics of airfield categorization. Clarifying these definitions early in the process was deemed crucial for efficient decision-making. The dialogue also highlighted the importance of setting clear expectations regarding the accommodation of older devices and the need for a consistent standard to avoid last-minute disputes that could undermine previously reached agreements. The contributions of dedicated staff in evaluating technical claims and maintaining the integrity of the process were acknowledged as vital to ensuring that rules are thoughtfully developed and adhered to.

Recommendations were made to redefine indoor-only policies, emphasizing a focus on containment strategies that consider both urban and rural contexts. The speaker acknowledged the complexities involved in managing indoor usage, where different environments present unique challenges. The recommendations aimed for a more holistic approach to containment, recognizing that urban locations often complicate the task compared to rural settings, such as outdoor strip mines where containment can be more straightforward. The WG also considered existing work and discussions to identify potential frequency bands and sharing mechanisms that could enhance indoor usage efficiency. A particular focus was placed on leveraging the Spectrum Access System (SAS) to facilitate collaborative sharing, aiming for a unified framework to manage the introduction of diverse bands and technologies effectively. This approach highlights the need for careful consideration of both technical and practical outcomes in the evolving landscape of indoor communications.

The potential for leveraging SAS and enhanced measurements using device sensors for a unified spectrum sharing approach was discussed, centered on the strategic advantages of utilizing SAS alongside advanced measurement technologies, emphasizing a collaborative and unified approach to spectrum sharing. Participants highlighted the evolving nature of sharing mechanisms as new bands and technologies emerge, suggesting that a consolidated framework could enhance operational efficiency. The conversation also pointed to the potential of using the vast amounts of data generated by affordable sensors, such as those embedded in smartphones, to create a more comprehensive understanding of spectrum usage. This telemetry could enable the monitoring of previously uninstrumented areas, bolstering efforts in spectrum management. Additionally, references were made to existing policies from the cable industry that might be adapted to support next-generation sharing mechanisms. The importance of higher GHz bands was noted for their easier containment in indoor environments, while acknowledging the need for policies addressing more challenging industrial settings. Near consensus was reached on recommendations, pending a formal vote by the working group.

Several key preliminary recommendations aimed at improving spectrum management and fostering collaboration within the industry. The first recommendation emphasized adopting a containment-centric approach to spectrum management, which would involve defining specific bands for distinct use cases to minimize conflicts and enhance efficiency. The second proposal highlighted the importance of establishing measurable standards, leveraging widely available sensors to monitor signal strength and interference, thereby facilitating regulation within that environment. Thirdly, the discussion underscored the necessity of industry collaboration, advocating for a shared data repository to streamline research and automate band selection, reducing reliance on numerous experts for system adjustments. Lastly, the potential of Dynamic Spectrum Access technology was discussed, addressing the challenges posed by limited spectrum resources and advocating for better measurement and assessment of spectrum usage, which is currently lacking. These recommendations aim to enhance overall efficiency and adaptability in spectrum management practices.

A discussion focuses on the promising potential of Dynamic Spectrum Access as a solution to the challenges posed by limited spectrum resources. Emphasis was placed on the need for effective management of these resources, which includes not only their registration but also the measurement of their usage and overall effectiveness. Currently, these measurements are not being conducted, which hinders optimal provisioning and quality assessment of spectrum use. Participants acknowledged the roadmap being developed to address these issues and expressed a desire to expedite its implementation. Comments from attendees reflected appreciation for the clarity of the presentation, with one participant noting the relevance of the topic to ongoing challenges in the 6 GHz band. The concept of containment in spectrum management was particularly welcomed, highlighting its importance in the broader context of communication technologies. The atmosphere was collaborative, fostering a shared commitment to advancing spectrum efficiency and innovation.

During the meeting, industry representatives expressed their support for containment concepts in challenging environments such as stadiums and mines. One participant highlighted the frequent issues encountered with the 6 GHz band, noting that customers often purchase Wi-Fi equipment without fully understanding its limitations, particularly the restriction to indoor use. This confusion is especially evident in scenarios like mining operations, where the distance from fixed links raises questions about equipment use. Another example discussed was sporting venues, where the distinction between indoor

and outdoor spaces can blur, creating challenges in applying regulations. The conversation shifted to the potential for using 6 GHz technologies in embedded vehicles and aircraft, which are generally well-shielded yet do not conform to traditional models. Participants emphasized the need for a streamlined approach to avoid the cumbersome process of obtaining waivers for various applications, allowing for more efficient use of the spectrum in diverse settings.

In the meeting on efficiency and sustainability in spectrum use, a discussion unfolds regarding the intersection of spectrum sharing, network efficiency, and energy sustainability. Initial findings reveal that spectrum sharing not only enhances efficiency but also promotes energy savings, particularly through increased network density. Research from UCSD indicates that closer proximity of network nodes to end users significantly boosts energy efficiency by reducing propagation and non line of sight losses. This observation is supported by detailed simulations that suggest small cell networks can achieve up to three times the energy efficiency of traditional macro networks, primarily by optimizing node placement. The ongoing expansion of small cell deployments is noted, with a recent report highlighting a substantial increase in such nodes, which operate on lower power and share spectrum with federal users. The synergy between shared spectrum frameworks and energy-efficient operations is emphasized as a key area for further exploration and validation in future recommendations.

