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Celona appreciates the opportunity to provide input to the National Telecommunications and Information Administration ("NTIA") on implementing the Public Wireless Supply Chain Innovation Fund, as directed by the CHIPS and Science Act of 2022. The NTIA wants to support the promotion and deployment of open, interoperable, and standards-based Radio Access Networks (RAN).

Celona Inc. ("Celona") is a leading innovator and a pioneer of 5G LAN network solutions, expanding the mobile network to the enterprise market. Celona has developed the industry's first end-to-end, vertically integrated private 5G platform explicitly designed for mission-critical enterprise environments including manufacturing plants, ports, and distribution centres. Our unique solution architecture combines O-RAN with AI-based operations and a cloud-native architecture that integrates easily with existing enterprise infrastructure.

Celona supports the NTIA's initiatives and the implementation of the Public Wireless Supply Chain Innovation Fund of $1.5 billion (over ten years) to promote the development of the Open Radio Access Network (O-RAN), fostering market competition and diversity in the 5G market vendors. As a result, accelerated 5G deployments of open and interoperable standards-based O-RAN will increase exponentially in the U.S. and strengthen U.S. competitiveness in many industries. Below are our comments on the questions posed in the notice.

The current state of the telecommunications industry:

The next generation of wireless technologies will be suitable for applications beyond consumer broadband. However, the U.S. market continues to be highly consolidated, with public mobile network operators dominating the market share and leaving little to no room for competition and innovation for new entrants focused on private enterprise networks, thus reducing the supply chain resilience and security. Another threat to the U.S. economy is high market prices to deploy 5G networks, making it challenging for new innovative U.S based companies to enter the marketplace. In addition, third-nation vendors providing lower-cost solutions pose an unacceptable risk and threat to the national security of the United States.

The current 5G RAN infrastructure is primarily built on a closed, end-to-end proprietary hardware stack. Most traditional RAN is not dynamic regarding interference management, handover threshold selection, channel selection, and resource allocation. Therefore, there is a need for more Artificial Intelligence (AI) based learning and automation to make the system more dynamic in various environments like warehouses, logistics, retail, ship ports, and university campuses.

As the demands for reliable, fast, secure, and robust 5G connectivity continue to grow, an AI-based O-RAN infrastructure will allow enterprises to migrate from closed hardware-centric architecture to open software-centric cloud-based architecture. Hence, Research and Development (R&D) is needed to learn the data from devices, radio heads, and core networks to analyse and create a unique and optimized radio access network.

Private 5G networks are especially suitable for an O-RAN architecture since it enables enterprises to mix and match network elements to reduce costs as compared to the infrastructure deployed by mobile operators. The Celona RAN solution is the first private 5G-network solution focused on O-RAN, thus reducing costs significantly. Celona's solution is not derived from the traditional telco network but is designed from scratch with enterprise requirements in mind and minimizes integration cost and complexity.

The Celona RAN includes all O-RAN components, including the Radio Unit (RU), Distributed Unit (DU), and Control Unit (CU), with automated configuration and management enabled by the Celona's Enterprise RAN Intelligent Controller (eRIC) to provide a robust solution that meets the dynamic requirements of mission-critical private 5G deployments.

Technology Development and Standards:

Two standard development organizations (SDOs) play a crucial role in developing O-RAN standards: 3GPP and O-RAN Alliance. 3GPP is primarily responsible for setting standards for various security-relevant functions and technological innovations in RU and Baseband Unit (BBU) communication protocols. At the same time, the O-RAN alliance is responsible for establishing standard interface specifications, such as eCPRI for the RU to CU and the DU, O1, E1, E2, F1-C, F1-U, eRIC, A1 to N-eRIC. Hence, both standards are essential for different radio units from different radio vendors to work effectively with CU, DU, or BBU.

The RU, CU, DU, or BBU must all work efficiently with the 5G core network (5GC). The enterprise 5GC Standalone Architecture (SA) is responsible for User Plane Function (UPF), Access and Mobility Management Function (AMF), and Session Management Function (SMF). Providing a reliable end-to-end connection using O-RAN can be challenging if the RU, BBU, and 5GC come from different vendors with different hardware and software requirements.

