

## **Adeunis-NA, Inc. Exhibit for File No. 0604-EX-CN-2018**

### The Company

Adeunis-NA, Inc. ("Adeunis") is the United States subsidiary of Adeunis RF ("ARF"), a French corporation engaged in the design, manufacture and marketing of wireless communications systems. Adeunis is headquartered at 25 Main Street, Third Floor, Tuckahoe, NY 10707. ARF headquarters is located at 283 rue Louis Néel Crolles, Rhône-Alpes, 38920, France.

### The VOKKERO Radio System and Its Uses

Among ARF's products sold by Adeunis is the VOKKERO<sup>®</sup> radio system (FCC Identifier U3Z-ARF7822). The VOKKERO radio system, including its Squadra<sup>®</sup> microphones, is an all-in-one, full-duplex, hands-free communication system that enables individuals to speak to each other, using a private and portable wireless network. The VOKKERO radio system can be set up in minutes and requires no base station or license, as it operates on unlicensed Part 15 spectrum as an "intentional radiator" (a "Part 15C device"). Specifically, it operates 25 <500 KHz channels within the 902-928 MHz band, transmitting and receiving signals between 902.25 MHz and 927.75 MHz, at 0.233 watts of power. Its signals have a range of approximately 800 meters in an open field environment and somewhat less in a major college or professional football stadium. Its high-performance noise filter ensures optimal sound quality in noisy environments.

In Europe and other parts of the world, ARF has sold the VOKKERO radio system to many customers, especially those in competitive sports. One of the leading uses of the product is by soccer referees in major competitions such as the World Cup and the Champions League. It is also used by all of the best European-wide and nationwide leagues, as well as by many leagues and competitions in the Americas that belong to, or are affiliated with, the Confederation of North, Central American and Caribbean Association Football ("CONCACAF").

Additionally, use of the VOKKERO radio system has spread to other sports, including American football, ice hockey, rugby, basketball, field hockey, and competitive sailing. At the present time, Adeunis provides wireless microphone systems for game officials (referees) for the NFL<sup>1</sup> and multiple Division 1 College Football Conferences, including the SEC, Big Ten, Big 12, ACC and Pac 12.<sup>2</sup>

Another manufacturer of similar wireless microphone systems, CoachComm, generally sells its systems to various college coaching staffs throughout the United States. Both the Adeunis and CoachComm systems operate using TDMA technology. And both systems use frequency "hopping" technology to avoid interference and to provide clear communications.

### Previous History

In 2013-14, Adeunis found that, inside a stadium (closed environment), college coaching staffs used four synchronized systems together and the CoachComm system<sup>3</sup> used four channels that began to create interference with VOKKERO system, which, of course, is not synchronized with the CoachComm radios. Adeunis engineers determined that, in a real-time audio transmission system, 1% of frame error rate is the

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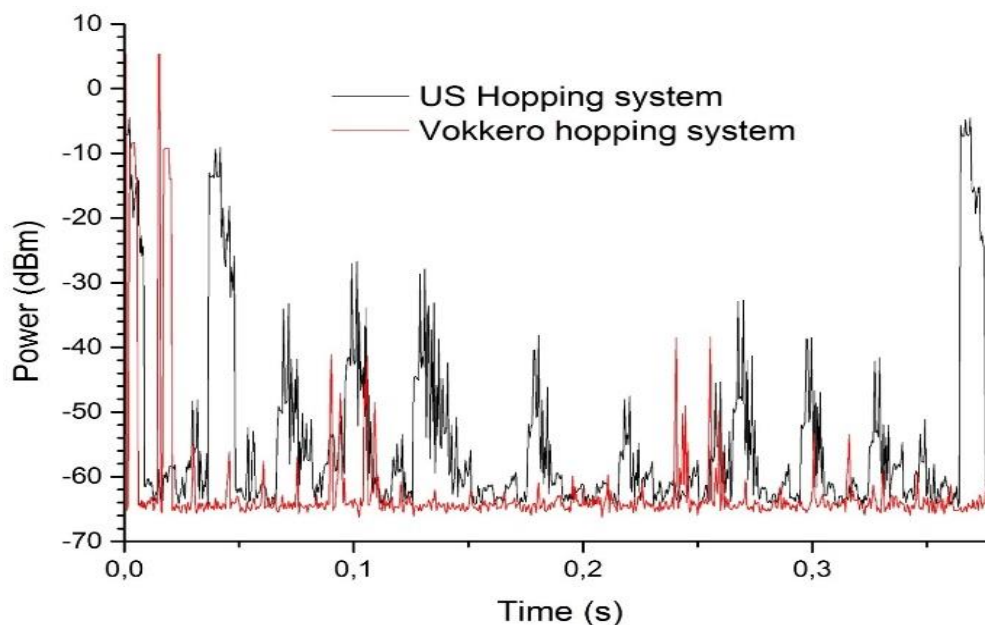
<sup>1</sup> It is the understanding of Adeunis that CoachComm systems are not used by the NFL but would be used for college football games held in NFL stadiums when the participating college conferences are Adeunis customers.