Trends indicate growth in small cell networks, which are low power and use spectrum shared with federal incumbents, enhancing energy efficiency. Recent insights reflect a significant expansion in small cell networks, with deployments reaching 400,000 nodes, marking an increase of nearly 100,000 within a year. These networks operate on low power, utilizing spectrum shared with federal incumbents, which not only facilitates more efficient use of spectrum but also promotes energy efficiency. The synergy between spectrum sharing and energy efficiency is emphasized as these lower power commercial transmissions are designed to coexist with incumbent users. Additionally, a notable trend reveals that users predominantly engage with mobile devices indoors, with around 90% of data being served through indoor Wi-Fi networks. This indoor usage pattern underlines the effectiveness of local Wi-Fi in managing mobile traffic, contributing to energy savings due to reduced distance and fewer non-line-of-sight losses. The ongoing evolution of Wi-Fi technology, including new standards and efficiencies, further supports the growth of small cell networks as they cater to the increasing demand for data-intensive applications like video.

Data trends show video as a major application, reinforcing the need for efficient local network delivery to reduce energy consumption. Data trends reveal that video consumption is a significant application in both fixed and mobile networks, predominantly occurring in indoor settings like homes and offices. This underscores the necessity for efficient local network delivery systems to effectively manage the increased data load on fixed networks compared to mobile ones. By focusing on optimizing wireless delivery through local networks, the aim is to enhance energy efficiency for local traffic. Additionally, advancements in mobile network architectures are poised to improve energy efficiency, despite potential increases in energy consumption due to the addition of spectrum bands and larger antenna arrays. However, techniques such as shared spectrum infrastructure and network optimization can help alleviate these effects. The evolution from earlier mobile technologies to modern implementations allows for greater capacity at reduced energy costs. Similar trends are observed in Wi-Fi, where increased speeds have not significantly raised energy consumption at access points, promoting further energy-efficient practices across the board.

Technological advancements in network architecture, like shared spectrum and optimized deployments, promise increased energy efficiency. In a recent meeting focused on technological advancements in network architecture, discussions highlighted the promising potential of shared spectrum and optimized deployments to enhance energy efficiency. Observations noted a trend where, despite increasing data delivery speeds in Wi-Fi technology, energy consumption from access points has remained relatively stable. This data, representing an industry-wide perspective across various routers and vendors, underscores the commitment of an industry consortium to fostering further energy efficiency improvements. The conversation advanced to exploring next steps in this ongoing initiative, emphasizing the importance of continuing efforts to achieve greater energy savings while accommodating the growing demand for data capacity. The atmosphere within the meeting reflected a proactive approach to integrating technological innovations that align with sustainability goals.

- **AI/ML WG**

The importance of understanding the energy implications of AI-driven network architectures and the role of AI in enhancing network efficiency were emphasized. The discussion focused on the significant implications of integrating AI and machine learning into wired network performance, highlighting various benefits that could reshape network operations. Key observations presented included the potential for dramatically enhancing network performance, which could lead to increased efficiency and reliability. The insights also pointed out the dual advantage of minimizing failure rates in both wired and wireless networks, thus ensuring smoother communication and connectivity. Furthermore, operational costs could see a substantial reduction, which is particularly relevant for organizations like the FCC. This efficiency gain is essential for better utilization of resources, ultimately leading to advancements in how networks are managed and optimized for future demands. The meeting underscored the critical need for understanding these energy implications as AI-driven network architectures evolve, emphasizing their role in enhancing overall network efficiency.

Discussions covered the impact of virtualization on energy use and the need for more detailed data on baseline and incremental power consumption. The meeting examined the transformative effects of virtualization on network performance, emphasizing enhancements in reliability and significant reductions in operational costs and energy consumption. Discussions highlighted the importance of optimizing spectrum utilization, which could lead to more efficient national networks. However, the integration of artificial intelligence and machine learning (AI/ML) into these networks presents several challenges. Concerns were raised regarding the establishment of appropriate policies and legal frameworks, ensuring data privacy and security, and the inherent flaws within AI technologies, such as algorithm bias and model trustworthiness. The increasing resource demands of AI/ML, including computational power and storage, were also noted. To address these issues, preliminary recommendations were made, suggesting the formation of organizations to guide interoperability and develop network architectures that leverage AI/ML. An emphasis was placed on the necessity for collaboration both domestically and internationally to achieve technological leadership and harmonize standards.

The role of AI in reducing power consumption for uplink traffic from devices was noted, with suggestions to consider the energy efficiency of network protocols. During a recent meeting of the TAC, discussions centered around the significant role of artificial intelligence in optimizing power

consumption, particularly for uplink traffic from various devices. The meeting highlighted the importance of exploring energy-efficient network protocols to enhance overall system performance. Members emphasized the need for innovative approaches that leverage AI technologies to minimize energy usage without compromising connectivity. As the dialogue progressed, various strategies and recommendations were put forth, focusing on the intersection of advanced technology and sustainable practices. The atmosphere fostered a collaborative spirit, encouraging participants to consider both current challenges and future opportunities in the realm of energy efficiency within telecommunications.