The O-RAN alliance proposed the eCPRI standard interface to work effectively or transparently with RU and BBU. Unfortunately, most of the time, the connectivity between RU and BBU from different vendors can be more complex. This connectivity issue is mainly due to an incorrect SFP model (in RU and BBU) and improper configuration of physical layer parameters such as frequency, code rate, transmission power, and slot pattern at the BBU. We expect the RU and BBU to work cohesively without any intervention in the real world or a tactile environment. Therefore, there is a need for R&D and a standard body to make the RU and BBU work more seamlessly, making the customers easy to deploy in a plug-and-play fashion.

Security

Confidentiality and privacy are routinely rated as the top security concerns of public 5G. Fears over an increased attack surface, lack of visibility, and limited in-house knowledge are other recurrent themes cited by enterprises.

The collective concern in public 5G networks is that with faster and more capable networks, MNOs will have more access to more data, including corporate data, through 5G- connected devices. Without strict privacy laws and governance, users of public 5G networks remain at the mercy of the MNOs' discretion regarding how their private data is used. Data and metadata are often monetized through data correlation and trend analysis and sold to third parties for marketing purposes. And now, MNOs are turning to private cellular to augment their indoor coverage, bringing MNO-managed private 5G into the fold of concerns already present in public 5G use.

Celona's private 5G LAN solves the privacy and confidentiality concerns inherent in public 5G and private cellular offered by MNOs. Knowing that mobile network operators may access corporate data across public and MNO-managed private networks, enterprises seek more secure options and provide better data privacy controls. Celona's 5G LAN ecosystem was designed to give enterprises complete control over their data and end-to-end data path.

Organization-specific data is never visible to Celona. All endpoint payloads are secured and contained within the enterprise 5G LAN. Only metadata and system performance metrics are securely sent to the cloud-hosted Celona Orchestrator, where the metrics data offers visibility into your 5G LAN performance. Customer metadata is never used for monetization and is not provided to third parties except those involved in servicing your 5G LAN, such as the Spectrum Access System (SAS) provider.

Trials, Pilots, Use Cases, and Market Development

Celona urges the NTIA to foster O-RAN to facilitate a competitive, diverse private 5G ecosystem powered by virtualization and cloudification of software and hardware components. The modularity and flexibility of O-RAN should yield widespread benefits to the wireless market and, ultimately, the U.S. economy.

Celona urges the NTIA to consider the unique applications of private 5G enterprise deployments and the role O-RAN can play in facilitating next-generation wireless spectrum-sharing frameworks like Citizens Broadband Radio Service (CBRS). For example, use cases for 5G and private O-RAN systems often include deployments on high velocity manned and unmanned platforms, including aerial platforms, which experience a wide range of doppler and interference.

Private 5G open the doors to a new set of use cases and applications poorly served by mobile wireless operators. Further, O-RAN deployments will first find a home in “greenfield” networks primarily deployed by the private 5G industry. As use cases and applications of private 5G proliferate, increasing demands will be placed on these networks, such as:

- Wire-like reliability that can be measured, adjusted, and programmed without any guesswork.
- Adaptive network core that can scale on-demand as app performance requirements and density of devices evolve.
- We have automated configuration changes to ensure guaranteed service levels without manual intervention.

Conclusion

While much of the focus of discussions around O-RAN has been on implementation and adoption by the mobile broadband operators, we urge the NTIA to consider the private 5G space as one where O-RAN is most likely to make an impact is already doing so, as is evident from Celona’s solutions in this space, which combine O-RAN with AI-based operations and cloud-native architecture to integrate with existing enterprise infrastructure easily.

The private 5G industry is meeting the needs of many markets that are unserved or underserved by the mobile broadband operators: for example, Celona's O-RAN-based wireless solutions deployed in CBRS deliver unprecedented range and predictability of operation to mobile devices and IoT infrastructure for smart cities, schools, colleges, enterprises, and industrial settings such as factories, ports, and warehouses. These and other verticals have begun deploying private 5G networks to achieve cost-effective operational efficiency, safety, and productivity.

In addition, many Fortune 500 companies in the U.S. are investing in private 5G to deploy sensors, interconnected devices, IoTs, and AGVs targeting increasingly sophisticated automation processes using AI and ML. As O-RAN deployments evolve and mature in the private 5G space, adoption by mobile broadband operators will follow.

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