<sup>2</sup> In 2013, Adeunis sold its radios only in the SEC. In 2014, Adeunis's market presence expanded to include the Big Ten conference.

<sup>3</sup> In the 2013-2014 time period, CoachComm's Tempest<sup>®</sup> system was the most commonly used wireless system used by coaching staffs.

maximum permitted value regarding the audio quality – customers do not want to risk using a system that could exceed this frame error rate. The main concern was not the ~2MHz used bandwidth among 26 MHz of 902-928 MHz frequency band. Section 15.247 of the Federal Communications Commission’s (“FCC” or “Commission”) rules does not define maximum out of channel power during frequency hops. In such situations, energy to pass from one channel to another during frequency hopping is very high as the FCC does not require the “ramp up and ramp down” operations as are mandated by European Union (“EU”) rules. Under EU rules, no energy can be transmitted from the time the radio leaves the initial frequency until it reaches the target frequency. The following chart demonstrates a comparison of energy transmissions for both standards while frequency “hopping.”

Figure 1



Shown in black, the out-of-channel energy is very high. Thus, as four systems are synchronized, an additional asynchronous system has a very low chance of operating correctly in such environment.

While Adeunis engineers worked on a technical solution for the VOKKERO system to prevent the operation of the CoachComm system from causing interference, Adeunis applied for, and received, Special Temporary Authority (“STA”) for the 2013 football season (WG9XXH-0772-EX-ST-2013) and for the 2014 football season (WH9XSZ-0630-EX-ST-2014) to operate its systems on different frequencies.

Meanwhile, Adeunis modified its communication protocol to be able to coordinate with up to four synchronized CoachComm Tempest systems. Adeunis’s TDMA mechanism has been modified to be similar to the CoachComm system. At the beginning, our cycle was 30 ms and has been changed to 10 ms to be equivalent to the CoachComm cycle. With such evolution, our system will only be subject to maximum eight channels during one cycle, which is better than 32 channels in case of 30 ms cycle,

Secondly, we have implemented a real-time repetition algorithm to maximize the likelihood of audio transmission. This technology has been specifically studied to be more robust than CoachComm Tempest systems has described above. With such R&D investments (made over more than 12 months), we have created a new Squadra system able to “resist” interference from the severe electro-magnetic (EM) environment created by synchronized CoachComm systems. Both Companies’ systems worked in the same locations at the same times without interference for several football seasons.

2018 Situation

Subsequently to the 2014 football season, CoachComm introduced a new wireless microphone system known as the CoachComm System X™. Initially, most college coaching staffs continued to use the Tempest system but, over time, more colleges and universities began purchasing the System X equipment.

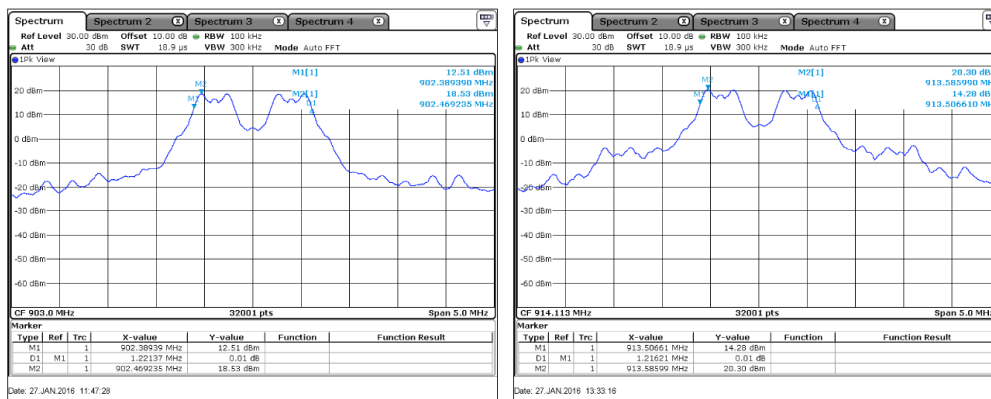
The technical and operating specifics of the System X equipment include:

- Frequency Hopping equipment operating in the 902-928 MHz band
- Certification per Section 15.247 of the FCC’s rules as a digital transmission system
- Frequency Range: 903 – 927.079 MHz
- Number of channels: up to 14 channels available
- Frequency Hopping tables use 14 Channels
- Modulation Type: FSK
- Data rate: 362 kbps
- Maximum Conducted power: 23 dBm
- Channel Spacing: 1.72 MHz
- 6dB bandwidth: 1.22 MHz
- 20dB bandwidth: ~1.4 MHz

During Adeunis’s most recent off-season testing, it learned greater usage of the System X equipment with its changed parameters from the Tempest equipment would likely increase the likelihood of interference with the VOKKERO equipment. Adeunis’s analysis showed:<sup>4</sup>

Figure 2

Frequency [MHz]	6dB Bandwidth [MHz]	99% Bandwidth [MHz]
903.000	1.22	1.38
914.113	1.22	1.51
927.079	1.22	1.34



<sup>4</sup> Maximum Spectral Density: 1 dBm /3 kHz -- Source: certification test report FCC ID: HSW-CCT900.

Figure 3

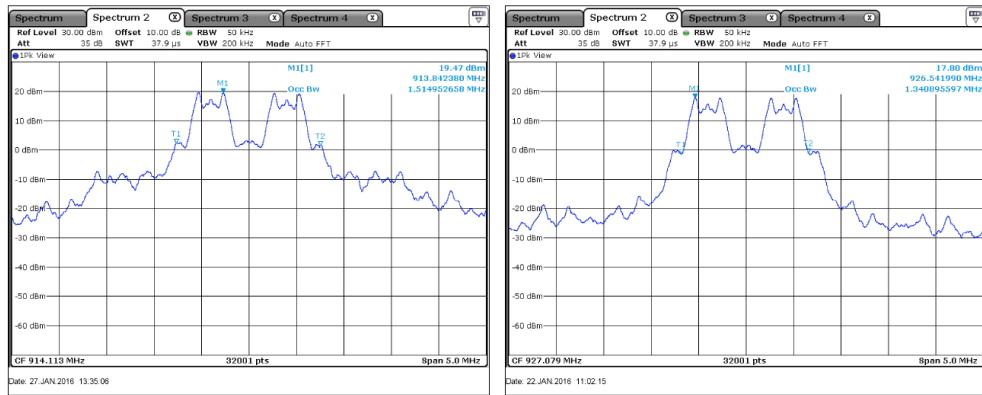
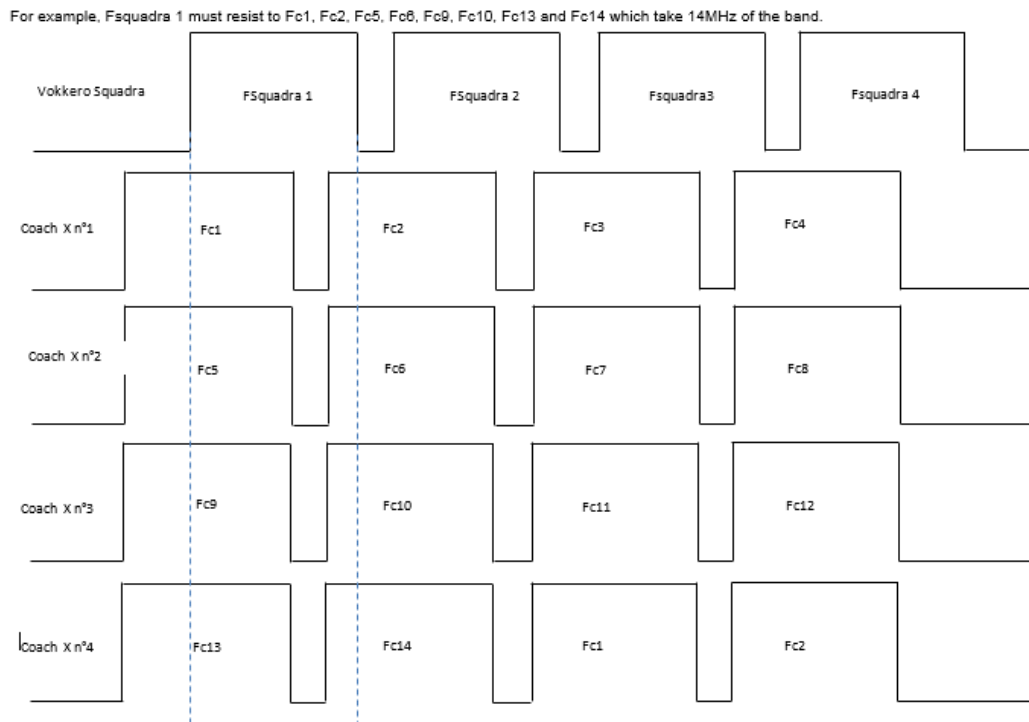