The discussion begins with the importance of understanding when technology reaches maturity for safe use. AI/ML techniques can address data quality through data cleaning, anomaly prediction, and natural language processing. The meeting highlights the critical need for a systematic approach to gauge when technology attains a level of maturity that ensures its safe application. Emphasis is placed on AI and machine learning techniques, particularly in enhancing data quality. Several key strategies are discussed, starting with the necessity of cleaning existing data to ensure accuracy. Anomaly prediction is introduced as a method to fill in gaps within datasets, while the use of natural language processing is noted for its potential to improve data interpretation. Reinforcement learning is mentioned as a means to establish adaptive rules, fostering better data integration across various networks. The conversation also touches on leveraging AI for anonymizing data, which is crucial for privacy protection, alongside other cryptographic methods like multiparty computing and encryption, ensuring a robust framework for data security and integrity.

AI can be used for anonymous data and data protection, combining with cryptological methods like encryption and multiparty computing. The discussion centers around the application of artificial intelligence in the realm of anonymous data handling and data protection. It highlights the potential of AI to enhance privacy measures by processing data without revealing identities. Additionally, the conversation emphasizes the importance of integrating AI with advanced cryptological techniques. Methods like multiparty computing and encryption are presented as essential tools in safeguarding data, ensuring that sensitive information remains protected while still being accessible for analysis. The overall atmosphere of the meeting underscores a collaborative approach to leveraging technology in a secure manner, fostering both innovation and privacy.

Recognition of existing AI/ML testing frameworks in other sectors is emphasized, with a focus on telecommunication networks. Testing involves the entire network lifecycle, requiring data sets and continuous model evaluation, network testing and potential in 5G, and the importance of forming the right group within the FCC to handle AI/ML testing is discussed that AI/ML can help manage the complexity of 5G networks through parameter setting and anomaly detection.

- **6G WG**

The meeting discusses the recommendation on a new framework for IMT 2030. Technical performance requirements are being developed to meet this framework, which will set the base for 3GPP to define standards. Evaluation criteria and methodology have just begun and will continue through mid-2026. Templates for evaluation will be available to the industry, and technology proposals will be submitted back to the ITU for evaluation. The process for IMT 2030 is similar to that of 5G and

previous IMT generations. Future work involves defining IMT 2030. Overview of diagrams define usage scenarios for IMT 2030, extending enhancements from 5G in various communication aspects. Four overarching aspects include sustainability, connecting the unconnected, ubiquitous intelligence, and security and resilience. Performance requirements for IMT-2030 are underway, and enhanced capabilities are being considered. Nine trends toward 6G are identified, including ubiquitous intelligence and sustainability.

3GPP is defining mobility specifications for IMT-2030. The 6G study is in progress, with Release 20 content to be decided by 2025. A 3GPP workshop on 6G is planned for March 2025 to define vision and priorities for 6G. Release 21 will involve specification work for 6G, which will be the basis for IMT-2030 submission. SA1 study on network security and cloud deployment roles in 6G is underway, with a focus on secure network access.

Integrated sensing and computing, ubiquitous connectivity, and resilient positioning for 6G, will provide spatial information about devices and environments, supporting various use cases. The discussion centers around the advancements in integrated sensing and computing, emphasizing its potential to provide comprehensive spatial information about both connected and unconnected objects. This technology is poised to enhance various applications, including the coordination of search and rescue efforts in extensive disaster zones, ensuring safety for vulnerable individuals in urban environments, and creating high-resolution topographic maps. Furthermore, it plays a crucial role in supervising low-altitude unmanned aircraft and managing traffic effectively. As the focus shifts towards the development of 6G networks, integrated sensing and computing emerges as a vital area of exploration, aiming to facilitate ubiquitous connectivity across all locations, even in remote areas characterized by difficult geographic conditions like mountainous terrains. The emphasis on these advancements signifies a significant step toward improving technology's role in everyday life and emergency preparedness.

Efforts to ensure ubiquitous connectivity using a combination of terrestrial and non-terrestrial networks, including satellites. The meeting focuses on the initiative to achieve comprehensive connectivity through a blend of terrestrial and non-terrestrial networks, emphasizing the importance of reaching remote areas with challenging geographical features, such as mountains and forests. The discussion highlights the goal of ensuring that connectivity extends to various terrains, including aerial operations and open ocean environments. To achieve this, a combination of technologies is proposed, which includes not only satellites but also high-altitude platform stations (HAPS), air-to-ground networks, and unmanned aerial vehicles. The aim is to create a seamless experience for end users, meeting their expectations for bit rates and latency across different networks. Additionally, there is a concern regarding the reliance on satellite networks for positioning services, as disruptions such as jamming or obstructions pose significant risks. The development of the 6G system addresses these vulnerabilities to enhance resilience in connectivity.

Resilient positioning in satellite networks is crucial, with 3GPP technologies providing positioning services. The discussion emphasizes the importance of resilient positioning within satellite networks, highlighting a significant reliance on satellites for accurate positioning services. This reliance introduces potential vulnerabilities, such as threats from jamming, spoofing, or physical obstructions that could disrupt satellite connectivity. The advent of the 6G system, which will incorporate satellite access, offers a promising avenue for enhanced positioning services through 3GPP technologies, as opposed to relying

on independent non-3GPP methods. This resilience in positioning is identified as a critical area for development in 6G technology. Additionally, immersive communication is explored, with applications in interactive gaming and seamless immersive experiences in education being notable examples. The ongoing evolution from 5G to 6G also aims to enhance fixed wireless access, ensuring optimized network capabilities to facilitate connections for stationary devices, thereby broadening the scope of potential applications and services in the next generation of communication technology.

