WiFrost Inc. Comments to NTIA “Notice and Request for Comment” - Docket number NTIA-2022-0003

WiFrost company introduction:

WiFrost is a 5G for rural broadband company with a mission to connect the next billion people to the internet through 4G and 5G Open RAN technology over unlicensed TVWS spectrum.

WiFrost develops 4G and 5G solutions for the fixed wireless access (FWA) market using Open RAN technology for underserved markets in the US and internationally. WiFrost has developed the first and only 4G and 5G solution for unlicensed television whitespace (TVWS) spectrum. WiFrost has significant intellectual property in the areas of radio front end engineering, interference, and spectrum management, as well as network automation.

Our key product focus and differentiation is to make 4G and 5G systems plug and play, easy to use and low-cost, to enable existing and new wireless internet service providers (WISP) to provide affordable internet connectivity in rural areas. WiFrost has also network and spectrum management software to cut the cost of operation for WISPs. The combined benefits of a open standard technology, unlicensed spectrum and cloud based network automation software will result in a low cost 5G Open RAN end to end solution that will accelerate the adoption of FWA solution in the rural market to bridge digital divide.

Our products have been deployed in the US, Canada, South Africa, Kenya, Senegal, Nigeria, and South Korea. The current use cases that our customers support is fixed wireless access for rural areas, and agriculture machine connectivity for precision agriculture.

WiFrost was incorporated in Nov 2020 in the state of California. WiFrost is a women and minority owned business.

1. What are the chief challenges to the adoption and deployment of open and interoperable, standards-based RAN, such as Open RAN? Are those challenges different for public vs. private networks?

As a fixed wireless access (FWA) provider of 4G solutions in the unlicensed spectrum, WiFrost has started development on Open RAN for its 5G solution. Cost and ease of use are two very important factors for WiFrost customers.

The focus of the comments below is for greenfield deployments and private networks.

The major challenges in adoption and deployment of Open RAN in the fixed wireless market is the cost of the solution, i.e., cost of system and the cost of licensed spectrum.

The Open RAN 5G base station (BS) including CU/DU/RU in the market will cost WiFrost between $10,000 to $20,000 per sector, while the current 4G BS costs in the $3,000 to $5,000 range. The OpenRAN BS also consumes 5x to 7x more power compared to the 4G solution. These are the key barriers to adoption of the Open RAN technology and commercialization for the underserved market. It is still more cost effective to build an integrated 5G solution using a traditional 5G baseband platform, as compared to building the same product using Open RAN. The bulk of the cost is captured in the hardware acceleration card, as well as software licenses for the CU and DU. E.g. A traditional 5G small cell can be developed at roughly ½ to ⅓ of the cost of a similar specification using 5G Open RAN. These numbers are obtained from WiFrost's significant work to scope, design and budget our next generation (5G) Base Station product, working with vendors in Europe, North American and Asia.

Further compounding the challenges of adoption of Open RAN is the predominant focus on mobile operator networks. While benefiting from economy of scale and mass market efficiencies of the mobile broadband market, adoption of Open RAN for rural broadband and private IoT network use cases would require dedicated investment and innovations to address the unique requirements of each.

Another challenge of cost reduction and operational efficiency is automation. WiFrost is developing network management software to automate the deployment process to be plug and play and operation to be completely remote controlled. This is a key requirement for the internet service providers to improve operational efficiency and build sustainable business models in low ARPU (average revenue per customer) markets.

Unfortunately, there is little private investment funding to devote to the R&D in Open RAN hardware due to the high capital investment requirements. In this regard, government funding is central to the commercialization of the technology and provides opportunities for small and medium sized vendors to participate in breaking down the cost barriers.

4. What is the current climate for private investment in Open RAN, and how can the Innovation Fund help increase and accelerate the pace of investment by public and private entities?

Based on our experience with the venture capital and investment community over the last two years, the willingness to invest in hardware generally, and Open RAN specifically, is very low. There is very little name recognition for Open RAN. A general investor knows what 5G is, but does not know what Open RAN is.

To accelerate the pace of innovation in Open RAN and the related product development, government funding is key. Government funding programs such as the Innovation Fund are a critical factor that will attract private investment in small start-ups to diversify the vendor pool. This creates competition, benefits consumers and will promote US leadership in Open RAN.

NTIA should set aside grant funds to specifically target smaller, early-stage U.S. based Open RAN hardware companies, which will make them more attractive for prospective investors. Eligible small companies should have less than $2,000,000 in annual revenues and be incorporated within the last three years.

13. What are the foreseeable use cases for open and interoperable, standards-based networks, such as Open RAN, including for public and private 5G networks? What kinds of use cases, if any, should be prioritized?

There are two primary use cases that should be prioritized, 1) Rural broadband for underserved communities in the US and Internationally, and 2) Industrial IoT connectivity use cases that require high-definition video and imaging at the edge.

The primary use case for Open RAN to date has been mobile operator networks, and, as such, requirements, investment, and innovation has been narrowly focused. In contrast, rural fixed wireless broadband networks are one of the key use cases for Open RAN technology, for both public and private 5G networks.