Figure 7.3.2-5: 99% Bandwidth Plot – MCH

Figure 7.3.2-6: 99% Bandwidth Plot – HCH

Comparing the CoachComm System X to the CoachComm Tempest system, the occupied bandwidth on one channel of the X system is more than three times higher than the Tempest one: 1.4 MHz vs 0.42 MHz. If we consider four synchronized systems, the CoachComm X equipment takes around 7 MHz of bandwidth vs 2 MHz for the Tempest system. Even if our Squadra system uses the same TDMA cycle as the CoachComm X, it cannot be synchronized to it (because Adeunis does not have not the necessary information), so our system must “resist” interference from eight channels of CoachComm which occupy 14 MHz (2x7 MHz of bandwidth), e.g., half of the 28 MHz available. As the exact channel being used is three times as unpredictable, the “collision” rate is very high and incompatible with a real-time audio communication system. The next figure demonstrates this point.

Figure 4



Given the lack of “ramp-up/ramp-down” requirements in the United States<sup>5</sup> and the energy needed to pass from one channel to another during frequency hopping, it seems virtually impossible for the VOKKERO radios to operate successfully with the CoachComm X system (four synchronized base stations) in 902-928 MHz band. The game officials are likely to experience interference and not clear communications, something that is not conducive to their obligations as referees. Adeunis is not certain as to how it will re-engineer its system to work around the CoachComm X system even as Adeunis has begun research and testing. However, Adeunis can state with certainty that, despite best efforts, a technical solution should not be expected during the 2018 football season.

Besides engaging in research and testing to develop another technical “fix,” Adeunis has approached CoachComm with a request for the two manufacturers to negotiate an agreement to share the 902-928 MHz band by re-tuning each vendor’s customers’ radios. For example, CoachComm could tune its equipment to operate on 902-920 MHz and Adeunis could tune its radios to operate on 920-928 MHz. This approach, if agreed to by the manufacturers, would give CoachComm’s users of synchronized systems 18 MHz of spectrum and Adeunis’s users 9 MHz. However, at the time of the filing of this application, Adeunis is not aware of whether CoachComm would be agreeable to such a frequency sharing agreement. And, even in the event agreement is reached, the two vendors would need to work out the technical and operational details for re-tuning the radios; discuss the plan with their customers; obtain customer “buy-in”; and physically adjust the thousands of wireless microphones. Adeunis submits that this effort could take much, if not all, of the 2018 football season to accomplish.

The above facts and analysis demonstrate Adeunis’ need for an experimental license to enable it to serve its customers with clear communications during the 2018 football season while Adeunis works towards more permanent solutions.

#### Other Licensed Users

Adeunis realizes that there are other licensees of spectrum in the 900-902 and 928-930 MHz bands.<sup>6</sup> In conjunction with the preparation of this application, Adeunis has researched the Commission’s ULS database for all license-holder of such spectrum within 2 km of the each stadium location (latitude and longitude) where Adeunis seeks an experimental authorization and agrees to contact each licensee so identified and obtain its consent to the Adeunis application. Moreover, Adeunis can demonstrate to such licensees that no actual interference to their license is likely given the operation of the VOKKERO radios within enclosed stadiums at ground level and at a very low power level – 0.233 watts. Given this commitment and ongoing effort to satisfy such commitment, Adeunis respectfully urges the Commission to begin processing the application promptly, while realizing full consent must be obtained before a license is issued to Adeunis.

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<sup>5</sup> Use of “ramp-down, ramp-up” protocol would allow more parties to share unlicensed frequency bands, helping to use radio spectrum more efficiently.

<sup>6</sup> Adeunis is seeking an experimental license to operate in both the 900-902 MHz and 928-930 MHz bands in order to have multiple options for re-tuning its VOKKERO systems as one band may work better than the other band for certain customers.