Immersive communication and sustainability are emphasized as part of 6G developments. The discussion highlights the advancements in communication technologies, particularly focusing on the transition from 5G to 6G. It emphasizes the potential of seamless immersive reality in educational contexts, showcasing various use cases that could revolutionize learning experiences. As fixed wireless access continues to gain traction with 5G, the conversation points out how these capabilities are being enhanced and integrated into 6G frameworks. This integration aims to deliver optimized network performance, especially for stationary devices, thereby improving connectivity and accessibility. The commitment to fostering immersive communication while prioritizing sustainability underscores the transformative vision for the future of technology, positioning 6G as a pivotal advancement in the evolution of network systems.

Planning is underway for a 3GPP workshop to discuss integration and interoperability with Open RAN systems. Sustainability emerges as a pivotal focus, aiming to enhance energy efficiency in 6G systems, particularly in comparison to their 5G predecessors. Planning is in progress for a forthcoming workshop organized by the alliance in April, intended to explore the harmonization of the open interfaces and architecture of Open RAN with the 3GPP protocols. The objective is to facilitate seamless integration and interoperability between 3GPP and Open RAN systems, with a particular emphasis on leveraging artificial intelligence and machine learning for network management that transcends both open and traditional RAN structures. This workshop is set to articulate the vision and essential requirements for the next generation of connectivity, building upon the groundwork laid by 5G and adhering to Open RAN principles. Additionally, the establishment of an Open RAN committee by ATIS aims to scrutinize the deployment of Open RAN in North America and evaluate the potential adaptation of Open RAN alliance specifications into ATIS standards.

ATIS created an Open RAN committee to evaluate Open RAN alliance specifications for North American standards. The Open RAN committee has been established by ATIS to delve into the principles and topics surrounding Open RAN, particularly focusing on its implementation and utilization in North America. This initiative aims to evaluate the specifications set forth by the ORAN Alliance for potential integration into ATIS standards, mirroring the existing transposition process applied to 3GPP standards. The committee's work seeks not only to adopt these specifications as North American standards but also to identify any modifications necessary to address specific regional requirements. These insights may then be relayed back to the O-RAN Alliance for further consideration. The discussion also hints at a broader perspective on future technologies, including an inclusive examination of what 6G could encompass, signaling a shift in focus from traditional standards frameworks.

IEEE is involved in future network evolution, focusing on strategic areas beyond 3GPP. The discussion centers around the evolution of future network technologies, with an emphasis on the role of IEEE in shaping next-generation communication systems beyond the established 3GPP framework. Analyzing the unique requirements of North America, potential adjustments to existing standards may

be necessary, which could then be proposed to the O-RAN Alliance. The narrative highlights a holistic vision for 6G, recognizing that while ITU and 3GPP are crucial, other technological pathways must also be explored. The presentation details various IEEE projects aimed at developing standards for massive architecture frameworks and smart city communication architectures, which complement 3GPP initiatives and enhance the overall ecosystem. Furthermore, the IEEE Future Networks Technical Community is pioneering an innovation test bed that facilitates collaboration among diverse participants in 5G and 6G technologies, fostering a synergistic environment for technological advancement and roadmap development.

The IEEE 5G, 6G innovation test bed serves as a collaborative platform that brings together a diverse range of stakeholders involved in the advancement of 5G and 6G technologies. This cloud-based network facilitates various testing and innovation initiatives, focusing on critical use cases such as interoperability, conformance testing, load testing, and security assessments. By allowing the integration and testing of different hardware and software components, the test bed significantly reduces the costs associated with experimentation and development, fostering faster innovation amidst economic constraints. Furthermore, it presents valuable opportunities for academic institutions to utilize the test bed as a resource for education, workforce development, and research projects, thereby supporting a holistic approach to technological advancement. The inclusive nature of this initiative encourages a win-win collaboration among industry players and educational entities alike, aiming to shape the future landscape of communication technologies.

U.S. Government efforts in 6G development and spectrum strategies were reviewed including, National Security Council's release on principles for 6G focusing on open and resilient networks, National Spectrum Strategy's outlines in relevancy on future networks, including AI and microelectronics, and World Radio Conference resolutions impact 5G and 6G spectrum perspectives. The U.S. has positions on spectrum sharing and national spectrum strategy for future technology studies.

Upcoming workshops and use case studies for 6G. The meeting delves into the 6G use case workshop held in May 2024, emphasizing its significance as an initial step in identifying potential applications for 6G technology. The discussion highlights the necessity of exploring a broad spectrum of use cases that could be enabled by this emerging technology, which in turn will inform the development roadmap and technological advancements. The collaborative effort, led by the SA1 group, attracted around 200 stakeholders, including a significant representation from global consortia focused on various sectors such as satellite communications, automotive innovations, and public safety. This workshop served as a platform for international participants to converge and share a unified vision for the future of 6G, allowing diverse perspectives to shape the ongoing development of this next-generation technology.

