Mr. Gordon,

Please address the following issues for this application,

2. Please clarify if the antennas connected to the module were maximized for different polarizations within their range of motion.

[LAG] The WaveRider Antenna has a vertical polarization. The diversity is based on switching beam patterns, with the primary beam pattern having the maximum gain along the normal vector to the antenna ground plane. The secondary beam pattern has its maximum peak at about 90 degress horizontal to the primary and is also vertically polarized, but the peak is about 3 dB less than the primary beam pattern. The WaveRider antenna was tested so that it directly faced the test antenna with no up or down tilt so that the test antenna would see the peak antenna gain. The variable elevation of the test antenna and rotation of the test table ensure that any alignment errors are found.

[LAG] The YAGI antenna can be physically mounted for either horizontal or vertical polarization. The test lab chose the horizontal polarization so that the maximum gain would be seen on the horizontal orientation of the test antenna and the max. sidelobes of the YAGI beam patterns would be seen doing the test table rotation. Again, any alignment errors would be removed by the test table rotation and test antenna elevation changes.

So the short answer is "yes the antennas were maximized for their polarization".

[LAG] The following is a statement from our test lab in response to your question:

Hello, Lawrence;

The EUT yagi antenna was mounted in horizontal polarization on the turntable. This was rotated through 360 degrees to determine the azimuth relative to the receiving antenna that produced the maximum emission at each test frequency. The receiving antenna was scanned from 1 m to 4m in order to find the height at which the received emission was maximum. These maximization searches were performed for both polarizations of the receiving antenna.

Please contact me if you have any questions or comments.

Regards,
David Raynes
draynes@etc-mpbtech.com
Laboratory Supervisor
Electronics Test Centre (Airdrie)
[LAG] ----------

**********Follow up by TCB to item 2 **********

In your response to item 2, it appears YAGI antenna has been tested in H polarization only. If there will be installations where the installer will make use of the V polarization, the test data does not specifically represent this case. Please clarify how compliance is ensured in case of V polarity.

For a YAGI, the E-plane is the plane in which the dipole elements lie and the H plane is the plane at right angles to the E-plane and along the main strut of the YAGI. For the antenna in the horizontal position, as in our test, the E-plane is scanned for a full 360 degrees since it is parallel to the turntable. The H-plane is scanned from -18 degrees (test antenna at 0 (1 meter below height of antenna) to about 45 degrees (3 meter elevation over 3 meter distance). This is direct line of sight.

As you can see from the spec sheets, the 3 dB beamwidth of a 13 dBi YAGI is 35-40 degrees in the E-plane (i.e. +/- 17 to 20 degrees from the main antenna strut), and 40-45 degrees in the H-plane (i.e. +/- 20 to 23 degrees from the main antenna strut). And as the beam patterns show the biggest sidelobe for a 13 dBi YAGI is at least 12 dB less than the main lobe.

From this, I conclude that inspection of the main lobe is representative of the worst case possible for a YAGI antenna and for a high-gain YAGI this main lobe is less than +/- 25 degrees off the main strut line, in both planes. So, the testing of the antenna over 360 degrees of the E-plane and -18 to +45 degrees of the H-plane more than covers the main lobe.

Turning the antenna 90 degrees to vertical polarization would swap the E and H planes, but not affect the main lobe geometry. And the main lobe geometry is confirmed by the test report, where all peaks with the Horizontal test antenna are directly in front of the antenna (0, 4 and 360 degrees for 905, 915 and 925 MHz). The Vertical/Horizontal ratio is at least 20 dB as shown by the test report. All peaks (carrier and spurious emissions in restricted bands) were within 30 cm of the antenna height (1 m) or less than 6 degrees.

When we tested the same antenna in the vertical position for the EUM3004, all peaks were found by the vertical orientation of the test antenna at 0 degrees azimuth and an antenna height of 100 cm, or 0 degrees with respect to the antenna. This shows the same main lobe geometry as the current testing, notwithstanding the 90 change in antenna orientation.