Today, according to the FCC's latest Broadband Data Collection, there are about 18 million people in the USA that lack access to 25/3 Mbps broadband internet service. Worldwide, there are about 3 billion people that lack broadband internet services at home. This is due to the fact that the rural population is low density, geographically isolated, and often in heavily forested areas. The inherent limitations of traditional broadband technologies, spanning fiber to high-frequency fixed wireless and satellite technologies, make them cost prohibitive for internet service providers to provide services in low density rural markets. The open standard based interoperable network such as Open RAN combined with unlicensed managed spectrum such as TVWS and CBRS hold the key to the goal of getting broadband internet access to everyone by lowering the cost of RAN. The Open RAN for rural broadband will complement other NTIA initiatives such as its $65 billion Internet for All program to connect every American to high-speed, affordable internet service.

The majority of industrial IoT use cases (Precision Agriculture, Mining, Oil & Gas, Ports) require broadband like connectivity to transmit high-definition video and imaging for industrial

automation which cannot be served by narrowband IoT protocols. Open RAN for vertical industry and private 5G networks needs to offer low-cost hardware and software solutions to these enterprises.

14. What kinds of trials, use cases, feasibility studies, or proofs of concept will help achieve the goals identified in 47 U.S.C. 906(a)(1)(C), including accelerating commercial deployments?

a. What kinds of testbeds, trials, and pilots, if any, should be prioritized?

Rural communities that may be 5-10 years away from getting fiber connectivity would be ideal areas to start pilots focused on commercially viable and sustainable networks, in the US and internationally. This would include locations where the cost of fiber deployments exceeds available subsidies, as well as those locations that will take years to reach even with available subsidies.

Similarly, industrial use cases which are in areas not covered by existing mobile networks (Farms, Oil & Gas fields, Mining areas) are ideal to test, prove and commercialize Open RAN technology and showcase its benefits.

16. What sort of outcomes would be required from proof-of-concept pilots and trials to enable widespread adoption and deployment of open and interoperable, standards-based RAN, such as Open RAN?

Commercial viability and sustainable business models need to be the basis of any proof-of-concept to showcase Open RAN technology and its impact. The two main drivers of cost and ease of use will be pivotal in showcasing commercial viability.

For industrial IoT use cases, an industry partner with a strong pedigree as a deployment partner may be able to attest to the business and technical feasibility of Open RAN proof-of-concepts.

22. How can NTIA ensure that a diverse array of stakeholders can compete for funding through the program? Are there any types of stakeholders NTIA should ensure are represented?

NTIA should establish a category of funding for smaller companies with 4G and 5G solutions. This specific category should focus on providing sizable grants of $10 million to $25 million to companies that have less than $2,000,000 in revenue and have been incorporated in the last three years. This category of funding would encourage innovation and diversify the wireless industry supply chain pool.

The other criteria may be initial customer traction and deployment in markets where the US wants to compete with Huawei and ZTE (for example, developing markets in Africa and South America).

24. How can NTIA maximize matching contributions by entities seeking grants from the Innovation Fund without adversely discouraging participation? Matching requirements can include monetary contributions and/or third-party in-kind contributions (as defined in 2 CFR 200.1).

Matching contribution requirements create an additional barrier for private investments, especially for smaller companies. NTIA should not require matching contributions by entities as part of this Innovation Fund. If NTIA does require matches, it should exempt small entities, such as those with less than $2,000,000 in annual revenues, from this requirement.

25. How can the fund ensure that programs promote U.S. competitiveness in the 5G market?

a. Should NTIA require that grantee projects take place in the U.S.?

No, the NTIA should allow grantee projects in the US and internationally. Most of the developing markets where Huawei and ZTE are well represented are in the developing countries, and, as such, require significant investment from the US, focused on OpenRAN, to start to prove the technology and competitiveness.

b. How should NTIA address potential grantees based in the U.S. with significant overseas operations and potential grantees not based in the U.S. (i.e., parent companies headquartered overseas) with significant U.S.-based operations?

NTIA should preclude applications from U.S. based subsidiaries of parent companies headquartered overseas. The U.S. is the most important market in the world, so naturally many foreign companies will have significant U.S.-based operations. The fact that a foreign-owned company has significant U.S.-based operations should not matter. This program should only be available to U.S. headquartered and owned companies.

c. What requirements, if any, should NTIA take to ensure "American-made" network components are used? What criteria (if any) should be used to consider whether a component is "American-made"?

Most of the components that are used in developing a 4G and 5G product are the intellectual property (IP) and design of US companies like Marvel, Qualcomm, Qorvo, Skyworks, Analog Devices, and Texas Instruments to name a few. The US based companies own most of the key network components and IP in the world in both digital processing and RF components. As long as the network component and intellectual property are designed and controlled by US companies, where the final systems are assembled may be less important. It may be very restrictive to add a hard requirement of "American-made" systems, as it takes years to set up a manufacturing ecosystem to assemble products that will be cost competitive. In fact, a lot of developing countries, including US trade partners, have low-cost manufacturing capacity and can help to sustain their network business model by assembling locally should be allowed.

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