The workshop was a collaborative effort with participants from various global consortia and interest groups, which gathered a diverse assembly from various global consortia and interest groups, focusing on multiple sectors such as satellite, automotive, and public safety. This collaborative event provided a platform for international participants, including representatives from Japan, South Korea, North America, and Europe, to share a collective vision for potential 6G applications. The discussions emphasized the exploration of various use cases without prioritizing or adopting specific ones, aiming instead to broaden understanding of the landscape for different applications. A summary encapsulated

key themes and potential drivers for the diverse use cases presented by the participating groups. Notably, security emerged as a common thread, aligning with preliminary topics already addressed by 3GPP, indicating a forward-thinking approach to the evolving technological landscape. The atmosphere reflected an earnest endeavor to foster collaboration and innovation among global entities.

Key themes included network security, AI, sustainability, and ubiquitous coverage. The meeting highlighted several key themes concerning the future of telecommunications, particularly focusing on network security, artificial intelligence, sustainability, and ubiquitous coverage. Emphasizing the critical role of network security, it was noted that this aspect is integral to the development of 6G technology, aligning with global standards set by organizations like 3GPP. Artificial intelligence emerged as a focal point, with discussions on its expanding influence within the network infrastructure, especially concerning radio access and service management. Sustainability and the need for widespread connectivity were also underscored, reflecting ongoing technical studies. The integration of sensing and communications was identified as a vital component within the framework of 6G, indicating its importance to the broader goals of the community. Additional topics included the significance of positioning and exploring new opportunities within the evolving ecosystem, all supporting the overarching vision for advanced telecommunications.

Positioning and other emerging technologies were discussed in relation to 6G capabilities. The meeting focused on the advancements in positioning technologies and how they intersect with emerging 6G capabilities. A detailed discussion highlighted the importance of positioning within the context of fixed wireless access and various devices. Insights were shared about the current ecosystem and the potential opportunities presented by 6G technology, particularly in enhancing positioning beyond traditional global satellite systems. This exploration emphasized a broad interest across different communities, showcasing the collaborative efforts within the alliance that provided a thorough analysis of these developments. The dialogue then transitioned to the topic of Wi-Fi, indicating a shift towards discussing the role of the Wi-Fi alliance in relation to the broader technological landscape and its implications for future connectivity and innovation.

Progress in Wi-Fi advancements and their role in 6G were discussed, focusing on standards and protocols. There was notable enthusiasm as they highlighted the extensive efforts within close to 200 working groups dedicated to developing standards across both wireless and wired communications. The focus was on enhancing the link and physical layers of the network stack to improve capacity and reduce latency. Significant progress was reported in increasing throughput in the 2.5 and 6 GHz bands, often referred to as Wi-Fi 7. The discussions also covered wireless sensing technologies aimed at indoor positioning and localization, emphasizing data privacy and extended range capabilities across larger bandwidths. Furthermore, there was a concerted effort to address low power, battery-free communication solutions while improving efficiency and latency through enhancements to Wi-Fi, particularly within working groups focused on wider channels and backward compatibility with existing standards.

Efforts are underway to enhance Wi-Fi 7's throughput while tackling critical issues related to data privacy and localization. Significant advancements are being explored to improve efficiency and reduce latency, particularly through enhancements in wireless communication techniques. Focus is placed on wider channel modulations, specifically utilizing 4096 modulations, and ensuring backward compatibility with existing standards. There is also an emphasis on harnessing wireless signals to effectively project

features of targets within specific environments. Concurrently, studies are being conducted on the integration of artificial intelligence and machine learning to enhance performance, optimize channel selection, and improve transitions between communication links. The discussion then shifts to envisioning the future of 6G technologies, with insights drawn from the developments in 5G and the current technological landscape. This exploration aims to set a foundation for standardization and innovation across various sectors as the next generation of wireless communication approaches.

The meeting progresses with a focus on envisioning the future of 6G technologies across various sectors. The discussion shifts from current advancements in Wi-Fi to analyzing the achievements and capabilities of 5G. The working group highlights the necessity of understanding the present state of technology as a foundation for the development of 6G. Emphasis is placed on the importance of standardization in this evolution, which will ensure seamless integration and enhance the overall efficiency and performance of wireless communications. This strategic planning aims to address the growing demands for low latency connectivity and improved network efficiencies, paving the way for innovations that could arise from 6G advancements. The atmosphere is one of collaboration and forward-thinking, as participants explore the potential impacts of these emerging technologies on various industries and their applications in everyday life.

The discussion shifts towards envisioning the future of 6G technologies, focusing on insights garnered from the advancements made with 5G. The working group examines the current state of technology and standards, contemplating how these developments can influence future applications across various sectors. Emphasis is placed on the potential of artificial intelligence and machine learning to enhance network performance, particularly in the realm of link adaptation. This dialogue seeks to explore innovative solutions that could emerge from AI/ML applications, aiming to optimize communication networks for better efficiency and reliability. The atmosphere is one of forward-thinking and collaboration, as experts share their visions for the integration of advanced technologies in the telecommunications landscape, setting the stage for the next generation of connectivity.