Given these arguments and the previous testing of the identical antenna for our predecessor products in the other orientation with no adverse findings, I think it is safe to conclude that this testing of the YAGI is sufficient for either polarization.

3. Please provide specifications of unique antenna connector that is currently on the module.

[LAG] See WBF (000-958) Data Sheet.pdf and WCM (000-957) Data Sheet.pdf for the board and cable connectors. These connectors were designed exclusively for WaveRider, which holds the exclusive rights to these connectors.

4. The test report shows a maximum conducted output power measurement of 27.9 dBm. Other exhibits of the application shows 27.3dBm. Please clarify or supply corrected exhibits (RF exposure, etc.)

[LAG] The max. output power is set for each and every modem at the factory during production. We have been setting our current modems to 27.3 dBm and wish to continue to do so. However, during FCC testing, we set the unit to as high an output power as we can and still pass. In this case, the output power is between 27.6 and 27.9 dBm depending on frequency. By having test results showing that we pass at a higher output power than we will be producing gives us confidence that our units will remain FCC compliant. We also prefer the slightly lower power setting so that we do not overheat the modem. Also, if we use a higher output power, we must reduce the antenna system gain, which does not affect TX EIRP, but does affect Received power.

[LAG] Therefore, we have applied via FCC form 731 for 27.3 dBm as our power limit. We have also structured all of our antenna gain discussions to this output power level at the antenna port. The test report however was done at the stated max TX power.

[LAG] NOTE: The MAX TX Output power is set at the factory and cannot be altered by the customer. The customer can reduce to TX output power if desired, but cannot increase it above 27.3 dBm.

5. In accordance with item 4 the theoretical EIRP limit of 36dBm will be exceeded with the current cable loss for YAGI. Please clarify/correct.

[LAG] As per the above discussion, we use 27.3 dBm as our MAX TX output power at the antenna connector. This requires that the installer must ensure an antenna system gain of no more than 36 - 27.3 = 8.7 dBi. So for a 13 dBi YAGI, we require the installer to ensure at least 4.3 dB loss due to cable, surge protectors, etc. So I believe we are consistent and compliant.

6. A manual that is specific to the module is required. "Radio Operational Req." document could be used for that purpose, however all the FCC compliance related statements, warnings against modifications, labeling warnings for end-devices must be part of this manual. EUM3005 manual can not be used for this application and manuals of specific end-devices are not required. All the antenna gain and cable loss information in this document must be consistent with the rest of the application. Currently indoor antenna gain is listed as 6.5dBi.

[LAG] I have updated the 915A Radio Operational Requirements document to rev. B (attached). I have added all the regulatory notices and warnings previously found in the EUM3005 Installation Guide. Please delete the "APCD-LM047_2.1_EUM3005_Installation_Guide.pdf" from this submission. I have corrected the indoor antenna gain to 4.4 dBi which is consistent with its spec. sheet.

********** Follow up by TCB to item 6 **********

Page 7 of the module Radio Op. Req. document still shows 6.5dBi in the 3rd paragraph.

[LAG] Fixed.

7. The manual must be intended for WaveRider installers only and any reference to end user installation of the device or its antenna must be removed. The document must also state that the manuals of end-devices that will use this module should not provide any instructions on how to install/remove the module to the end-user. Remember that WaveRider is responsible for the compliance of all end-devices that use this module as part of LMA.

[LAG] I hope the Rev B of the 915A Radio Operational Requirements now meets your requirements.

********** Follow up by TCB to item 7 **********

7. Any reference to USER installation in this manual will imply the installation of the module itself by the end user which is prohibited. Under RF connectors section of the manual, when users are mentioned (probably for the end-device) it may imply installation of the module. Please make a clear distinction in this document between WaveRider and end-users of final devices. Preferably remove all references to end-users from this document.

[LAG] Deleted all references to user, except in the required regulatory text.

In addition : Please include a warning in this document about not providing end-users with installation information/instructions about the module in the manuals of end-devices making use of this module (manufactured under WaveRider control (such as EUM xxxxx)).

[LAG] Added to Introduction