The working group examined 5G advancements and the current state of the art for various verticals. The working group engaged in a thorough examination of advancements in 5G technology, focusing particularly on enhanced mobile broadband (eMBB). The discussions highlighted efforts aimed at increasing data rates, expanding coverage, and reducing latency, which are essential elements for improving connectivity. Attention was also given to the challenges associated with end devices, such as smartphones, emphasizing their role in the ecosystem. The meeting noted ongoing deployment efforts in the automotive sector, reflecting the transformative potential of 5G in various verticals. Overall, the atmosphere was one of collaboration and innovation, aimed at addressing both current capabilities and future developments in the field of telecommunications.

The meeting focuses on advancements in eMBB, emphasizing the goal of increasing data rates and reducing latency, particularly for automotive applications. Discussions highlight ongoing efforts to improve the deployment of these technologies, which are essential for the evolution towards 6G. The aim is to unlock new value and services while ensuring cost-effectiveness, moving beyond the capabilities of 5G and 5G advanced. The conversation also touches upon leveraging various components of vehicles to provide these enhanced services, with an emphasis on the importance of connectivity. Achieving ubiquitous connectivity is identified as a critical requirement for the automotive sector, marking it as a priority in the evolution of mobile broadband technologies. The overall atmosphere

suggests a progressive approach to integrating advanced technologies into transportation, showcasing the potential for innovation in automotive connectivity solutions.

The goal is to unlock new use cases and services in a cost-effective manner using 6G technologies: on the transformative potential of 6G technologies, particularly in the automotive sector, aiming to unlock innovative use cases and services while maintaining cost-effectiveness. A significant emphasis is placed on the necessity for ubiquitous connectivity, which is deemed essential for meeting the demands of advanced remote vehicle services. This involves ensuring secure, reliable, and low-latency communication capabilities, which are critical for enhancing both in-vehicle applications and pedestrian protection. Key applications discussed include immersive media and entertainment within vehicles, as well as improved location services that can operate with high precision. The conversation also highlights the importance of resilient communication systems that will support the functionality of automated driving services, addressing the evolving requirements of the automotive industry in the context of advanced technologies that 6G promises to deliver.

The meeting focuses on the automotive sector's evolving requirements, highlighting the critical need for enhanced connectivity, secure communication, and advanced sensing capabilities. Key driving factors include providing improved location information with sub-meter accuracy, which is essential for the development of functional automated driving services. The discussion emphasizes the role of enabling 6G technologies to facilitate resilient communication, ensuring service continuity. Attention is drawn to the integration of both public and nonpublic networks, as well as a hybrid architecture that combines terrestrial and non-terrestrial elements. Additionally, there is a focus on innovative sensing capabilities around vehicles, utilizing the concept of Integrated Sensing and Communication (ISAC) and exploring the use of refractive meta services to enhance internal vehicle placements. This comprehensive approach aims to address the pressing needs of the automotive industry in a rapidly advancing technological landscape.

ATSC 3.0 was adopted to enable convergence with broadband streaming and improve latency and coverage. The recent adoption of ATSC 3.0 marks a significant advancement in broadcasting technology, aimed at enhancing interoperability with broadband streaming services. Utilizing COFDM technology, this new standard allows for data casting that facilitates low latency transmission of information and high-definition TV broadcasts across metropolitan areas. This capability is particularly beneficial in congested environments, enabling timely communication and efficient content delivery. The technology is designed to support cellular networks by offloading content during capacity surges, thereby enhancing overall network efficiency. Additionally, it offers hyper-localization features that improve the targeting of broadcasting transmissions, catering specifically to local audiences and enabling various applications, including emergency alerts. The implementation of ATSC 3.0 not only broadens coverage and improves latency but also enriches the user experience by allowing for personalized content delivery and positioning services.

Benefits include content offloading, hyper localization, and increased network capacity. The discussion highlights the advantages of integrating advanced technologies into cellular broadband networks to enhance overall efficiency. Emphasis is placed on the ability to manage capacity surges through content offloading, which alleviates network congestion and improves performance during peak usage times. Hyper localization is another key aspect, where networks target specific local and metro areas for broadcasting transmissions, allowing for tailored applications such as emergency alerts and

personalized content delivery. The increased network capacity is achieved through alternative routing paths for data, facilitating faster download speeds that can rival traditional broadband services, reaching up to 50 megabits per second. Furthermore, innovative applications of this technology in data casting are explored, showcasing its potential in various domains such as signage, map updates, media services, and even in the agriculture sector, illustrating the broad impact these advancements can have across different industries.

Use cases include signage, map updates, media services, and agriculture. The meeting highlights advancements in data casting technology, particularly through the utilization of ATSC receivers, enhancing various sectors. Key use cases discussed include interactive signage that can provide real-time information, map updates for navigation, and media services that deliver content seamlessly. Additionally, the integration of this technology in transportation is emphasized, showcasing its potential to connect vehicles for improved communication and safety. The agricultural sector also stands to benefit significantly, with innovative applications aimed at optimizing farming practices and resource management. These developments illustrate the transformative impact of emerging technologies across diverse fields, promoting efficiency and connectivity.

A presentation delivered by the U.S. Department of Defense to the WG, emphasized the importance of open architectures in radio access networks. This concept centers around the development of an open source, open access, end-to-end radio access network, known as open RAN. The initiative aims to create components that serve both government and commercial users, facilitating enhanced collaboration within the ecosystem. The presentation highlighted ongoing efforts by the future office at the Office of the Secretary of Defense, showcasing significant investments in high-performance hardware and advancements in laboratory-to-fabrication processes. These improvements are designed to elevate hardware capabilities, radio functionalities, and computational infrastructure. By adopting an open paradigm, the project seeks to establish a software stack that is accessible to both the Department of Defense and commercial sectors, thereby fostering innovation and efficiency in radio access technologies.

The meeting discusses significant advancements in the development of high-performance hardware and the enhancement of laboratory-to-fabrication capabilities, with a focus on improving radio and computing infrastructure. Emphasis is placed on adopting an open paradigm that fosters the creation of open-source software stacks, intended for both government and commercial applications. These efforts aim to expedite commercial adoption while also serving academic users, thereby influencing industry standards. A key advantage of this approach includes enhanced security, which arises from the complete transparency of the software stack, allowing for thorough observability. Additionally, the software's customizable nature caters to specific needs, whether for extreme use cases, such as in tactical or mission-critical environments, or for public safety applications. Interoperability with public networks is also a critical aspect, ensuring seamless integration and functionality across various platforms and users.

The meeting discussed the innovative advancements in technology, particularly focusing on customizable solutions tailored for specific needs, such as tactical missions or public safety operations. Emphasis was placed on the importance of interoperability within the framework of a heterogeneous 5G and 6G radio access network. Security was highlighted as a critical aspect, achieved through a design that promotes transparency and cost-effectiveness. By adopting an open-source approach, the initiative encourages collaboration among numerous developers and community partners, fostering innovation

and progress. The discussion revolves around the Department of Defense's initiative to shape the development of 6G standards by advocating for open-source alternatives. This approach aims to foster innovation and collaboration, ensuring that a diverse range of contributors can participate in the standards-setting process. Transitioning to a broader industry perspective, the focus shifts to examining the specific requirements for extended reality (XR), including both augmented reality (AR) and virtual reality (VR). The session delves into defining these concepts and exploring their implications for various sectors, emphasizing the importance of understanding the unique demands each domain presents. The atmosphere is one of active engagement, highlighting the critical role of technological advancements in shaping future communication standards and applications.

XR involves the blending of physical and virtual worlds, with key drivers being immersive interactions and digital twins. The discussion focuses on the importance of managing latency in the realm of XR, which blends physical and virtual environments. Key aspects include the necessity of minimizing round trip time and optimizing device processing on the end user’s device. This management of latency is crucial for ensuring that users experience seamless and immersive interactions. The conversation highlights how advancements in computing at the edge can enhance the performance of XR applications, ultimately contributing to a more engaging and effective user experience. The emphasis on communication paradigms underlines the technical intricacies involved in delivering high-quality interactions within these digital spaces, indicating a significant area of focus for future technological developments.

Latency management is crucial for quality user experiences, requiring high network capacity and bandwidth. The discussion emphasizes the critical importance of latency management to ensure a seamless user experience, highlighting the role of compute processing at the edge of the network. Key concepts include the significance of round trip time and processing on user devices, which must be optimized so that latency remains imperceptible to users, thereby enhancing Quality of Experience (QOE). Achieving this requires a substantial increase in network capacity, particularly at the edge rather than the core, with demands for high bandwidth levels reaching up to 10 gigabits per second per user. The conversation also touches on emerging trends such as immersive and digital interactions that promise to elevate human augmentation, emphasizing the need for consistent low-powered access. Additionally, the integration of joint communications and sensing, along with the creation of digital twins, is noted as vital for both network planning and for rendering complex simulations of the physical world in immersive digital environments.

The meeting delves into advancements in human augmentation through the provision of low-powered, ubiquitous access, emphasizing joint communications and sensing capabilities. The discussion highlights the significance of digital twins in network planning and the creation of intricate representations of the physical world within the digital realm. It addresses the ongoing efforts in standardization and the enhancements required to manage the increased network loads associated with these applications. A focus on improving power efficiency and device handling is central, with studies exploring innovative strategies such as staggering traffic arrivals and implementing sleep modes after low-latency transmissions. Visual aids illustrate the relationship between infrastructure and device management, showcasing key features under consideration to facilitate the broader adoption of 5G and 6G technologies. The conversation underscores the commitment to enhancing mobile technology through targeted updates and collaborative efforts within the industry.

Full duplex technology faces challenges of self-interference and analog architecture scalability. The discussion centers on the challenges faced by simultaneous full duplex technology, which, despite its long-standing existence, has yet to achieve widespread adoption. Experts in the field highlight the primary concern of self-interference, emphasizing the need for effective mitigation strategies such as cancellation or suppression techniques that allow simultaneous transmission and reception on the same frequency band. Additionally, the limitations of current analog architectures are noted, particularly their inability to scale with the large antenna systems required for 5G networks, which are necessary for enhanced coverage and capacity. There are also concerns regarding the performance of certain analog-to-digital converters in the RF chain, which appear to be stagnating in line with Moore's law. Moreover, the complexities involved in deploying this technology in existing environments, along with necessary adjustments to time division duplexing configurations, present further obstacles that need to be addressed for successful implementation.

The meeting discusses advancements in communication technology, highlighting the significant benefits such as increased data rates and the potential for joint sensing and communication. This dual capability allows the same channel to be utilized for various applications simultaneously. A focus is placed on the sub band full duplex technique, which involves splitting component bandwidth into distinct uplink and downlink channels, enabling concurrent transmission and reception. The conversation also addresses the challenges associated with this technology, particularly concerning self-interference and echo mitigation. The ongoing developments are recognized as crucial, with efforts being made to incorporate these advancements into the upcoming release specifications, particularly in Release 18 and the current phase for Release 19. The overall atmosphere reflects a commitment to overcoming technical hurdles while maximizing the advantages of modern communication systems.

Global competition in positioning systems is increasing, with multiple constellations providing alternatives to GPS. The meeting highlights the growing global competition in positioning systems, emphasizing the emergence of various satellite constellations that serve as alternatives to the established GPS framework. With nations such as China, Russia, and the European Union launching their own systems, there is a noticeable shift in the landscape of navigation and timing capabilities. These advancements not only enhance competition but also raise concerns regarding the reliability of positioning, navigation, and timing (PNT) services, especially for mission-critical applications that underpin the global economy. The discussion underscores the importance of monitoring these developments closely, as they could significantly impact the effectiveness and coverage of existing technologies while promising improvements in latency and throughput. The atmosphere of the meeting reflects a sense of urgency and excitement regarding these technological advancements, as stakeholders aim to navigate the evolving competitive landscape.

The discussion centers around the significant advancements anticipated with 6G technology, particularly in enhancing PNT systems. Emphasizing the need for improved resiliency against potential vulnerabilities, the dialogue highlights the importance of developing multifailure modes to safeguard against jamming and interference. The integration of 6G aims to bolster navigation and timing accuracy, especially in densely populated urban and indoor environments, reducing reliance on satellite systems that are susceptible to external threats. The conversation also suggests utilizing late-stage 5G technologies for initial testing and refining these resiliency strategies. This focus on robust PNT solutions is seen as critical for mission-critical applications and the broader global economy, positioning it as a

vital component of future technological advisements to the FCC. The anticipation of 6G's capabilities marks a pivotal step in addressing current challenges in navigation and timing reliability.

The meeting emphasizes the critical preparations underway for the advancement of 6G technology, set to intensify in 2025. Initial advisements highlight the importance of closely monitoring ongoing studies within the 3GPP framework, particularly the SA1 study focused on identifying use cases and service requirements for 6G. Preliminary findings suggest a need to explore potential use cases emerging from 3GPP Release 20 and their implications for telecommunications policy. The agenda includes tracking developments from an upcoming workshop in March, which will cover various aspects such as RAN and service architecture, as well as an April workshop involving both Open RAN and 3GPP aimed at understanding the evolution of specifications towards 6G. Additionally, the discussions signal an exploration of new service delivery opportunities, indicating a proactive approach to shaping the future landscape of telecommunications.

During the meeting, discussions centered around essential advancements for future network technologies, particularly focusing on the transition towards 6G. Key topics included the incorporation of ISAC, the implementation of native artificial intelligence within the RAN, and strategies for integrating non-terrestrial networks. The significance of the upcoming joint Open RAN and 3GPP workshop scheduled for April was highlighted, as it is expected to provide valuable insights into the evolution of specifications leading to 6G. As preparations continue for a final deliverable set to be completed by September, the group emphasized the importance of ongoing collaboration and regular working group meetings held weekly in the afternoons. Monitoring and reporting on progress within the 3GPP, particularly regarding the study on 6G, was also underscored as a priority in their efforts for 2025 and beyond.

The final deliverable for the TAC is due in September, with continued group meetings planned. As the meeting progresses, the final deliverable for the TAC is highlighted, with a due date set for September. Continuous group meetings are scheduled every Thursday from 4:00 to 5:00 p.m. Eastern Time, dedicated to monitoring and reporting on developments within the 3GPP framework, particularly focusing on the study of 6G and upcoming workshops. Upcoming presentations by subject matter experts are planned to delve into crucial topics such as millimeter wave technology, terahertz integration for communication and sensing, and the alignment of Open RAN with 3GPP standards. The session wraps up with acknowledgments of the various experts involved, ensuring that a summary of the presentations will be available for broader dissemination, although no further details are discussed at this stage.

CLOSING REMARKS

The meeting wrapped up with expressions of gratitude for the comprehensive report presented, highlighting the importance of ubiquitous connectivity, which encompasses various delivery mechanisms beyond just cellular options. A key point raised was the necessity of addressing the end-to-end costs associated with technology development, as this is vital for bridging the digital divide. Ensuring that technological advancements not only meet performance standards but also remain commercially viable is crucial for future progress. This emphasis on cost reduction was acknowledged as an essential component of the overarching goals discussed. As the council transitions into new leadership, there is a

clear focus on these critical issues, setting the stage for the committee's future directions and initiatives in promoting advanced technological solutions.

MEETING PRESENTATION SLIDES
https://www.fcc.gov/sites/default/files/12-19-2024-FCC-TAC-Meeting-Slides-Merged-for-Meeting.pdf

VIDEO LINK
https://www.fcc.gov/news-events/events/2024/12/technological-advisory-council-meeting-december-19-2024

SIGNED, COMMITTEE CHAIR

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Dean Brenner Date